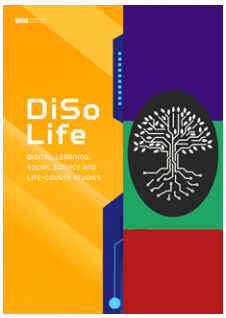

WISE Pendidikan Indonesia

DIGITAL LEARNING, SOCIAL SCIENCE, AND LIFE-COURSE STUDIES
VOL. 2 NO. 1 (2026)

ISSN: 3109-8096

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To cite this article. Y. Hariandini, I. B. Yuda and W. Ahmed, "Implementing Digital Integrated Learning in Schools: Evidence from Classroom Practices," *Dig. Soc. Life.*, vol. 2, no. 1, pp. 46-56, 2026.
DOI: https://doi.org/10.70211/disolife.v2i1.348

OPEN ACCESS

https://doi.org/ 10.70211/disolife.v2i1.248

Digital Learning, Social Science, and Life-course Studies Vol 2 No 1 (2026)

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Research Article

Implementing Digital Integrated Learning in Schools: Evidence from Classroom Practices

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Received: 2 March 2026	Revised: 12 May 2026	Accepted: 28 May 2026	Online: 30 June 2026

Abstract

The increasing integration of digital technologies in schools has raised critical questions regarding how digital integrated learning is enacted within everyday classroom practices. This study aimed to examine the pedagogical use of digital technologies by teachers, the instructional functions of digital tools, and the contextual factors shaping their classroom enactment. Employing a qualitative multiple case study design, data were collected through non participant classroom observations, semi structured teacher interviews, and analysis of instructional artifacts across selected secondary school classrooms. The data were analyzed using thematic analysis informed by constant comparative techniques to identify patterns of digital integration and pedagogical intent. The findings indicate that while digital technologies were consistently present in classroom instruction, their use was predominantly oriented toward content presentation and visualization, with limited integration into higher order, student centered learning activities such as inquiry, collaboration, and formative assessment. Teachers' pedagogical beliefs, digital competence, and institutional support emerged as key factors influencing the depth and quality of digital integration. By foregrounding classroom enactment, this study contributes empirical evidence that bridges the gap between conceptual models of digital integration and observable teaching practices. The findings imply that professional development and policy initiatives should prioritize pedagogical design and reflective teaching practices over technical skill acquisition alone to foster meaningful and sustainable digital integrated learning in schools.

Keywords: Classroom Practices; Digital Integrated; Educational Technology; Teacher Pedagogy

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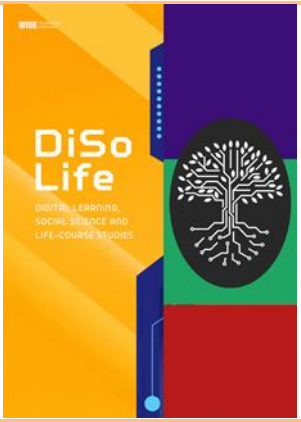

INTRODUCTION

The accelerating digital transformation of education has fundamentally reshaped expectations for teaching and learning across all levels of schooling. Contemporary education systems are increasingly required to prepare learners not only with disciplinary knowledge but also with essential 21st century competencies, including digital literacy, critical thinking, collaboration, and self regulated learning [1], [2], [3]. In response to these demands, digital integrated learning defined as the systematic and pedagogically meaningful incorporation of digital technologies into instructional practices has emerged as a central strategy in global educational reform agendas [4], [5], [6]. Digital integration is no longer viewed as a supplementary innovation but rather as an essential component of high quality teaching and learning environments.

A growing body of literature underscores the potential of digital technologies to enhance instructional quality, learner engagement, and access to learning resources when aligned with sound pedagogical principles [7], [8], [9]. Conceptual frameworks such as Technological Pedagogical Content Knowledge (TPACK) emphasize that effective digital integration depends on the dynamic interaction between teachers' technological knowledge, pedagogical strategies, and subject matter expertise [10], [11], [12]. Similarly, school level digital transformation models highlight the importance of leadership, professional development, infrastructure, and organizational culture in sustaining meaningful technology use [13], [14], [15]. Despite these comprehensive frameworks, empirical evidence suggests that the mere presence of technology does not automatically translate into improved learning outcomes.

Empirical studies consistently report a persistent gap between the intended goals of digital integration and its actual enactment in classrooms. Teachers frequently employ digital tools for administrative purposes or basic content delivery rather than for facilitating higher order thinking, collaborative learning, or student centered inquiry [16], [17], [18]. Observational and survey-based research across various subject areas indicates that digital technologies are often used to reinforce traditional teacher centered practices rather than to transform instructional approaches [19], [20], [21]. These findings suggest that digital integration remains largely superficial in many classroom contexts, limiting its potential pedagogical impact.

Scholars have identified multiple factors influencing the quality of digital-integrated learning, including teachers' beliefs about teaching and learning, levels of digital competence, access to professional development, and institutional support structures [22], [23], [24]. However, much of the existing research relies heavily on self reported data, such as questionnaires and interviews, which may not fully capture the complexity of teachers' instructional decision making and classroom interactions [25], [26], [27]. Consequently, there remains limited empirical insight into how digital technologies are operationalized during real time classroom instruction and how they function pedagogically within authentic learning activities.

Moreover, comparative and context sensitive evidence from under researched educational settings, particularly in developing and lower middle income countries, remains scarce. While policy discourses strongly advocate for digital transformation in education, few studies provide fine grained analyses of classroom level practices that reveal how contextual constraints, institutional cultures, and pedagogical traditions shape digital integration [28], [29], [30]. This lack of micro level evidence constrains the field's ability to bridge the long standing theory practice divide in educational technology research.

Based on this review, a clear research gap can be identified. Although prior studies have extensively examined digital integration through theoretical frameworks, large scale surveys, and teacher perceptions, there is insufficient empirical evidence documenting how digital integrated learning is enacted at the classroom level through observable teaching practices. Specifically, limited research has explored how teachers utilize digital tools to support meaningful learning processes during everyday instructional interactions and how contextual factors mediate these practices in school settings.

To address this gap, the present study aims to investigate classroom based evidence of digital integrated learning in schools by focusing on teachers' instructional practices. The study seeks to analyze how digital resources are integrated into daily teaching activities, to examine the pedagogical functions of digital tools in supporting active and meaningful learning, and to identify contextual factors that enable or constrain effective digital integration. By foregrounding classroom level practices, this research contributes empirically grounded insights that advance understanding of digital pedagogy and inform policy, teacher education, and professional development initiatives aimed at fostering high quality digital integrated learning.

METHODS

This study employed a qualitative multiple case study design to examine how digital integrated learning is enacted in authentic classroom practices. A qualitative approach was selected because it enables an in depth exploration of instructional processes, pedagogical interactions, and contextual factors that cannot be adequately captured through quantitative measures alone [31], [32], [33]. The multiple case design allowed for cross case comparison across different classroom contexts, thereby enhancing analytical rigor and transferability of findings. This methodological approach is particularly suitable for investigating complex educational phenomena situated within real life settings, where the boundaries between teaching practices, institutional conditions, and digital resources are intertwined.

Research Design

This study adopted a qualitative multiple case study design to explore how digital integrated learning is enacted in real classroom practices. This design was selected because it allows for an in depth and contextualized examination of pedagogical processes, teacher student interactions, and the instructional use of digital tools within authentic educational settings. By examining multiple cases, the study enabled systematic comparison across classroom contexts, thereby strengthening analytical robustness and enhancing the transferability of findings. The focus on classroom level practices aligns with the study's objective to capture the operationalization of digital integration beyond policy intentions or self reported perceptions.

Population and Sample

The population of this study comprised secondary school teachers who had integrated digital technologies into their instructional practices. A purposeful sampling strategy was employed to select cases that met specific criteria, including consistent use of digital tools during instruction, access to basic digital infrastructure, and willingness to participate in classroom observations and interviews. The sample consisted of teachers from different subject areas to capture variation in pedagogical approaches and forms of digital integration. This sampling approach ensured that the

selected cases were information rich and relevant to the research objectives, while allowing for cross case analysis of instructional practices.

Data Collection Procedures

Data collection was carried out over a period of one academic semester through non-participant classroom observations, semi tructured interviews, and analysis of instructional documents. Classroom observations served as the primary data source and were conducted across instructional sessions for each participating teacher, with each session lasting approximately. An observation protocol was used to systematically document instructional strategies, the pedagogical functions of digital tools, patterns of teacher student interaction, and levels of student engagement. Semi structured interviews were conducted after the observation phase to explore teachers' pedagogical rationales, beliefs about digital integrated learning, and perceptions of contextual enablers and constraints. Each interview lasted approximately and followed an interview guide aligned with the research focus. Instructional documents, including lesson plans, digital learning materials, and assessment tasks, were collected to contextualize observed practices and to support data triangulation

Data Analytics on X

Data analysis was conducted using a thematic analysis approach informed by constant comparative techniques. All qualitative data from observations, interviews, and documents were transcribed and systematically coded through an iterative process. Initial open coding was used to identify meaningful units of data, followed by axial coding to establish relationships among categories, and selective coding to refine overarching themes related to digital integrated learning practices. Cross case analysis was subsequently performed to identify convergent and divergent patterns across cases, enabling the development of analytically grounded interpretations. To ensure trustworthiness, data triangulation, member checking, and the maintenance of an audit trail were employed. Ethical considerations were addressed through informed consent, confidentiality measures, and adherence to institutional research ethics guidelines.

RESULT AND DISCUSSIONS

Patterns of Digital-Integrated Learning Practices

Classroom observations revealed that digital integrated learning was enacted through a range of instructional practices that varied in depth and pedagogical intent across cases. Teachers utilized digital technologies primarily to support lesson presentation, visualization of content, and access to online learning resources. However, differences were evident in how digital tools were aligned with instructional goals and student centered learning principles. In several observed classrooms, digital tools were used to facilitate interactive discussions, collaborative tasks, and inquiry based activities, while in others, their use remained limited to teacher led explanation.

Table1. Patterns of Digital Integrated Learning Practices Observed in Classrooms

Pedagogical Function of Digital Tools	Description of Classroom Practices	Frequency of Occurrence
Content presentation and visualization	Use of slides, videos, and animations to explain concepts	High
Student engagement and interaction	Digital prompts, questioning, and guided discussion	Moderate

Pedagogical Function of Digital Tools	Description of Classroom Practices	Frequency of Occurrence
Collaborative learning	Group tasks supported by digital resources	Low Moderate
Inquiry and problem solving	Use of digital tools for exploration and analysis	Low

The findings indicate that while digital technologies were consistently present in classroom instruction, their pedagogical use was uneven. Most teachers employed digital tools to enhance clarity and efficiency of content delivery, whereas fewer leveraged technology to promote higher order learning processes.

Pedagogical Functions of Digital Tools in Classroom Instruction

Further analysis focused on how digital tools functioned pedagogically within instructional sequences. Digital technologies were most frequently used to support explanation and demonstration, particularly when teaching abstract or complex concepts. Visual and multimedia elements were observed to capture students' attention and facilitate initial understanding. In some cases, teachers intentionally embedded digital resources into questioning strategies, encouraging students to interpret visual data, respond to prompts, or relate content to real life contexts.

Table 2. Pedagogical Roles of Digital Tools in Classroom Teaching

Pedagogical Role	Observed Instructional Use
Cognitive support	Clarifying concepts through multimedia representations
Motivational support	Increasing student interest and attentiveness
Instructional scaffolding	Guiding students through structured learning tasks
Assessment support	Limited use for formative feedback

Although digital tools contributed positively to student engagement, their integration into assessment and feedback processes remained limited. This suggests that digital technologies were not yet fully utilized to support continuous formative assessment or adaptive instruction.

Contextual Factors Influencing Digital Integration

The enactment of digital integrated learning was shaped by several contextual factors operating at the teacher and school levels. Teachers' digital competence and pedagogical beliefs played a significant role in determining how technology was used. Teachers with higher confidence in digital tools demonstrated greater flexibility in integrating technology into interactive and student centered activities. Conversely, teachers who perceived digital tools primarily as presentation aids tended to rely on teacher centered instructional approaches. Institutional conditions also influenced classroom practices. Access to stable internet connections, availability of digital devices, and administrative support affected the consistency and depth of digital integration. Table 3 outlines key enabling and constraining factors identified across cases.

Table3. Contextual Factors Affecting Digital Integrated Learning

Factor	Influence on Classroom Practices
Teacher digital competence	Enabled varied and interactive technology use
Pedagogical beliefs	Shaped instructional goals of digital integration
Infrastructure availability	Affected frequency and reliability of technology use
Institutional support	Influenced sustainability of digital practices

These findings underscore that digital-integrated learning is not solely a technical issue but a pedagogical and organizational one.

Discussion

The findings of this study corroborate a substantial body of research indicating that digital technologies in schools are predominantly used to support content presentation rather than to transform pedagogical practices. Similar to the results reported by Alptekin et al., [22] and Baziukė et al. [34], this study found that teachers most frequently employed digital tools for visualizing concepts and delivering instructional materials, while the use of technology to foster higher order thinking, inquiry, and collaborative learning remained limited. This pattern aligns with Asmayawati et al. [8], who observed that technology integration often reinforces existing instructional routines rather than enabling pedagogical innovation. However, by relying on systematic classroom observations rather than self reported data, the present study provides more granular evidence of how such patterns unfold during real-time instructional interactions.

The role of teachers' pedagogical beliefs and professional knowledge in shaping digital integrated learning observed in this study is consistent with the TPACK framework and prior empirical research. Zheng et al. [35] and Shiu [36] emphasize that effective digital integration requires the coherent alignment of technological, pedagogical, and content knowledge. In line with these arguments, the current findings demonstrate that teachers with stronger pedagogical reasoning were more likely to deploy digital tools as instructional scaffolds rather than mere presentation aids. This result also resonates with Lin et al. [37], who argue that teacher beliefs act as a critical mediator between technological access and meaningful classroom use. The present study extends this literature by illustrating how these beliefs translate into observable teaching strategies within classroom contexts.

From a broader educational technology perspective, the findings echo studies that highlight the gap between technological availability and pedagogical transformation. Alshammari et al. [38] and Pettersson [39] found that even in technology rich environments, instructional change remains incremental and highly dependent on contextual conditions. Similarly, this study revealed that infrastructural support and institutional policies influenced the consistency and depth of digital integration, but did not automatically lead to student centered practices. This reinforces the argument advanced by McCarthy et al. [13] that digital transformation in schools is a socio pedagogical process rather than a purely technical one.

The results also contribute to discussions in *Teaching and Teacher Education* concerning teacher agency and professional learning. Consistent with Shi et al. [40], the study found that teachers' confidence and instructional autonomy shaped how digital tools were incorporated into lessons. However, unlike survey based studies that focus on perceived competence, the present research demonstrates how teacher agency is enacted through concrete pedagogical decisions, such as the choice to integrate digital resources into questioning strategies or collaborative tasks. This classroom level focus provides empirical depth to theoretical claims regarding teacher professionalism in technology enhanced learning environments.

The novelty of this study lies in its emphasis on classroom enactment as the primary unit of analysis for understanding digital integrated learning. While prior research has extensively examined digital integration through policy analysis, conceptual frameworks, or teacher self reports, this study foregrounds observable instructional practices and interactions. By adopting a multiple-case qualitative design and systematic classroom observation, the study bridges a critical methodological gap in the literature and offers practice-based insights that are particularly relevant for journals such as *Education and Information Technologies* and *Computers & Education*.

Furthermore, the study contributes to under researched contextual settings, thereby enriching the global discourse on digital pedagogy beyond high income or technology saturated educational systems.

The implications of these findings are both theoretical and practical. Theoretically, the study reinforces the view that digital-integrated learning should be conceptualized as a pedagogical practice rather than a technological intervention, emphasizing the central role of teacher decision making and instructional design. Practically, the findings suggest that professional development initiatives should move beyond technical training and focus on supporting teachers in aligning digital tools with pedagogical objectives and student centered learning strategies. Policymakers and school leaders should also recognize that sustainable digital integration requires coherent institutional support, reflective teaching cultures, and opportunities for collaborative professional learning.

Despite its contributions, this study has several limitations. The qualitative nature and relatively small number of cases limit the generalizability of the findings to broader educational contexts. Additionally, the study focused primarily on teacher practices and did not systematically examine student learning outcomes or long term impacts of digital integrated instruction. The observational data were also confined to specific instructional sessions, which may not fully capture variations in digital integration over time. Future research could address these limitations by employing longitudinal designs, incorporating student performance data, or combining qualitative observations with quantitative measures to further elucidate the relationship between digital-integrated teaching practices and learning outcomes.

Several limitations of this study should be acknowledged when interpreting the findings. First, the qualitative multiple case design and the limited number of classroom cases constrain the generalizability of the results beyond the specific school contexts examined. Although the study provides in-depth insights into classroom enactment of digital integrated learning, the findings may not fully represent practices in schools with different levels of technological infrastructure, policy environments, or cultural contexts. Second, the analysis focused primarily on teachers' instructional practices and pedagogical use of digital tools, without systematically examining student learning outcomes or long term impacts on academic achievement and skill development. Third, classroom observations were conducted within a bounded time frame, which may not capture variations in digital integration practices across different instructional units or academic terms. Finally, while triangulation was employed to enhance trustworthiness, the interpretation of qualitative data remains subject to researcher perspective. Future research employing longitudinal designs, larger and more diverse samples, and mixed-methods approaches could extend the present findings and provide a more comprehensive understanding of how digital-integrated learning influences teaching and learning over time.

CONCLUSION

This study provides empirical evidence that the implementation of digital integrated learning in schools is a pedagogically situated process shaped by teachers' instructional decisions, professional knowledge, and contextual conditions rather than by the mere availability of digital technologies. Through a qualitative multiple case analysis of classroom practices, the findings reveal that while digital tools are consistently present in instruction, their use remains predominantly oriented toward

content presentation and visualization, with limited integration into higher order, student centered learning activities. The study contributes to the educational technology literature by foregrounding classroom enactment as a critical lens for understanding digital integration and by demonstrating how teachers' pedagogical reasoning mediates the instructional functions of digital tools. These insights advance ongoing debates in *Computers & Education*, *Teaching and Teacher Education*, and *Education and Information Technologies* by bridging the gap between conceptual models of digital integration and observable teaching practices. The findings underscore the need for professional development and policy initiatives that prioritize pedagogical design, reflective teaching, and institutional support to foster meaningful and sustainable digital integrated learning. Overall, this research reinforces the view that effective digital integration is fundamentally a pedagogical endeavor, requiring deliberate alignment between technology use, instructional goals, and learning processes within authentic classroom contexts.

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AUTHOR CONTRIBUTION

Y.H. and I.B.Y. was responsible for the conceptualization, methodology, software development, validation, formal analysis, investigation, data curation, writing the original draft, writing the review and editing, visualization, and project administration. W.A. contributed to the methodology, formal analysis, writing the review and editing, and supervision of the study.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

DECLARATION OF USE OF AI IN SCIENTIFIC WRITING

The authors used several generative AI tools in the process. ChatGPT was used to help organise complex concepts, while Grammarly was employed to enhance the grammar, style, readability of

the text and improve the overall clarity of the writing. Although these tools provided valuable support, the researcher wrote all the content and conclusions.

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