



Managing Digital Literacy Integration to Develop Teacher Competence and Support Instructional Quality in Primary Schools: A Qualitative Multiple-Case Study

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Abstract:

Technology integration in schools depends on more than device availability. It also requires coherent planning, role allocation, teacher support, monitoring, and follow-up. This study examined the management of digital literacy integration and its relationship with teacher competence and instructional quality in two public primary schools in West Jakarta, Indonesia. A qualitative multiple-case study was conducted at SDN Kapuk 11 Pagi and SDN Kapuk 08 Petang. Data were collected through interviews, observations, and document review involving school leaders, teachers, education staff, students, and parents. Analysis proceeded in two stages: within-case analysis and cross-case comparison. Themes were organized around planning, organizing, implementation, monitoring, and follow-up. Source and method triangulation supported the credibility of the findings. SDN Kapuk 11 Pagi applied a more systematic management cycle by mapping readiness, establishing a team, developing a teacher learning community, using more varied media, and conducting structured monitoring and mentoring. SDN Kapuk 08 Petang had begun digital integration, but its practices were simpler, more informal, and constrained by devices, training, and technical support. Across both schools, digitally supported practices accompanied by collegial support were associated with greater teacher confidence, more varied instruction, and more visible student participation. The study did not measure causal effects or statistically test improvements in learning outcomes. The findings suggest that developing teacher competence requires alignment among leadership, professional learning, infrastructure, and continuous evaluation.

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Introduction (مقدمة)

Digital technology has become an important part of teaching and learning. However, access to devices does not automatically lead to meaningful learning. Teachers must select technology that fits the learning objectives, subject matter, student characteristics, and assessment strategy. Teacher digital literacy therefore includes technical, pedagogical, critical, ethical, and reflective capabilities. Teacher digital competence frameworks also position technology use within lesson planning, resource development, assessment, learner empowerment, and professional engagement (Caena & Redecker, 2019; Falloon, 2020).

Digital competence must be integrated with pedagogical and content knowledge. The technological pedagogical content knowledge, or TPACK, framework explains that sound technology decisions emerge from the interaction of technological, pedagogical, and content knowledge (Mishra & Koehler, 2006). Training that focuses only on operating applications is therefore insufficient. Teachers also need to understand when, why, and how technology can clarify concepts, encourage interaction, and help students reach learning goals.

Research indicates that both personal and workplace factors shape teacher digital competence. Experience, attitudes, self-efficacy, collegial collaboration, management support, and infrastructure are associated with teachers' readiness and classroom technology use (Hatlevik & Hatlevik, 2018; Lucas et al., 2021; Nurhikmah et al., 2024). A meta-analysis of technology acceptance also found that perceived usefulness and ease of use contribute to teachers' adoption decisions (Scherer et al., 2019). Developing digital competence cannot therefore be treated solely as the responsibility of individual teachers.

Schools need to create conditions in which teachers can learn, experiment, and improve their practice. School leaders must establish direction, organize resources, build a collaborative culture, provide technical and pedagogical support, and use monitoring evidence to refine programs. Research on technology leadership highlights the importance of a shared vision, capacity building, equitable access, and organizational support (Dexter & Richardson, 2020). Transformational leadership has also been associated with more pedagogically demanding technology use when teachers are empowered to act (Schmitz et al., 2023).

School digitalization is an organizational change process rather than a device procurement project. Pettersson (2018, 2021) argues that digital competence should be understood at individual, group, and organizational levels. School leaders must translate digital policy into routines, roles, and professional learning suited to the local context. This process is often complex because it involves limited time, differences in teacher competence, technology selection, device maintenance, and diverse student needs (Håkansson Lindqvist & Pettersson, 2019; Reis-Andersson, 2024).

Teacher collaboration is an important mechanism within this change. Colleagues can offer support close to classroom problems, share instructional examples, and help teachers review their practice. Collegial collaboration has been positively associated with ICT self-efficacy and classroom technology use (Hatlevik & Hatlevik, 2018). Evidence from the SELFIE tool also suggests an association between teacher collaboration and students' digital competence. This relationship should be interpreted in context and does not by itself establish causality (Castaño Muñoz et al., 2023).

Effective professional development is generally sustained, connected to teachers' work, and designed to provide opportunities for practice and feedback. A systematic review of professional development for online and blended learning identified the importance of relevant design, support, interaction, and organizational conditions (Philipsen et al., 2019). Another study found that the quality characteristics of online professional development were associated with teachers' satisfaction and changes in professional practice (Meyer et al., 2023). Workplace mentoring and

professional learning communities may therefore be more useful than one-off training that is detached from classroom needs.

The quality of technology integration is also more important than the amount of use. Moving a lecture onto a screen may not increase student engagement. Activities that allow students to explore, receive feedback, create products, collaborate, and reflect are more likely to support learning. Consoli et al. (2025) found positive associations between the quality of technology integration, students' behavioral engagement, and digital competence for learning. This evidence supports evaluating the purpose and pattern of technology use rather than merely recording its frequency.

Inequitable access remains another challenge. Network quality, school devices, personal devices, and family support vary among communities and schools. These differences can shape teachers' opportunities to practice and students' opportunities to participate. Research in primary education suggests that school context is associated with teachers' TPACK and attitudes toward technology integration (Li, 2025). Digital policy must therefore address resource distribution, technical support, and learning alternatives for students with limited access.

Previous research has examined digital competence, leadership, collaboration, and infrastructure. Less attention has been given to how these elements are managed as one cycle in primary schools with different organizational capacities and resources. This study uses the management functions of planning, organizing, actuating, and controlling proposed by Terry and Franklin (1972). Follow-up was added because it emerged strongly from the data. The framework serves as an analytical tool, not as a fixed standard for ranking the schools.

This study aimed to analyze: (1) how two schools planned, organized, implemented, monitored, and followed up digital literacy integration; (2) the similarities and differences between their management practices; and (3) reported or observed indications of change in teacher competence and instructional quality. The main research question was: How was digital literacy integration managed in two primary schools with different organizational capacities and resources, and how was its implementation related to teacher practice and students' learning experiences?



Method (منهج)

Research design and settings

The study used a qualitative multiple-case study design. This design was selected because the research focused on management processes in real-life settings and required evidence from several sources. A case study is appropriate for examining how a program is implemented, especially when the program cannot be clearly separated from its context (Crowe et al., 2011; Yin, 2018).

The first case was SDN Kapuk 11 Pagi and the second was SDN Kapuk 08 Petang, both located in West Jakarta, Indonesia. The schools operate in nearby communities but differ in digital readiness, device availability, organizational support, and teacher development practices. These differences provided a basis for examining how context shaped the management functions. The unit of analysis was school-level management of digital literacy integration, with particular attention to leadership practice, teacher support, classroom instruction, monitoring, and follow-up.

Participants and data sources

Participants were selected purposively on the basis of their direct roles in, or experience of, digitally supported learning at the two schools. The participant groups included school principals, teachers, education staff, students, and parents. Principals and education staff were included because of their involvement in planning, coordination, infrastructure, or technical support; teachers because they implemented digital media in classroom practice; and students and parents because they could provide perspectives on learning participation and access.

Selection therefore prioritized information-rich roles relevant to the unit of analysis rather than statistical representation.

Data collection

Data were collected through interviews, observations, and document review. Interviews explored program goals, role allocation, teacher experiences, school support, barriers, and perceived changes. Observations examined how digital practices appeared in classroom settings, with attention to the use of devices and applications, teacher-student interaction, student participation, and support provided during lessons. Document review covered available program records, lesson materials, digital resources, monitoring notes, and other relevant school documents. These sources were selected because they provided complementary evidence about intended programs, enacted practice, and documented follow-up.

Interview accounts were compared with observed practices and documentary evidence. Convergent evidence strengthened an interpretation, while differences across sources were retained and examined as possible contextual variations rather than forced into a single account. This procedure supported source and method triangulation and reduced reliance on any one participant group or data type.

Data analysis

Data analysis followed the iterative processes of data condensation, data display, and conclusion drawing and verification (Miles et al., 2014). The analysis proceeded in two linked stages. First, data from each school were examined separately. Interview notes, observation records, and documents were coded into planning, organizing, implementation, monitoring, and follow-up, while remaining open to inductive themes such as access inequality and collegial support. A within-case matrix was then used to connect management practices with supporting evidence, barriers, and indications of change. Second, the two cases were compared systematically across the same categories to identify recurring patterns, contrasts, and context-specific explanations. The cross-case synthesis was checked against the original evidence before conclusions were drawn.

The cross-case analysis was not used to rank the schools against a fixed standard. Instead, it examined how differences in readiness, organizational support, infrastructure, and follow-up shaped implementation in each setting. Themes appearing in both schools were treated as recurring patterns, whereas themes concentrated in one school were interpreted in relation to that case's context. This procedure maintained a clear connection among the research questions, the management-function framework, and the empirical evidence, while preserving the contextual logic of a multiple-case study (Nowell et al., 2017; Yin, 2018).

Trustworthiness and ethics

Credibility was supported through source and method triangulation. Information from different participant groups was compared with observations and documents. Triangulation was used to broaden understanding and examine the consistency of evidence, not to treat one account as a single objective truth (Carter et al., 2014). Cross-case comparison also helped determine whether a theme was limited to one context or reflected a wider pattern across the two cases. The study examined processes and experiences in two schools. The data were not designed to test causal effects or statistically estimate improvements in competence and learning outcomes. The terms improvement and development are used only when participants reported change or when a change in practice was visible in observations and documents. The conclusions are therefore contextual indications rather than generalizations to all primary schools.

Result (نتائج)

Planning digital literacy integration

SDN Kapuk 11 Pagi demonstrated a more systematic planning process. The school began by mapping teacher readiness and available infrastructure. The mapping informed its annual

program and support priorities. Planning extended beyond device operation to technology use in material design, teaching, assessment, and responsible digital practice.

At SDN Kapuk 08 Petang, planning was simpler and focused on foundational needs. The school prioritized internet access, computers or projectors, and teachers' basic ability to use digital media. This approach reflected the capacity available at the school, but there was no evidence of a structured competence map or phased development targets. Immediate needs received more attention than a longer-term competence development plan.

The cross-case comparison suggests that an initial readiness map can connect program goals with actual conditions. Without information about teacher competence, devices, and instructional needs, a program can become a list of activities or procurement items. Planning also needs to remain flexible so that a school can respond to resource constraints and emerging problems.

Organizing roles and support

SDN Kapuk 11 Pagi established a digital literacy team and developed a teacher learning community. Teachers with stronger digital skills served as mentors for their colleagues. Support addressed both technical problems and the pedagogical use of technology. This distribution of roles brought assistance closer to classroom practice and reduced dependence on one person.

SDN Kapuk 08 Petang relied on an information technology coordinator and teachers with stronger digital skills. Support was informal and usually provided when problems arose with devices, connectivity, or applications. This arrangement helped meet immediate needs, but pedagogical mentoring and systematic knowledge sharing were not institutionalized. When support depends on a small number of individuals, program continuity becomes vulnerable to workload and staff turnover.

Both schools showed that differences in teacher expertise can become an internal learning resource. The main differences concerned the formality, reach, and degree to which technical assistance was connected to instructional purposes.

Classroom implementation

Teachers at SDN Kapuk 11 Pagi used a wider range of media and applications, including interactive videos, digital quizzes, interactive presentations, Google Classroom, Canva, and Zoom when appropriate. Technology supported the presentation of content, assignments, assessment, discussion, and student products. Students had more opportunities to respond to quizzes, join discussions, collaborate, and present their work.

Teachers at SDN Kapuk 08 Petang used PowerPoint, projectors, WhatsApp groups, and downloaded videos. These resources helped present information and enrich explanations. However, they were used mainly for teacher presentations and task communication. Students had fewer opportunities to interact directly with digital media or create digital products.

The findings indicate different levels of integration depth. Both schools used technology, but the number of applications was not itself a measure of quality. A more important distinction concerned how technology supported student activity, feedback, assessment of understanding, and connections between content and learning experience.

Monitoring and follow-up

SDN Kapuk 11 Pagi monitored implementation through routine meetings, classroom supervision, teacher reflection, and assessment records. Monitoring information was used to identify difficulties and determine mentoring needs. Follow-up included peer mentoring, the Kelas Digital Mandiri program, and collaboration with the local education authority or training institutions. These practices created a clearer link between evaluation and improvement.

At SDN Kapuk 08 Petang, monitoring took place through informal discussions, direct questions, and manual notes. This approach was flexible and easy to implement, but the findings were not always documented or translated into a follow-up plan. Teachers expressed a need for further training and additional devices. The school continued to depend heavily on education authorities to meet these needs.

Follow-up distinguished a program that ended with implementation from one that developed through organizational learning. When monitoring evidence was recorded, discussed, and connected to support, the school was better able to set the next priority.

Table 1. Cross-case synthesis by management function

Management function	SDN Kapuk 11 Pagi	SDN Kapuk 08 Petang	Cross-case interpretation
Planning	Teacher and infrastructure readiness mapping; annual program; technical, pedagogical, and ethical goals	Focus on basic access, devices, and initial skills	A fuller readiness map helped connect needs, objectives, and development stages
Organizing	Digital literacy team, learning community, and peer mentors	IT coordinator and informal support from more capable teachers	Distributed support broadened technical and pedagogical assistance and reduced dependence on individuals
Implementation	Varied media; more interactive activities; use for content, tasks, assessment, and student products	PowerPoint, projectors, WhatsApp, and videos; mainly presentation and task communication	Integration quality depended on learning design rather than the number of applications
Monitoring	Routine meetings, supervision, reflection, and documentation	Informal discussions and manual notes	Documented monitoring made it easier to identify problems and determine follow-up
Follow-up	Mentoring, Kelas Digital Mandiri, and external collaboration	Requests for training and devices; reliance on external support	Sustainability required internal capacity and access to external support

Indications of change and contextual barriers

Teachers at SDN Kapuk 11 Pagi reported greater confidence in selecting and using digital media. Observations and documents also indicated greater variety in presentations, assignments, quizzes, and learning communication. At SDN Kapuk 08 Petang, teachers were motivated to use technology and had developed foundational skills. Their progress was more constrained because devices, training, and technical support were not equally available.

At the student level, multimedia use and digital tasks at SDN Kapuk 11 Pagi occurred alongside more visible participation in quizzes, discussions, collaboration, and projects. At SDN Kapuk 08 Petang, digital media helped attract attention and present content, but interaction was more often one-way. This evidence indicates changes in learning experience and engagement. It is not sufficient to establish improvement in academic achievement.

Access inequality appeared in both cases but was more evident at SDN Kapuk 08 Petang. Some teachers used personal devices, while students did not have equal access to devices and

internet connections at home. Facilities were more available at SDN Kapuk 11 Pagi, and some parents were able to provide devices. These differences shaped media choices, activity continuity, and students' opportunities to continue digital learning outside school.



Discussion (مناقشة)

Digital literacy integration as organizational capacity

The findings indicate that digital literacy integration was stronger when the school managed it as a connected cycle. Planning defined needs and direction, organizing established roles and support, implementation translated plans into learning experiences, monitoring generated evidence, and follow-up converted that evidence into further action. This pattern extends the POAC functions of Terry and Franklin (1972) by showing that explicit follow-up is important in school digitalization because evaluation has limited value unless it informs subsequent support, resources, or instructional adjustment.

The contrast between the two schools was therefore organizational as well as technological. SDN Kapuk 11 Pagi connected readiness mapping, a digital literacy team, peer mentoring, classroom experimentation, and documented monitoring. SDN Kapuk 08 Petang also showed initiative, but support was more informal and often reactive. This finding is consistent with Pettersson's (2018, 2021) view that digital competence develops across individual, group, and organizational levels. It also aligns with technology-leadership research emphasizing shared vision, capacity building, supportive conditions, and equitable access (Dexter & Richardson, 2020).

Distributed support helped translate leadership into day-to-day teacher learning. At SDN Kapuk 11 Pagi, the digital literacy team, learning community, and peer mentors brought technical and pedagogical assistance closer to classroom problems. At SDN Kapuk 08 Petang, support from an IT coordinator and digitally skilled teachers was useful but less institutionalized. The contrast supports evidence that teacher empowerment and organizational support are associated with more demanding forms of technology integration (Schmitz et al., 2023). It also suggests that even a light structure, such as designated mentors, regular consultation, and documented needs, can reduce dependence on a small number of individuals.

Practice-connected professional learning

Practice-connected professional learning was another important difference. Mentoring and the learning community at SDN Kapuk 11 Pagi gave teachers opportunities to try digital strategies, ask questions, and revise lessons in relation to actual classroom needs. This pattern is consistent with evidence that effective professional development is sustained, relevant to teachers' work, interactive, and supported by organizational conditions (Philipsen et al., 2019; Meyer et al., 2023). It also helps explain why one-off application training may be insufficient for lasting instructional change.

TPACK provides a clearer interpretation of the cross-case difference. At SDN Kapuk 11 Pagi, technology was used not only to present information but also to support assessment, discussion, collaboration, student products, and feedback. This indicates a tighter connection among technological, pedagogical, and content knowledge. At SDN Kapuk 08 Petang, PowerPoint, projectors, WhatsApp, and videos expanded access to digital media, but use remained more concentrated on presentation and task communication. The distinction is therefore not simply between more and fewer applications. It concerns how technology is combined with pedagogy and content to create learning activity (Mishra & Koehler, 2006). This interpretation is also consistent with teacher digital competence frameworks that place technology use within pedagogical, critical, ethical, and professional responsibilities (Caena & Redecker, 2019; Falloon,

2020). Collegial support may facilitate this development, as prior research links collaboration and facilitation with ICT self-efficacy and classroom use (Hatlevik & Hatlevik, 2018; Nurhikmah et al., 2024).

Integration quality and student engagement

The cross-case comparison also shows why integration quality matters more than the number of applications used. Presentation and task distribution can improve efficiency, but they may preserve one-way communication. Interactive quizzes, discussion, collaboration, projects, student products, and feedback give students a more active role. This distinction is consistent with Consoli et al. (2025), who reported positive associations between the quality of technology integration, behavioral engagement, and digital competence for learning. The present findings should nevertheless be interpreted as contextual indications because the study did not measure causal effects or academic achievement.

Teacher collaboration may help explain this pattern by expanding the repertoire of tasks and support available to teachers. Castaño Muñoz et al. (2023) reported an association between teacher collaboration and students' digital competence. In the present study, the school with more structured collegial support also showed more varied digital activities and more visible student participation. This convergence does not establish a causal pathway, but it strengthens the interpretation that organizational support and instructional design should be examined together when evaluating digital integration.

Infrastructure, support, and equitable access

Infrastructure remained an important boundary condition. Limited devices at SDN Kapuk 08 Petang constrained instructional choices and continuity, while unequal home access affected students' opportunities to participate beyond school. Teachers' use of personal devices showed commitment, but it is not a sustainable substitute for institutional provision. These findings reinforce the need to interpret TPACK and teacher digital competence within the context in which teachers work, rather than as individual attributes alone.

This interpretation is consistent with Li (2025), who found that school context was associated with primary teachers' TPACK and attitudes toward technology, and with Lucas et al. (2021), who reported relationships between contextual factors and teacher digital competence. In the present cases, stronger facilities coexisted with more structured professional and organizational support. The evidence does not allow these factors to be separated causally, but it suggests that device provision, technical assistance, professional learning, and monitoring should be planned as connected conditions for instructional use.

Practical implications and limitations

The findings have five practical implications. First, schools should map teacher competence, instructional needs, infrastructure, and access risks before setting program priorities. Second, targets should describe desired instructional practices, not only numbers of devices or training sessions. Third, technical and pedagogical support should be distributed through mentors or professional learning communities. Fourth, monitoring should examine evidence of practice, including sample tasks, student participation, teacher reflection, and access problems. Fifth, each monitoring cycle should lead to a concrete decision about mentoring, resources, or instructional design so that evaluation becomes part of continuous improvement.

The study has several limitations. It involved only two schools and used purposively selected information-rich participants, so the findings are not intended for statistical generalization. Evidence of changes in teacher competence and instructional quality came from participant accounts, observations, and available school documents rather than standardized pre-post measures. The study therefore identifies contextual patterns and plausible relationships, not causal effects or quantified improvement.

Future research could use mixed-method or longitudinal designs to examine whether the processes identified here are associated with measurable changes in teacher competence, lesson-design quality, student engagement, digital access, and learning outcomes over time. Studies across more varied school contexts could also test specific mechanisms suggested by the cases, including peer mentoring, distributed leadership, TPACK-oriented professional learning, and the use of monitoring evidence for follow-up decisions.



Conclusion (خاتمة)

The two schools demonstrated different levels of coherence in managing digital literacy integration. SDN Kapuk 11 Pagi connected readiness mapping, a digital team and learning community, varied classroom practice, structured monitoring, mentoring, and external collaboration. SDN Kapuk 08 Petang used digital media and provided basic support, but its processes were more informal and constrained by devices, training, documentation, and technical assistance.

Teacher competence and instructional quality were related to more than the ability to operate applications. They developed within environments that provided direction, professional learning time, collegial support, infrastructure, opportunities to experiment, feedback, and follow-up. More coherent management occurred alongside greater teacher confidence, more varied activities, and more visible student participation. The study did not establish causal effects or statistically measured improvements in learning outcomes.

Schools can begin with realistic actions: map needs, define pedagogical targets, distribute support roles, monitor evidence of practice, and follow up on the findings. Local education policy should complement these actions by providing equitable devices and connectivity, sustained professional development, and assistance suited to each school's capacity.



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