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Digital Based IPAS Learning Strategies in Elementary Schools: A Comparative Case Study of Two Schools in Jakarta

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Abstract:
This study examines digital-based Natural and Social Sciences (*Ilmu Pengetahuan Alam dan Sosial*—IPAS) learning strategies for Grade VI students at SDN Tegal Alur 19 Petang, West Jakarta, and SDN Kramat Pela 09, South Jakarta. The study employed a qualitative comparative case study design involving school principals, Grade VI teachers, and students. Data were collected through interviews, classroom observations, and document analysis and were analyzed through data reduction, data display, and conclusion drawing. The analysis was guided by the Plan–Do–Check–Act (PDCA) framework to examine planning, implementation, evaluation, and follow-up in digital learning. The findings show that both schools integrated digital media such as Canva, Quizizz, learning videos, and other online platforms into IPAS learning, although with different instructional emphases. SDN Tegal Alur 19 Petang demonstrated a more structured and collaborative pattern, particularly in addressing differences in device access and student digital readiness, whereas SDN Kramat Pela 09 provided greater opportunities for individual creativity and digital product development. Digital-based learning supported student engagement, conceptual understanding, digital literacy, creativity, collaboration, critical thinking, and problem-solving. However, implementation remained influenced by differences in infrastructure, teacher digital competence, student access, and parental support. The study concludes that effective digital IPAS learning depends not merely on the use of technological applications but on the systematic alignment of technology, pedagogy, student characteristics, school readiness, and continuous instructional improvement.

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Introduction (مقدمة)

The rapid development of information and communication technology has fundamentally transformed the educational landscape, including teaching practices at the elementary school level. Learning is no longer limited to face-to-face instruction and printed textbooks but

increasingly involves digital platforms, online learning resources, multimedia, and interactive applications (*Frontiers | Digital Learning in the 21st Century: Trends, Challenges, and Innovations in Technology Integration*, n.d.; Kovtaniuk et al., 2025). a subject that requires students to understand natural and social phenomena while simultaneously developing observation, reasoning, communication, collaboration, and problem-solving skills. Consequently, learning strategies for IPAS need to respond not only to curriculum content but also to the demands of digital literacy and twenty-first-century competencies (González-Salamanca et al., 2020; Subiantoro et al., 2025).

The integration of digital technology into learning is closely related to the teacher's ability to combine technological, pedagogical, and content knowledge. The Technological Pedagogical Content Knowledge (TPACK) framework proposed by Mishra and Koehler (2006) emphasizes that effective technology integration is not determined by technological proficiency alone, but by the ability to connect technology with appropriate pedagogical strategies and subject-matter knowledge. In IPAS learning, this integration is particularly important because many scientific and social concepts can be made more concrete through visualization, interactive media, digital projects, simulations, and collaborative learning activities. Digital technology therefore has the potential to shift learning from teacher-centered knowledge transmission toward more active, exploratory, collaborative, and student-centered learning. From a constructivist perspective, such learning enables students to construct understanding through interaction, exploration, production, and reflection rather than simply receiving information from the teacher (Koehler & Mishra, 2009; N. R. Mishra, 2023; P. Mishra & Koehler, 2006).

The need for systematic digital integration is also related to the broader principle of continuous improvement in learning management. The Plan–Do–Check–Act (PDCA) cycle provides a useful framework for understanding how instructional strategies can be continuously planned, implemented, evaluated, and improved. In this context, *Plan* involves identifying learning needs, preparing teaching modules, selecting appropriate digital media, and considering students' readiness; *Do* refers to the implementation of technology-supported learning activities; *Check* involves assessing student engagement, conceptual understanding, and learning outcomes; while *Act* concerns revising instructional strategies based on evaluation results. When applied to IPAS learning, this cycle positions digital learning not as a one-time intervention but as a continuous instructional process that requires reflection and adaptation (Deming, 1986; Nashihin et al., 2021).

Previous studies have shown that digital technology can positively influence elementary science learning. The use of interactive applications, multimedia, augmented reality, virtual reality, e-learning platforms, and visual learning media has been associated with improvements in student motivation, engagement, conceptual understanding, and learning participation (AlGerafi et al., 2023). Canva and similar applications have also been used to support visual learning, creativity, collaborative work, and the production of student-generated digital content (Kovtaniuk et al., 2025). Other studies have emphasized that digital-based learning can facilitate science process skills, critical thinking, creativity, communication, and problem-solving. However, the literature also consistently identifies major challenges, including uneven access to devices and internet connectivity, differences in teacher digital competence, limited school infrastructure, and insufficient institutional support. These findings suggest that the educational value of technology is highly dependent on how teachers and schools organize its use within actual learning conditions.

Despite these potential benefits, preliminary observations at SDN Tegal Alur 19 Petang, West Jakarta, and SDN Kramat Pela 09, South Jakarta, indicate that digital integration in Grade VI IPAS learning still faces important practical challenges. Some teachers have limited ability to integrate digital technology effectively into instructional activities and continue to rely on conventional, teacher-centered approaches. As a result, digital media are not always used

optimally to increase student participation, motivation, or conceptual understanding. Student access also varies because not all learners have adequate personal devices or stable internet access. These conditions reveal a discrepancy between the expectation that students develop digital literacy and the actual learning practices that remain partially dependent on conventional approaches. At the same time, teachers face difficulties related to infrastructure, digital skills, and the limited availability of instructional strategies that are sufficiently responsive to student characteristics.

The two research sites also demonstrate different contextual characteristics that are relevant to understanding digital learning strategies. At SDN Tegal Alur 19 Petang, teachers tend to emphasize structured and collaborative use of digital media, whereas at SDN Kramat Pela 09, learning practices provide relatively greater emphasis on individual creativity in producing digital work. The research findings further indicate that differences in facilities, learning environments, student backgrounds, and technological readiness shape how teachers organize digital learning activities. These differences are important because they demonstrate that a digital learning strategy cannot be separated from the organizational and classroom context in which it is implemented. Thus, the effectiveness of technology-supported IPAS learning depends not only on the selection of applications but also on how teachers adapt instructional strategies to student readiness, available facilities, and the specific characteristics of each school.

Based on the state of the art and the empirical conditions at the two schools, several research gaps can be identified. First, at the conceptual level, previous studies have largely focused on the effectiveness of particular digital applications or media, whereas fewer studies have examined digital IPAS learning as a comprehensive instructional strategy that includes planning, implementation, evaluation, and continuous improvement. Second, at the pedagogical level, research often emphasizes the use of technology itself without sufficiently explaining how digital media are integrated with active, collaborative, project-based, and student-centered learning processes. Third, at the contextual level, there is a need for comparative evidence showing how digital learning strategies are implemented in elementary schools with different levels of technological readiness, facilities, and student characteristics. These gaps indicate that understanding digital learning requires attention not only to technological tools but also to the instructional management processes through which those tools are selected, used, evaluated, and improved.

Accordingly, the novelty of this study lies in its **comparative and process-oriented analysis of Grade VI IPAS learning strategies in the digital era at SDN Tegal Alur 19 Petang and SDN Kramat Pela 09**. Unlike studies that focus primarily on the effectiveness of a single digital medium, this research examines how digital learning strategies are designed and implemented systematically through planning, classroom implementation, evaluation, and follow-up. The study also examines the integration of digital applications such as Canva, Quizizz, learning videos, and other digital platforms with collaborative, project-based, and student-centered activities. Furthermore, by comparing two schools with different contextual characteristics, the study provides a more nuanced explanation of how teacher readiness, infrastructure, student access, and school support influence the implementation of digital IPAS learning.

Therefore, this study aims to **describe and analyze Grade VI IPAS learning strategies in responding to educational challenges in the digital era at SDN Tegal Alur 19 Petang, West Jakarta, and SDN Kramat Pela 09, South Jakarta**. Specifically, the study examines how teachers plan digital-based IPAS learning, implement technology-supported instructional activities, evaluate student engagement and learning outcomes, and conduct follow-up actions to improve subsequent learning. The study also explores the contextual constraints and adaptive strategies used by teachers and schools in addressing differences in digital competence, device availability, infrastructure, and student readiness.

This study has theoretical, pedagogical, and practical significance. Theoretically, it contributes to the literature on digital learning by connecting technology integration, student-centered pedagogy, and continuous improvement in the context of elementary IPAS learning. Pedagogically, it provides empirical insight into how digital media can be integrated with collaborative and project-based learning to strengthen conceptual understanding, digital literacy, creativity, critical thinking, and problem-solving skills. Practically, the findings are expected to assist teachers and school leaders in designing digital learning strategies that are realistic, adaptive, and responsive to school conditions. The study may also provide a reference for educational authorities in strengthening teacher digital competence, improving technological infrastructure, and supporting sustainable digital transformation in elementary education.

Method (منهج)

Research Design

This study employed a qualitative approach using a comparative case study design to obtain an in-depth understanding of Grade VI Natural and Social Sciences (*Ilmu Pengetahuan Alam dan Sosial*—IPAS) learning strategies in responding to educational challenges in the digital era. The study focused on two elementary schools, namely SDN Tegal Alur 19 Petang, West Jakarta, and SDN Kramat Pela 09, South Jakarta. A qualitative case study design was considered appropriate because the research sought to explore digital learning practices, teacher strategies, student participation, and contextual challenges within their natural classroom settings rather than to test predetermined causal relationships (Adrias & Ruswandi, 2025; Creswell & Clark, 2017; Yin, 2017).

The analytical orientation of the study was informed by the Plan–Do–Check–Act (PDCA) framework, which emphasizes continuous improvement through planning, implementation, evaluation, and follow-up. In the context of this study, *Plan* referred to the preparation of teaching modules, learning objectives, digital media, and learning activities; *Do* referred to the implementation of digital-supported IPAS instruction; *Check* concerned the evaluation of student participation, learning processes, and learning products; while *Act* involved instructional reflection, revision of teaching strategies, and follow-up improvement. This framework enabled the researchers to examine digital learning not as a single technological intervention but as a continuous instructional process.

Research Setting and Participants

The research was conducted at SDN Tegal Alur 19 Petang, West Jakarta, and SDN Kramat Pela 09, South Jakarta. The two schools were selected purposively because they represented different social characteristics, levels of technological readiness, learning environments, facilities, and student backgrounds. These contextual differences provided an appropriate basis for comparing how Grade VI IPAS teachers adapted digital learning strategies to different school conditions.

Participants were selected using **purposive sampling** based on their direct involvement in the planning, implementation, supervision, or experience of digital-based IPAS learning. The participants comprised school principals, Grade VI teachers, and Grade VI students from both schools. School principals were selected because they were responsible for supervising instructional implementation and providing institutional support for digital learning. Grade VI teachers were selected because they directly prepared IPAS teaching modules, selected digital media, implemented classroom activities, and evaluated student learning. Students were selected because they had directly participated in digital-based IPAS activities, including the use of digital applications, collaborative learning, and the production of digital learning products.

The inclusion criteria required participants to **(1)** be directly involved in Grade VI IPAS learning during the period of the study, **(2)** have experience with the digital learning activities examined in this research, and **(3)** be willing to participate and provide information relevant to the research focus. Student participants were selected to represent learners who had direct experience with the digital activities observed in the classroom. This purposive selection strategy was intended to ensure that the data were obtained from information-rich participants who could provide relevant perspectives on the phenomenon under investigation (Patton, 2015).

Data Collection

Data were collected through interviews, classroom observation, and document analysis. The use of multiple data sources was intended to obtain a comprehensive understanding of digital IPAS learning strategies and to strengthen the credibility of the findings through triangulation.

Interviews were conducted with school principals, Grade VI teachers, and students to obtain information about learning preparation, digital media selection, instructional implementation, student responses, evaluation practices, and challenges encountered during digital learning. Interviews also provided information regarding teachers' digital readiness, availability of technological resources, school support, and strategies used to overcome limitations in devices and internet access.

Classroom observations were conducted to capture actual learning practices, including teacher–student interactions, time management, group organization, collaborative processes, student engagement, and responses to digital teaching modules and media. Particular attention was given to the use of Canva and other digital applications in supporting IPAS learning activities. Observation also enabled the researchers to identify differences between planned instructional strategies and their actual implementation in the classroom.

Document analysis was conducted using teaching modules, student digital products, posters, infographics, digital quizzes, teacher meeting records, classroom activity records, and learning evaluation documents. These materials provided documentary evidence of the planning, implementation, and evaluation of digital IPAS learning. Student products were particularly useful for examining how digital activities were translated into observable learning outcomes, including creativity, collaboration, conceptual representation, and digital literacy (Khoa et al., 2023; Opara et al., 2023).

Data Analysis

Data analysis was conducted iteratively throughout the research process through data reduction, data display, and conclusion drawing. In the data reduction stage, information obtained from interviews, observations, and documents was reviewed, selected, categorized, and organized according to the major research focus. The data were grouped into themes related to learning planning, implementation, evaluation, follow-up, use of digital media, student participation, teacher readiness, infrastructure, and learning constraints.

During data display, the categorized findings were organized systematically to facilitate interpretation and comparison between SDN Tegal Alur 19 Petang and SDN Kramat Pela 09. Cross-case comparison was used to identify similarities and differences in the ways teachers integrated digital technology into Grade VI IPAS learning. Particular attention was given to differences in collaborative learning, student creativity, use of digital applications, technological readiness, and responses to resource limitations.

The final stage involved drawing and verifying conclusions by comparing evidence across interviews, observations, and documents. Interpretations were developed by examining

recurring patterns as well as context-specific differences between the two schools. The PDCA framework was subsequently used to organize the findings into planning, implementation, evaluation, and follow-up processes, allowing the researchers to interpret digital learning strategies as a continuous cycle of instructional improvement (Miles et al., 2014).

Trustworthiness of the Data

The trustworthiness of the findings was strengthened through triangulation of data sources and data collection techniques. Information obtained from school principals, teachers, and students was compared to identify consistency across participant perspectives. Methodological triangulation was conducted by comparing interview data with classroom observations and documentary evidence, including teaching modules, student digital products, and evaluation records.

Data verification also involved comparing observed classroom practices with documented instructional plans and student learning products. This process was intended to ensure that the findings were grounded in multiple forms of evidence rather than relying on a single participant or data source. Through this triangulation process, the researchers sought to enhance the credibility, consistency, and contextual depth of the findings concerning digital IPAS learning strategies in both schools (Alexander, 2019; Nowell et al., 2017; Patton, 2015; Shenton, 2004).

Research Procedure

The research procedure consisted of four interconnected stages. The first stage involved identifying the research sites, participants, research focus, and data collection instruments. The second stage involved collecting field data through interviews, direct classroom observations, and documentation of learning activities and digital products. The third stage consisted of organizing and analyzing the collected data to identify patterns related to digital IPAS learning strategies. The final stage involved verifying the findings through triangulation and conducting cross-case interpretation to identify similarities, differences, challenges, and adaptive practices at SDN Tegal Alur 19 Petang and SDN Kramat Pela 09.

Result (نتائج)

Planning Digital-Based IPAS Learning

The findings indicate that planning for digital-based IPAS learning at SDN Tegal Alur 19 Petang and SDN Kramat Pela 09 was carried out through the preparation of instructional documents, selection of digital applications, and adjustment of learning activities to students' readiness and available school resources. Teachers developed lesson plans or teaching modules, semester programs, and annual programs as the basis for organizing Grade VI IPAS learning. Digital platforms and applications such as Google Classroom, Microsoft Teams, Zoom, Canva, and Quizizz were also considered in the planning stage to support material delivery, project activities, and learning evaluation. This indicates that digital integration was not treated merely as an additional classroom activity, but was incorporated into the instructional planning process.

At SDN Tegal Alur 19 Petang, planning tended to emphasize structured use of digital media and collaborative learning arrangements. Teachers considered how students could access digital applications, work in groups, and follow technical instructions when using Canva and other platforms. Planning was therefore closely connected to the availability of devices and the varying levels of students' digital competence. This approach suggests that the teacher's planning role extended beyond determining learning content to anticipating technical and organizational challenges that might emerge during digital learning activities.

At SDN Kramat Pela 09, planning showed relatively greater readiness in utilizing digital learning facilities and supporting students' individual creativity. The school was supported by adequate infrastructure and teachers with stronger competence in digital technology, which enabled learning plans to incorporate more varied digital activities. Teachers planned projects such as digital presentations and visual products related to IPAS concepts, including food chains, by using Canva and other presentation tools. This condition indicates that institutional readiness influenced the breadth of digital strategies that could be included in instructional planning.

Interview data also demonstrate that planning was closely related to teachers' efforts to align instructional objectives with available digital media. The research findings indicate that teachers initially prepared learning tools, including teaching modules, semester programs, and annual programs, before selecting suitable applications for managing materials, assignments, and digital projects. One participant explained that teachers **"first prepare learning tools such as lesson plans or teaching modules, semester programs, and annual programs, and then use learning applications as the main means of managing materials and assignments"** (Interview data). This statement reflects that digital learning planning was perceived as a systematic process in which technological tools were selected after instructional objectives and learning structures had been determined.

The comparison between the two schools therefore shows that planning for digital-based IPAS learning was shaped by both pedagogical considerations and school readiness. SDN Tegal Alur 19 Petang placed stronger emphasis on structured and collaborative digital use, particularly in response to differences in student access and readiness, whereas SDN Kramat Pela 09 demonstrated broader opportunities to integrate digital creativity due to relatively stronger infrastructure and teacher technological competence. These findings suggest that effective digital learning planning requires teachers to align curriculum objectives, student characteristics, digital applications, and available resources within the specific context of each school.

Table 1. Comparison of Planning Practices for Digital-Based IPAS Learning

Planning Aspect	SDN Tegal Alur 19 Petang	SDN Kramat Pela 09	Interpretation
Instructional preparation	Teaching modules, semester programs, and annual programs are prepared before implementation	Similar instructional documents are prepared as the basis for digital learning	Both schools demonstrate systematic instructional preparation
Digital applications	Canva, Quizizz, and other learning platforms are planned for structured and collaborative use	Canva and other digital applications are integrated more broadly into creative activities	Digital tools are adapted to school and student conditions
Student readiness	Greater attention to differences in device access and digital ability	Students have relatively stronger opportunities to engage in digital activities	Student readiness influences the complexity of planned activities
Infrastructure	Planning is adjusted to available devices and internet access	Relatively more supportive facilities enable wider digital integration	Infrastructure shapes the scope of digital learning strategies
Planning orientation	More structured and collaborative	More creative and technology-supported	The two schools demonstrate different contextual planning emphases

Overall, the findings indicate that planning for digital-based IPAS learning at both schools involved more than selecting technological applications. It required teachers to coordinate

learning objectives, teaching modules, digital media, student readiness, and school resources before classroom implementation. The differences between SDN Tegal Alur 19 Petang and SDN Kramat Pela 09 further demonstrate that digital learning planning is context-dependent; therefore, the effectiveness of the planning stage is strongly influenced by teachers' ability to adapt technological possibilities to the actual pedagogical and infrastructural conditions of each school.

Implementing Digital-Based IPAS Learning

The findings show that the implementation of digital-based IPAS learning at SDN Tegal Alur 19 Petang and SDN Kramat Pela 09 was characterized by the integration of digital media into active and student-centered learning activities. Teachers implemented learning in accordance with the learning objectives and learning achievement targets stated in the teaching modules, while digital applications were used to support explanation, visualization, project work, and student participation. Canva emerged as one of the main applications used by students to create digital products related to IPAS topics, while learning videos and other digital resources were used to strengthen students' understanding of abstract concepts.

At SDN Tegal Alur 19 Petang, implementation placed stronger emphasis on structured and collaborative participation. Students were organized into groups and guided to use digital media together, particularly when access to devices was limited. This arrangement allowed students with different levels of digital competence to support one another during the learning process. The collaborative structure also helped teachers ensure that students remained actively involved despite differences in device ownership and technological readiness. The implementation pattern therefore reflected an adaptive strategy in which digital learning was adjusted to actual classroom conditions rather than requiring each student to work independently with individual devices.

At SDN Kramat Pela 09, digital learning implementation provided relatively greater space for individual creativity and the production of visually communicative learning products. Students used Canva to design posters, infographics, and other digital outputs that represented their understanding of IPAS concepts. Teachers combined visual elements, text, and learning videos to make abstract content more accessible and engaging. This approach positioned students not merely as recipients of digital information but as creators of learning products, allowing them to express conceptual understanding through visual and digital forms.

Student responses further indicate that the use of digital media contributed to a more engaging learning experience. Students at both schools reported positive experiences when learning IPAS through Canva because its visual features and templates helped them understand learning content and made classroom activities more enjoyable. One Grade VI student stated that "learning IPAS using Canva is enjoyable because the visual features, templates, and interactive media make the concepts easier to understand" (Student interview). This response suggests that the effectiveness of digital media was related not only to technological novelty but also to its ability to make learning content more concrete, visually accessible, and personally engaging for students.

The comparison between the two schools indicates that digital-based IPAS learning was implemented through different instructional emphases. SDN Tegal Alur 19 Petang demonstrated a more structured and collaborative pattern, whereas SDN Kramat Pela 09 emphasized individual creativity and digital product development. Despite these differences, both schools showed a shift from conventional teacher-centered learning toward more active student participation. The findings therefore suggest that the implementation of digital learning becomes more meaningful when technology is integrated with collaboration, project activities, visual representation, and opportunities for students to construct and communicate their own understanding.

Table 2. Comparison of Digital-Based IPAS Learning Implementation

Implementation Aspect	SDN Tegal Alur 19 Petang	SDN Kramat Pela 09	Interpretation
Main digital media	Canva, learning videos, and supporting digital applications	Canva, learning videos, and digital presentation tools	Both schools integrate digital media into classroom learning
Learning pattern	More structured and collaborative	More individual-creative and product-oriented	Implementation reflects differences in classroom and school contexts
Student organization	Group work is emphasized, particularly to address device limitations	Students have greater opportunities for individual digital production	Access to technology influences how students participate
Student role	Active participants in collaborative digital activities	Active creators of posters, infographics, and digital products	Digital learning shifts students from recipients to producers of knowledge
Teacher role	Provides guidance and manages collaborative use of digital tools	Facilitates creativity and digital expression	Teachers adapt facilitation to student and school conditions
Learning response	Increased participation and mutual support	Increased creativity and visual expression	Both patterns support active student engagement through different mechanisms

Overall, the findings indicate that the implementation of digital-based IPAS learning at the two schools was effective when technological tools were embedded within meaningful pedagogical activities. The collaborative approach at SDN Tegal Alur 19 Petang enabled students to participate despite differences in device access, while the stronger emphasis on creative digital production at SDN Kramat Pela 09 provided students with opportunities to represent their understanding through authentic learning products. These differences reinforce the view that effective digital learning does not depend on uniform technological use, but on the teacher's ability to adapt digital media to student characteristics, available resources, and the intended learning experience.

Evaluating Digital-Based IPAS Learning

The findings indicate that the evaluation of digital-based IPAS learning at SDN Tegal Alur 19 Petang and SDN Kramat Pela 09 was conducted through a combination of supervision, project assessment, digital quizzes, student reflection, and teacher feedback. Evaluation was not limited to measuring final learning outcomes but also considered students' participation, collaboration, creativity, and engagement during the learning process. This approach suggests that assessment was designed to capture both cognitive achievement and the broader competencies developed through digital learning activities.

At SDN Tegal Alur 19 Petang, evaluation tended to emphasize structured monitoring of student participation and collaborative performance. Teachers assessed digital projects using criteria related to task completion, group participation, and the accuracy of IPAS concepts represented in student products. Digital quizzes were also used to identify students' understanding of learning materials, while classroom observation enabled teachers to monitor how effectively students interacted with digital media. This evaluation pattern was closely connected to the collaborative organization of learning, where assessment considered not only individual outcomes but also students' ability to work together and support one another.

At SDN Kramat Pela 09, evaluation placed relatively greater emphasis on the quality of students' digital products and individual creative expression. Teachers examined posters, infographics, and other digital outputs as evidence of conceptual understanding and digital competence. In addition to product assessment, students were encouraged to reflect on their learning experiences and discuss the difficulties they encountered during project activities. This combination of product evaluation and reflection provided teachers with information not only about what students had achieved but also about how they experienced and understood the digital learning process.

The interview and observation data further show that students' active involvement in evaluation contributed to a more reflective learning process. Students were given opportunities to discuss project results, identify difficulties, and respond to teacher feedback. One participant explained that evaluation "does not only focus on the final result, but also considers the process of collaboration and the active involvement of students during the project" (Interview data). This statement indicates that evaluation was understood as a process-oriented activity rather than a purely summative judgment, thereby providing space for students to recognize their strengths, difficulties, and areas for improvement.

The comparison between the two schools demonstrates that evaluation practices were shaped by the different emphases of their digital learning strategies. SDN Tegal Alur 19 Petang placed greater attention on collaborative participation and structured monitoring, whereas SDN Kramat Pela 09 provided greater emphasis on creativity, product quality, and reflective learning. Despite these differences, both schools used evaluation as a mechanism for understanding student progress and identifying areas requiring further instructional support. The findings therefore indicate that evaluation in digital-based IPAS learning becomes more meaningful when it combines learning outcomes, participation, digital products, reflection, and formative feedback.

Table 3. Comparison of Digital-Based IPAS Learning Evaluation

Evaluation Aspect	SDN Tegal Alur 19 Petang	SDN Kramat Pela 09	Interpretation
Evaluation focus	Student participation, collaboration, and conceptual understanding	Digital product quality, creativity, and conceptual representation	The two schools emphasize different dimensions of learning performance
Assessment methods	Digital quizzes, project assessment, observation, and teacher monitoring	Product assessment, reflection, discussion, and digital evaluation	Both schools use multiple forms of assessment
Student involvement	Students are evaluated during collaborative activities	Students are actively involved in reflection on learning experiences	Evaluation supports active student participation
Role of digital products	Used as evidence of group learning and concept understanding	Used as evidence of creativity and individual expression	Digital products function as authentic assessment evidence
Feedback process	Teacher feedback emphasizes participation and task completion	Feedback emphasizes product improvement and learning reflection	Feedback is adapted to the instructional orientation of each school
Evaluation orientation	More structured and collaborative	More reflective and product-oriented	Evaluation reflects different pedagogical emphases across the two cases

Overall, the findings indicate that evaluation of digital-based IPAS learning at both schools extended beyond conventional testing by incorporating project assessment, student participation, digital products, reflection, and feedback. The more structured and collaborative evaluation at

SDN Tegal Alur 19 Petang corresponded with its group-based learning approach, while the more reflective and product-oriented evaluation at SDN Kramat Pela 09 aligned with its stronger emphasis on creativity. These differences show that effective evaluation in digital learning should be aligned with the learning strategy itself, so that assessment can capture not only what students know but also how they participate, create, collaborate, and reflect during the learning process.

Follow-Up and Continuous Improvement of Digital IPAS Learning

The findings indicate that follow-up activities at SDN Tegal Alur 19 Petang and SDN Kramat Pela 09 were directed toward improving subsequent digital-based IPAS learning based on evaluation results. School principals followed up the evaluation process through continued supervision, reflection on teacher performance, and the preparation of learning reports, while teachers revised teaching modules, optimized the use of digital devices, and strengthened collaboration with colleagues. These practices indicate that evaluation was not treated as the final stage of instruction but as a basis for improving the next learning cycle. In this sense, follow-up functioned as a mechanism for continuous instructional improvement.

At SDN Tegal Alur 19 Petang, follow-up activities were particularly related to improving the accessibility and organization of digital learning. Because device availability and student digital readiness varied, teachers continued to optimize collaborative learning arrangements and the use of accessible digital applications. Improvements were directed toward ensuring that students could remain actively involved in learning even when technological resources were limited. Teachers also refined instructional materials and digital activities based on previous classroom experiences, suggesting that follow-up was closely connected to practical classroom problems identified during implementation and evaluation.

At SDN Kramat Pela 09, follow-up practices placed relatively greater emphasis on strengthening the quality of digital products, creativity, and student independence. Teachers revised teaching modules and continued to optimize applications such as Canva to provide students with opportunities to create more meaningful digital products. Collaboration among teachers also supported the exchange of instructional experiences and the development of more innovative learning activities. These follow-up practices contributed to the continued development of students' creativity, technological literacy, collaboration, and problem-solving skills through digital learning experiences.

Across both schools, follow-up was also associated with broader efforts to strengthen teacher capacity and sustain digital learning. The study identified several strategies for addressing implementation constraints, including continuous pedagogical digital-literacy training, teacher learning communities for sharing good practices, the use of student-friendly applications such as Canva, Quizizz, and YouTube, project-based digital learning, improved access to computers and the internet, and the development of digital portfolios. These findings demonstrate that continuous improvement requires not only revisions at the classroom level but also institutional support for teacher competence, infrastructure, collaboration, and the sustainable use of digital learning resources.

Table 4. Comparison of Follow-Up and Continuous Improvement Practices

Follow-Up Aspect	SDN Tegal Alur 19 Petang	SDN Kramat Pela 09	Interpretation
Basis for follow-up	Evaluation results, classroom observations, and student participation	Evaluation results, student products, and learning reflection	Both schools use evaluation findings as the basis for improvement
Teaching module improvement	Modules are adjusted to student readiness and resource limitations	Modules are refined to support creativity and digital product	Module revision reflects the different instructional needs of each school

		development	
Digital media optimization	Emphasis on accessible and collaborative use of digital applications	Emphasis on broader creative use of Canva and digital resources	Digital optimization is adapted to technological readiness
Teacher collaboration	Collaboration supports solutions to device and implementation constraints	Collaboration supports innovation and exchange of digital teaching practices	Collegial learning strengthens continuous improvement
Student development	Collaboration, digital participation, and problem-solving are strengthened	Creativity, digital literacy, and independent production are strengthened	Follow-up contributes to different but complementary twenty-first-century competencies
Improvement orientation	Accessibility and collaborative participation	Creativity and quality of digital learning products	Continuous improvement reflects the contextual characteristics of each school

Overall, the findings demonstrate that follow-up in digital-based IPAS learning served as a continuous improvement mechanism connecting evaluation results with subsequent instructional decisions. Although SDN Tegal Alur 19 Petang placed greater emphasis on accessibility, collaborative participation, and adaptation to resource limitations, SDN Kramat Pela 09 focused more strongly on creativity and the development of digital learning products. In both cases, sustainable improvement depended on the teachers' ability to revise instructional strategies, optimize available technology, collaborate with colleagues, and transform evaluation findings into concrete improvements in subsequent learning cycles.

Discussion (مناقشة)

The findings demonstrate that digital-based IPAS learning at SDN Tegal Alur 19 Petang and SDN Kramat Pela 09 is most effective when technology is integrated into a continuous instructional process rather than used as a stand-alone learning tool. Across the two schools, planning, implementation, evaluation, and follow-up formed an interconnected cycle that shaped the quality of digital learning. Teachers did not simply introduce Canva, Quizizz, videos, or other digital applications, but incorporated these tools into teaching modules, classroom activities, assessment, and subsequent instructional improvement. This pattern is consistent with the PDCA framework, which emphasizes continuous improvement through planning, implementation, evaluation, and corrective action. In the context of this study, the findings confirm that the educational value of digital technology depends largely on how systematically teachers organize its pedagogical use.

The planning findings further indicate that digital learning strategies are strongly influenced by school readiness, teacher competence, student access, and infrastructure. SDN Tegal Alur 19 Petang tended to adopt more structured and collaborative planning because teachers had to consider differences in device availability and students' digital readiness, whereas SDN Kramat Pela 09 showed broader opportunities to incorporate creative digital activities due to relatively stronger technological support. This result supports the TPACK perspective of Mishra and Koehler (2006), which emphasizes that effective technology integration requires the alignment of technological knowledge, pedagogical knowledge, and content knowledge. The finding also reinforces studies cited in the manuscript showing that limitations in infrastructure and variation in teacher digital competence remain major challenges in elementary education. Thus, effective planning requires more than selecting applications; it requires teachers to match

technology with curriculum objectives, pedagogical strategies, student characteristics, and available resources.

The implementation findings show that both schools moved away from purely teacher-centered practices toward more active and participatory learning, although the form of participation differed. At SDN Tegal Alur 19 Petang, digital learning was more strongly organized around collaborative activities, particularly as a strategy for overcoming differences in device access. In contrast, SDN Kramat Pela 09 provided greater space for individual creativity through the production of posters, infographics, and other digital products. These findings support the constructivist view that students learn more meaningfully when they actively construct knowledge through exploration, collaboration, and production. They are also consistent with studies cited in the manuscript indicating that the use of digital media such as Canva can increase student motivation, engagement, creativity, and conceptual understanding. The findings therefore suggest that the strength of digital IPAS learning lies not in the application itself, but in the way the application is embedded within active and meaningful learning experiences (Kovtaniuk et al., 2025; Utami et al., 2025).

The evaluation findings further show that assessment in digital-based IPAS learning is more meaningful when it includes both learning outcomes and learning processes. At both schools, teachers used project assessment, digital quizzes, observation, reflection, and feedback to evaluate students' conceptual understanding, participation, collaboration, creativity, and digital competence. However, SDN Tegal Alur 19 Petang placed greater emphasis on structured monitoring of collaborative participation, while SDN Kramat Pela 09 gave more attention to the quality of digital products and reflective learning. These findings are in line with the manuscript's discussion of digital assessment and project-based learning, where evaluation is expected to capture not only final achievement but also critical thinking, creativity, problem-solving, and active participation. The results therefore reinforce the argument that digital learning requires assessment practices that are multidimensional and aligned with twenty-first-century competencies.

The follow-up findings demonstrate that the effectiveness of digital learning depends on whether evaluation results are translated into instructional improvement. In both schools, teachers revised teaching modules, optimized digital media, strengthened collaboration, and adjusted learning activities based on previous experiences. At SDN Tegal Alur 19 Petang, follow-up was more closely related to accessibility and collaborative participation, while at SDN Kramat Pela 09 it focused more on improving creativity and the quality of digital products. This pattern reflects the principle of continuous improvement in the PDCA cycle, where evaluation is not treated as the end of instruction but as the basis for the next improvement cycle. The findings are also consistent with the manuscript's references on supervision and quality improvement, which emphasize that systematic reflection, corrective action, and continuous teacher development are necessary to sustain learning quality.

Taken together, the findings indicate that the differences between the two schools do not represent contradictory models of digital learning, but rather context-specific adaptations of the same instructional improvement process. SDN Tegal Alur 19 Petang demonstrates a stronger orientation toward collaboration, accessibility, and structured participation, whereas SDN Kramat Pela 09 emphasizes creativity, individual production, and broader use of digital facilities. These variations reinforce the argument that digital transformation in elementary education cannot be implemented through a uniform strategy. Instead, teachers need to adapt technological tools and pedagogical approaches to the characteristics of students, available infrastructure, school readiness, and learning objectives. This interpretation is consistent with previous studies in the manuscript that emphasize the importance of institutional readiness, teacher digital competence, and flexible learning strategies in determining the success of digital education.

The principal contribution of this study lies in demonstrating that **digital-based IPAS learning in elementary schools should be understood as a context-sensitive continuous improvement process rather than as the use of particular technological applications**. By comparing SDN Tegal Alur 19 Petang and SDN Kramat Pela 09, this study shows that the same digital tools can support different instructional strategies depending on school context, student readiness, and resource availability. The study therefore contributes theoretically by connecting digital technology integration with the PDCA continuous improvement framework, pedagogically by highlighting the importance of active, collaborative, creative, and reflective learning, and practically by showing that teachers and schools need to design digital learning strategies that are adaptive rather than standardized. This contribution provides a stronger basis for developing sustainable digital IPAS learning practices in elementary education.

Conclusion (خاتمة)

This study concludes that digital-based IPAS learning at SDN Tegal Alur 19 Petang, West Jakarta, and SDN Kramat Pela 09, South Jakarta, is most effective when implemented as a systematic and continuous instructional process encompassing planning, implementation, evaluation, and follow-up. The integration of digital media such as Canva, Quizizz, learning videos, and other digital platforms supported more active, collaborative, creative, and reflective learning experiences. Although the two schools demonstrated different implementation patterns—SDN Tegal Alur 19 Petang placing greater emphasis on structured collaboration and accessibility, and SDN Kramat Pela 09 emphasizing individual creativity and digital product development—both contexts showed that technology can strengthen student engagement, conceptual understanding, digital literacy, critical thinking, collaboration, and problem-solving. These findings confirm that the effectiveness of digital IPAS learning depends not merely on the availability of technological tools, but on the teacher's ability to align technology with pedagogical objectives, student characteristics, school readiness, and continuous instructional improvement.

This study is limited by its qualitative case study design involving only two elementary schools, meaning that the findings are intended to provide contextual understanding rather than statistical generalization. The implementation of digital learning was also influenced by differences in infrastructure, teacher digital competence, student access to devices and internet connectivity, and uneven parental support. Future research is therefore recommended to involve a wider range of schools with more diverse technological and socio-economic characteristics and to use mixed-method or longitudinal designs to examine changes in learning outcomes and digital competence over time. Practically, schools should strengthen continuous teacher training in digital pedagogy, improve access to technological infrastructure, develop teacher learning communities, and expand collaboration with parents and educational authorities. These efforts are essential to ensure that digital-based IPAS learning can be implemented more equitably, adaptively, and sustainably across different elementary school contexts.

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