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Digital Transformation Management In Fostering Learning Innovation In Kindergartens

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Abstract

The availability of digital technology in early childhood education does not necessarily lead to learning innovation without appropriate management. This study aims to analyze the management of digital transformation in fostering learning innovation at TK Kartika XIX-34 Purwakarta and TKAT Miftahul Huda Purwakarta from the perspective of the Plan-Do-Check-Act (PDCA) cycle, including supporting factors, inhibiting factors, and differences in management between the two institutions. The study employed a qualitative approach with a comparative case study design. Data were collected through in-depth interviews with principals, teachers, and parents, classroom observation, and documentation, and were analyzed using the interactive model together with within-case and cross-case analysis. The results show that both institutions follow a PDCA pattern with different emphases. Planning was based on learning needs and involved teachers; implementation was supported by training, mentoring, and supervision; evaluation drew on supervision, teacher reflection, children's responses, and parental input; and follow-up took the form of revising teaching modules, media, and training, as well as standardizing good practices. TK Kartika XIX-34 stood out in infrastructure development and direct supervision, whereas TKAT Miftahul Huda emphasized joint evaluation, media development, and the integration of Qur'anic values. Supporting factors included leadership, teachers, training, collaboration, devices, and internet access, while barriers related to teacher competence, connectivity, devices, and time. The study concludes that PDCA functions as a mechanism linking the management of digital transformation to the emergence of learning innovation, and that its application is contextual, depending on institutional characteristics.

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INTRODUCTION

Advances in digital technology have changed various processes in educational organizations, from planning, management, and implementation to the evaluation of educational services. Over time, digital transformation can no longer be understood merely as the use of digital devices to support administrative and learning activities. The transformation encompasses broader changes in leadership, governance, human resource competence, organizational culture, resource management, and innovation in pedagogical practice (Timotheou et al., 2023). These changes are particularly relevant to early childhood education because children are at a developmental stage that requires social interaction, concrete experiences, play, and direct guidance from educators. Through its review of 30 countries and jurisdictions, OECD (2023) shows that digitalization in Early Childhood Education and Care (ECEC) can provide opportunities for developing learning environments, increasing professional collaboration, strengthening educator competence, and improving relationships between educational institutions and families. Nevertheless, the quality of digital experiences matters more than the intensity of technology use. Technology also cannot replace the direct interaction that takes place between children and educators.

This situation shows that the fundamental problem of digital transformation in early childhood education concerns not only the presence or availability of technology but, above all, the institution's ability to manage and integrate technology so that it provides pedagogical benefits appropriate to children's needs and developmental characteristics. The problem is complex because digital transformation is formed through dynamic relationships among people, technology, organizational structures, and institutional culture. In this process, teachers do not act merely as users of digital devices but also determine how technology is integrated into learning experiences so that it carries pedagogical meaning. The initial conditions at the two educational units that served as research sites, namely TK Kartika XIX-34 Purwakarta and TKAT Miftahul Huda Purwakarta, provide the context for examining this problem. Both institutions had already used digital media in learning, making it relevant to examine how such use was managed to produce renewal in learning practice. The problem is important to study because the presence of technology does not automatically produce learning transformation; its achievement depends

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on the institution's capacity to direct, manage, and use digital resources pedagogically. The findings of Nurhayati and Judijanto (2026) in early childhood education institutions in West Java reinforce this urgency: in literacy and numeracy learning, digital technology tends to be positioned as an entry point for attracting children's engagement and used substitutively without pedagogical redesign.

To understand this management problem, this study uses the quality management perspective developed by W. Edwards Deming (1986), particularly the principle of Continuous Improvement embodied in the Plan-Do-Check-Act (PDCA) cycle. This perspective positions quality improvement as an ongoing process rather than an incidental activity. The process includes the stages of planning, implementation, evidence-based checking, and the determination of corrective action. The PDCA framework is relevant to digital transformation because the application of technology does not by itself produce sustainable change unless it is accompanied by continuous evaluation and refinement. In educational settings, the cycle can be used to understand how institutions set a vision and identify digital needs, manage resources, develop teacher competence, integrate technology into pedagogical practice, assess the effectiveness of its application, and use evaluation results as the basis for refining practice in the next stage. The study by Idrus et al. (2024) on digital culture leadership in basic education likewise positions digital leadership, digital culture, change management, digital innovation, and digital transformation as interrelated components in building a continuous improvement strategy. On this basis, PDCA in this study is not treated as a rigid administrative mechanism but as an analytical perspective for understanding how organizations learn from the experience of digital transformation and turn evaluation results into a basis for corrective action.

Relevant previous studies can be grouped into three focuses. The first group highlights teachers as agents of technology integration. Aditya and Andrisyah (2023), in a study of 100 early childhood teachers in Indonesia, showed that experience in using technology and motivation toward technology are related to teachers' self-regulation strategies in digital learning. Dardanou et al. (2023) found that the development of digital competence among Early Childhood Education and Care (ECEC) staff still faces limited research and policy support. This finding suggests that professional development needs to cover technical skills, the responsible use of technology, and social and collaborative dimensions. In line with this, the systematic review by Papavlasopoulou et al. (2026) shows that most pre-service early childhood teacher education curricula do not yet have a strong digital focus, so the preparation of pre-service teachers needs to combine

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theoretical knowledge with the practice of using technology with children. The second group highlights the organizational dimension. Haryanto et al. (2024), in a study of higher education institutions, showed that leadership plays a role in directing organizational adaptation to the demands of digital technology, but technology adoption does not automatically drive deep changes in organizational culture. The third group examines quality cycles in early childhood education units. Candra and Nurfitriyanti (2024) showed that the application of PDCA through the stages of planning, implementation, evaluation, and continuous improvement in Qur'an learning using the UMMI method at an Islamic kindergarten can be used to improve the quality of the learning process. In addition, Li et al. (2026), through a scoping review of digital pedagogy in early childhood education, identified four main profiles of technology-based pedagogical practice, namely play-based, cooperative and collaborative, project-based, and problem-based pedagogy, and showed the diverse roles of teachers, children, and technology in learning. Taken together, these findings show that successful digital transformation requires the integration of teacher competence, leadership, organizational culture, governance, and pedagogical orientation.

Although they provide an important foundation, these studies tend to examine the components of digital transformation separately, namely teacher competence, motivation, and readiness on the one hand, and leadership and organizational culture on the other. Candra and Nurfitriyanti (2024) did apply PDCA at the kindergarten level, but positioned it as a mechanism for improving the quality of a Qur'an learning program, not as a managerial mechanism linking digital transformation with learning innovation. Thus, the studies discussed have not comprehensively explained how the components of digital transformation are managed as part of a cyclical process of organizational change. There is still room to examine the managerial process that links the planning of digital transformation, implementation, evaluation, and corrective follow-up with the emergence of learning innovation in early childhood education units, particularly by comparing institutions with different institutional characteristics.

Based on this gap, the novelty of this study lies in the integration of digital transformation management, PDCA-based Continuous Improvement, and learning innovation in the context of early childhood education through a comparative case study of TK Kartika XIX-34 Purwakarta and TKAT Miftahul Huda Purwakarta. Unlike studies that focus on teacher competence or leadership separately, this study examines how school actors interpret and implement digital transformation as a single management cycle under different institutional conditions. The comparative approach

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makes it possible to identify similarities and differences in management patterns, supporting and inhibiting factors, and the ways each institution adapts the PDCA cycle based on organizational culture, institutional vision, resource availability, teacher competence, and learners' needs. Therefore, this study does not start from the assumption that PDCA principles can be applied identically in every institution, but explores how the principle of Continuous Improvement is negotiated and realized in different organizational environments. Theoretically, this study is expected to extend the application of Deming's perspective to the study of digital transformation management in early childhood education and to clarify the mechanisms linking leadership, teacher competence, governance, organizational culture, technology, evaluation, and learning innovation. Practically, the results are expected to provide contextual understanding for kindergarten principals, teachers, early childhood education administrators, and policymakers in designing digital transformation that does not stop at the procurement and adoption of technology but develops into a systematic, adaptive, and sustainable process of improving learning quality.

Based on the above description, this study aims to describe and analyze the management of digital transformation in supporting learning innovation at TK Kartika XIX-34 Purwakarta and TKAT Miftahul Huda Purwakarta from the perspective of the Plan-Do-Check-Act cycle. More specifically, this study seeks to answer how the two institutions planned digital transformation, implemented programs and developed teacher competence, evaluated implementation and learning quality, and followed up on evaluation results as part of the Continuous Improvement process. This study also examines which factors supported and hindered the implementation of digital transformation, and how management characteristics differed between the two institutions.

RESEARCH METHODOLOGY

This study applied a qualitative approach with a comparatively oriented multiple-case study design. The design was chosen because the study aimed to gain an in-depth understanding of the process of managing digital transformation under natural conditions in two early childhood education units. The study was not intended to measure relationships between variables statistically. Each case was examined separately so that the contextual characteristics of each institution were preserved. The two cases were then compared to identify the similarities, differences, patterns, and conditions that explain the implementation of digital transformation

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in supporting learning innovation. The scope of analysis covered the Plan-Do-Check-Act (PDCA) cycle, leadership, teachers' digital competence, resource management, organizational culture, use of technology, learning innovation, and the factors that supported and hindered the digital transformation process.

This design is consistent with the characteristics of case study research, which allows researchers to explore complex phenomena in real-life contexts using multiple sources of evidence. Yin (2018) also shows that case studies are appropriate when research aims to explain how and why questions through rich data with contextual depth. In this study, the PDCA framework was positioned as an analytical perspective rather than as an instrument for quantification. Analysis was first carried out on each case individually and then continued with cross-case analysis to obtain a comparative understanding.

The study was conducted from 13 July 2026 to 12 August 2026 at TK Kartika XIX-34 Purwakarta and TKAT Miftahul Huda Purwakarta, Purwakarta Regency, West Java. The two sites were selected purposively because both were relevant to the research focus, provided the necessary sources of information, and had institutional characteristics that allowed comparison. The two schools are located in a relatively similar geographical area and regional education policy environment. However, they differ in organizational culture, institutional characteristics, human resources, and patterns of technology use. These differences make the two institutions relevant as comparative cases for understanding the influence of organizational context on the management of digital transformation.

The research participants included actors with direct experience, relevant knowledge, or involvement in managing digital transformation and implementing learning innovation at the two kindergartens. Informants were determined through purposive sampling, that is, the selection of participants based on the fit of their experience and information capacity with the research focus. The informants were then categorized according to their function and level of involvement in the phenomenon studied. The total number of informants was 16, consisting of 2 principals, 12 teachers, and 2 parents. At TK Kartika XIX-34, the informants consisted of 1 principal, 8 teachers, and 1 parent. Meanwhile, TKAT Miftahul Huda involved 1 principal, 4 teachers, and 1 parent. In presenting the results, interview quotations were given informant codes indicating the informant's role, namely KS for principal, G for teacher, and OT for parent, and the institution of origin, namely K19 for TK Kartika XIX-34 and MH for TKAT Miftahul Huda, followed by the informant's sequence number. Principals and teachers were designated as key informants

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because they were directly involved in decision-making, implementation, supervision, and the development of learning innovation. Parents were positioned as supplementary informants to broaden the perspective and support triangulation. This selection is in line with the principle of information-rich cases in purposive sampling (Patton, 2015), namely selecting individuals with substantial experience and knowledge of the phenomenon studied. In case studies, purposive sampling can also be used to identify informants who have in-depth knowledge and positions relevant to the case under study.

Research data were obtained through semi-structured in-depth interviews, observation, and document study. Interviews were used to explore the experiences, meanings, strategies, decision-making considerations, obstacles, and practices of principals and teachers in carrying out each stage of digital transformation. The interview guide was developed based on the research focus, which included planning digital transformation, organizing resources, implementing technology, developing teacher competence, evaluation, follow-up, learning innovation, and supporting and inhibiting factors. Observation was conducted to obtain direct empirical evidence of the use of technology, the learning process, interaction between teachers and learners, children's responses and engagement, and the forms of learning innovation realized in practice. Meanwhile, documentation was used to trace institutional evidence, grouped according to the PDCA stage it supported. Planning-stage documents included work meeting minutes and attendance lists, vision and mission documents, device inventories, and proposed priority needs. Implementation-stage documents included RPPH (daily lesson plans) or teaching modules, documentation of learning media, training attendance lists, supervision schedules, and teacher mentoring notes. Evaluation-stage documents included classroom supervision reports, teacher reflection sheets, evaluation meeting minutes, records of parental input, and documentation of communication with parents. Follow-up-stage documents included revised teaching modules, media improvement reports, advanced training programs, good-practice standardization documents, and follow-up plans.

The three techniques were applied in a complementary manner so that information obtained through interviews could be confirmed through observations of behavior and documentary evidence. In this way, understanding of the phenomenon was built not solely on informants' perceptions but through the combination of multiple, mutually complementary sources of evidence. The use of diverse data sources is an important practice in case studies

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because triangulation can strengthen the depth of interpretation while increasing the traceability of the evidence used in the study (Yin, 2018).

The research process was carried out cyclically, so that the stages of data collection and analysis were not rigidly separated. After entering the field, the researcher transcribed the interview data, compiled observation notes, and grouped documents according to their relevance to the research focus. The researcher then read the data repeatedly to identify important information, recurring patterns of statements, differences in viewpoints, and events related to digital transformation and learning innovation. Data credibility was strengthened through source triangulation and technique triangulation. Source triangulation was carried out by comparing information obtained from principals, teachers, and parents. Technique triangulation was carried out by comparing findings from interviews, observation, and documentation.

Dependability and confirmability were pursued by ensuring that every interpretation could be traced back to the underlying empirical evidence, namely coded interview quotations, classroom observation notes, and institutional documents. Transferability was supported through descriptions of the organizational characteristics and contexts of the two schools and of the digital transformation practices in each case. These four criteria, namely credibility, dependability, confirmability, and transferability, refer to the trustworthiness framework of Lincoln and Guba (1985).

Data analysis in this study applied the interactive model of Miles et al. (2020), which comprises data condensation, data display, and conclusion drawing and verification. This framework was then combined with within-case and cross-case analysis. Analysis began as soon as data collection started and was carried out simultaneously until the entire research process was completed. At the data condensation stage, interview transcripts, observation notes, and documents were reviewed repeatedly and then subjected to initial coding. Codes with similar meanings were then consolidated into categories and themes. The analysis combined a deductive approach using the PDCA dimensions as its basis with an inductive approach that still allowed new categories or themes to emerge from the empirical findings.

The next stage was carried out through separate within-case analyses of TK Kartika XIX-34 and TKAT Miftahul Huda. This stage was aimed at understanding the characteristics, context, and dynamics of each case. After the patterns in each case had been identified, cross-case analysis was carried out to find the similarities, differences, mechanisms, and contextual conditions that could explain variations in the implementation of digital transformation.

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Conclusions were not established all at once but were built gradually and continuously verified by referring back to the raw data, including information that was different or contradictory. This process was carried out so that the interpretation would not be oriented solely toward confirming the most dominant pattern.

In data management, interview quotations, informant codes, and data trails were organized into matrices according to PDCA stage, while cross-case comparisons were summarized in a matrix such as the one in Table 1. The matrices helped with categorizing and tracing the data, but their use did not replace the researcher's role in interpretation. Their function was to help ensure that the analysis process was systematic, consistent, documented, and traceable.

RESULTS AND DISCUSSION

The analysis of interview, observation, and documentation data shows that the management of digital transformation at TK Kartika XIX-34 Purwakarta and TKAT Miftahul Huda Purwakarta has shifted from incidental use of technology toward more directed and structured change management. Both cases show a Plan-Do-Check-Act (PDCA) pattern, although its implementation takes different forms according to the characteristics of each institution. The main findings show that the presence of digital devices alone does not directly produce learning innovation. Innovation tended to develop when schools integrated needs-based planning, the strengthening of teacher competence, leadership, the application of technology, evaluation, and follow-up into a series of mutually continuous improvements.

The research data also show changes in the variety of learning media used, teacher creativity, learner engagement, the attractiveness of learning experiences, and efforts to strengthen teachers' digital competence through training and mentoring. This pattern shows that digital transformation in the context of early childhood education (Pendidikan Anak Usia Dini/PAUD) is better understood as a process of managing pedagogical change than merely as an activity of adopting technology.

1. Planning (Plan) as the Foundation of Digital Transformation

The Plan stage at both schools shows a relatively participatory and needs-oriented planning pattern. At TK Kartika XIX-34, the vision of digital transformation was built jointly through observation, discussion, evaluation, and work meetings. Infrastructure development was carried out gradually, taking into account the school's priorities and needs. At TKAT Miftahul Huda, needs were identified through observation of learning activities, discussion, evaluation,

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and the involvement of teachers in the planning process. Thus, the planning process at both institutions was not oriented solely toward providing or procuring technological devices. Planning also covered human resource readiness, program preparation, and learning needs, which served as the basis for determining the direction of digital transformation.

This pattern is evident in the statement of the principal of TK Kartika XIX-34, “We don’t buy devices right away. We observe classes, discuss with teachers, evaluate previous activities, and then hold a work meeting. So the priority is learning needs.” (KS-K19-01). A teacher at the same school added, “Devices are added gradually; whatever teachers and children need most comes first.” (G-K19-03). At TKAT Miftahul Huda, the principal stated, “We look at needs from observing activities, teacher discussions, evaluation, and meetings. Teachers are involved so that the plan doesn’t come only from the leadership.” (KS-MH-01), while a teacher emphasized, “Digital media are adjusted to the school’s mission and Qur’anic habituation; not every activity has to be digital.” (G-MH-02). These accounts are supported by planning documents in the form of work meeting minutes and attendance lists, vision and mission documents, device inventories, and proposed priority needs.

The findings show that the Plan stage plays a role in ensuring alignment between the use of technology and pedagogical needs. This is important because the characteristics of early childhood education require technology to remain directed at supporting play, exploration, social interaction, and children’s direct experiences. Thus, technology is not positioned as the main goal but as one of the resources used to support the achievement of learning objectives. This finding reinforces the view that the success of technology integration in early childhood education is influenced by the purpose of its use, teacher competence, administrative support, and the learning context. Çelik et al. (2026), through a qualitative study of 11 preschool teachers, also showed that technology integration is related to teachers’ competence and beliefs, administrative support, policy, and collaboration with parents. Mertala’s (2019) synthesis of 35 qualitative studies likewise confirms that early childhood teachers’ beliefs about technology integration are shaped by contextual factors.

Within Deming’s framework, this pattern shows that quality improvement begins with planning that takes actual needs and conditions into account, not merely with corrective action after problems arise. Based on these findings, the meaning of Plan in early childhood digital transformation can be understood more broadly. Plan covers not only the preparation of technology-related programs but also the process of preparing the organization to be able to

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produce pedagogical change. Planning that involves various parties gives teachers the opportunity to convey the real needs they face in learning activities. This makes decision-making about technology not entirely top-down.

2. Implementation (Do): Technology Translated into Pedagogical Practice

The Do stage shows the process in which digital transformation began to be realized in learning practice. At TK Kartika XIX-34, technology was applied in learning activities, accompanied by training and mentoring for teachers. The principal also carried out a supervisory function, while program implementation was supported through cooperation among stakeholders. A relatively similar pattern was seen at TKAT Miftahul Huda, although teachers' development of digital media and leadership support and collaboration were more prominent. These findings show that digital transformation does not stop at the ownership of devices. Technology began to be integrated into pedagogical practice through the use of media, the application of methods, and the development of learning experiences.

The principal of TK Kartika XIX-34 explained, "Teachers are trained and then mentored. I supervise to see whether the media are used for play and exploration, not just for watching." (KS-K19-01). A teacher described their practice, "I use simple apps and short videos; children are encouraged to ask questions, try things out, and then make something." (G-K19-02). Observations at the school showed that the use of short videos and simple quiz apps in theme-opening activities made children appear more focused, raise their hands, and imitate movements and songs. Children were also more active when given the opportunity to try things themselves, answer questions, and create works after watching the media. At TKAT Miftahul Huda, a teacher stated, "Teachers develop their own media according to the theme; leadership support and collaboration among teachers help." (G-MH-03). The principal added, "The principal provides room for collaboration and mentoring; we also involve parents." (KS-MH-01). Observations showed that teachers used self-made digital media adapted to the theme and Qur'anic values, while children took part in matching, singing, and storytelling activities. The implementation documents reviewed included RPPH or teaching modules, documentation of learning media, training attendance lists, supervision schedules, and teacher mentoring notes.

This finding is in line with research on digital transformation in early childhood education that positions teachers' technology experience and competence as important components of successful digital learning. Aditya et al. (2022), through interviews with 53 early childhood teachers in Indonesia, showed that teachers perceive technology as beneficial for learning but

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still face limited competence and various obstacles in using it. The study also emphasized the need for training that can support early childhood teachers' ability to use ICT. Furthermore, Aditya and Andrisyah (2023) showed that experience in using technology, motivation toward technology, and teachers' self-regulation strategies play an important role in digital learning environments. In the context of early childhood education in West Java, Nurhayati et al. (2026) also showed that digital creativity is not achieved simply by bringing apps, games, and animations into the classroom, but requires teachers' ability to transform them into play-based learning.

Another important finding concerns the principal's position as a link between policy and implementation in the field. The principal's role is not limited to providing administrative support but also includes supervision and mentoring throughout the implementation process. This finding is in line with the study by Haryanto et al. (2024) in higher education, which showed that leadership plays a role in directing the organization when facing pressures generated by the development of digital technology. However, technology adoption does not automatically produce deep changes in organizational culture. In the early childhood context, Mulyaniapi et al. (2024) found a strong relationship between digital leadership and the organizational capability of PAUD Sekolah Penggerak (Driving School early childhood units) in Bandung City. Therefore, the Do stage in this study shows that technology can produce pedagogical change when supported by a combination of leadership, teacher competence, mentoring, collaboration, and opportunities for teachers to develop new learning practices.

3. Evaluation (Check) as a Mechanism of Organizational Learning

The Check stage shows that evaluation had become part of the control mechanism in the digital transformation process. At TK Kartika XIX-34, evaluation was carried out through classroom supervision, teacher reflection, observation of children's responses, and review of learning outcomes. Meanwhile, TKAT Miftahul Huda involved input from teachers and parents and observed children's responses and level of engagement in learning. These findings show that evaluation was not directed solely at assessing program achievement administratively. Evaluation was also used to understand how technology and innovation were received, used, and functioned in learning practice.

At TK Kartika XIX-34, the principal stated, "Classroom supervision and teacher reflection; we look at children's responses, not just administration." (KS-K19-01). Children's responses also became the basis for teachers' assessment, "Children are more enthusiastic when digital media are used briefly and interactively; if it goes on too long, they get bored." (G-K19-05). This account

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is consistent with the observations: when digital media were used for more than about 10-15 minutes, some children began to get bored, talk to their friends, or ask for other activities, so the teacher switched to manipulative activities and role play. At TKAT Miftahul Huda, a teacher said, "Evaluation meetings involve teachers and parents; we discuss parents' input." (G-MH-04). This was confirmed by a parent, "I see my child talking at home about the activities; we give input through the group and meetings." (OT-MH-01). Observations at this school showed that children's engagement increased when the media were accompanied by teacher interaction, open-ended questions, and follow-up hands-on activities, although some children needed individual guidance, especially when taking turns using the devices. The evaluation documents reviewed included classroom supervision reports, teacher reflection sheets, evaluation meeting minutes, records of parental input, and documentation of communication with parents.

Theoretically, the findings show that evaluation functions as a mechanism of organizational learning, in line with Senge's (2006) idea of the learning organization. Within the PDCA framework, the Check stage holds an important position because it enables the organization to obtain information about gaps between planning and implementation. This information then becomes the basis for determining actions in the next stage.

The findings of this study pay particular attention to children's responses and parental input. In the context of early childhood education, the success of digital transformation cannot be measured with the same indicators as in non-educational organizations. The use of technology needs to be viewed in terms of its contribution to the quality of children's learning experiences. Therefore, children's engagement and responses, the quality of interaction, and input from parents become important sources of information in the evaluation process. These findings show that the Check stage in early childhood digital transformation has a dual character, functioning both as a pedagogical mechanism and as part of organizational management.

4. Follow-up (Act) and the Emergence of Continuous Improvement

The Act stage shows that evaluation results were used as the basis for refining existing practices rather than merely compiled into reports. At TK Kartika XIX-34, follow-up took the form of improvements to programs, teaching modules, infrastructure, learning media, and teacher competence. Meanwhile, at TKAT Miftahul Huda, improvement efforts were directed at media and learning practices as well as at the standardization of practices judged to be good. These findings show that Act becomes the mechanism that links evaluation results to the sustainability of the innovation process.

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The principal of TK Kartika XIX-34 stated, “Evaluation results are used to revise modules, media, and the training schedule; infrastructure is improved gradually.” (KS-K19-01). A teacher added, “We revise the teaching modules after reflection; digital activities are reduced if the children become too passive.” (G-K19-06). At TKAT Miftahul Huda, the principal explained, “Practices judged to be good are documented and made into a shared standard.” (KS-MH-01), while a teacher said, “Media are improved based on input from teachers and parents; there is follow-up mentoring.” (G-MH-02). This follow-up is reflected in documents in the form of revised teaching modules, media improvement reports, advanced training programs, good-practice standardization documents, and follow-up plans.

The significance of this stage is seen in the changing position of innovation within the organization. Innovation no longer depends solely on individual teachers’ creativity. When practices judged to be good are documented, refined, shared, and then standardized, innovation begins to develop into part of the organization’s capacity. Observations also showed responses to problems through adjustments to learning strategies and media in practice. From Deming’s perspective, which according to Moen and Norman (2010) evolved into a cycle of learning and improvement, this condition shows that PDCA functions as a cycle of organizational learning. Each action produces experience, that experience is evaluated, and the evaluation results are then used as the basis for determining actions in the next cycle.

These findings are supported by the study by Candra and Nurfitriyanti (2024) on Qur’an learning in a kindergarten, which showed that the application of PDCA through the stages of planning, implementation, evaluation, and continuous improvement can be used to improve the quality of the learning process. The difference is that this study does not position PDCA solely as a mechanism for improving the quality of a learning program. Instead, the findings show that PDCA functions as a managerial mechanism linking digital transformation with learning innovation at the level of the school organization. This position is an important part of the study’s conceptual contribution.

5. Similarities, Differences, and Supporting and Inhibiting Factors

The comparative analysis shows a similar fundamental pattern in both cases. Both institutions planned digital transformation, used technology in learning, developed teacher competence, received principal support, conducted evaluation, and carried out follow-up. Nevertheless, their implementation mechanisms differed. TK Kartika XIX-34 stood out more in infrastructure development, direct supervision, division of tasks, and the use of various digital

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applications. Meanwhile, TKAT Miftahul Huda placed greater emphasis on the use of feedback, joint evaluation, the development of digital learning media, and the standardization of practices judged to be good. This comparison is summarized in Table 1.

Table 1. Comparison of Digital Transformation Management Findings in the Two Cases

No	Dimension	TK Kartika XIX-34 Purwakarta	TKAT Miftahul Huda Purwakarta	Meaning of Findings
1	Planning	Needs-based, readiness of facilities and human resources	Based on classroom needs and the school's mission	Planning is contextual
2	Teacher involvement	Active in program preparation	Active in planning and evaluation	Teachers become agents of change
3	Implementation	Various digital devices and applications	Development of digital media and learning experiences	Technology enters pedagogical practice
4	Leadership	Direct supervision and leadership support	Leadership support and strengthened evaluation	Leadership becomes a lever of transformation
5	Evaluation	Supervision, children's responses, teacher competence	Supervision, evaluation meetings, input from teachers and parents	Evaluation is multidimensional
6	Improvement	Infrastructure, training, media, and teaching modules	Media improvement based on input from teachers	Act sustains innovation

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No	Dimension	TK Kartika XIX-34 Purwakarta	TKAT Miftahul Huda Purwakarta	Meaning of Findings
			and parents, follow-up mentoring, and standardization of good practices	
7	Barriers	Internet, teacher competence, devices, time	Competence, infrastructure, and development needs	Barriers are technical and organizational
8	Outcomes	More varied and attractive learning	More innovative learning and good child responses	Transformation contributes to learning innovation

Source: Compiled from research data.

The main supporting factors identified were leadership, teachers, training, collaboration, devices, and internet access. The barriers related mainly to teacher competence, internet connectivity, limited devices, and time. This pattern of barriers is in line with the finding of Tunç Genç and Göğüş (2026) that most kindergarten teachers face problems with internet connectivity and infrastructure, insufficient management support, and the absence of technical support units. These findings show that digital transformation is not determined by any single factor. The availability of infrastructure is insufficient if it is not accompanied by the competence needed to use it. Likewise, training does not automatically produce change if it is not supported by leadership capable of directing the transformation process. Conversely, strong leadership still requires resource support and a collaborative culture so that innovation can be sustained and continue to develop.

The difference in context between the two schools is theoretically important. TKAT Miftahul Huda has an institutional identity shaped by a Qur'anic culture, the instilling of good

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character (*akhlak*), habituation of worship, and parental involvement. This shows that the process of digital transformation does not erase the organizational character that has already been formed. Instead, technology is integrated and adapted to the values and identity that underpin the institution. This finding reinforces the view that digital transformation in educational organizations is a contextual process. In the context of higher education, Haryanto et al. (2024) also showed that the use of technology can encourage organizations to adapt without having to give up their cultural resilience.

6. Theoretical Synthesis: PDCA as a Mechanism Linking Digital Transformation and Learning Innovation

A synthesis of all the findings yields the main proposition that digital transformation in early childhood education can produce learning innovation when technology is managed through a continuous improvement cycle that integrates vision, needs, leadership, teacher competence, pedagogical implementation, evaluation, and follow-up. Thus, digital transformation does not directly produce learning innovation. Between the two lies a managerial mechanism that functions as a link. This mechanism is realized through the principle of Continuous Improvement in the PDCA cycle. The findings point to a tentative conceptual model that links the identification of vision and digital needs, strategic planning, resource organization, leadership, competence development, pedagogical application of technology, evaluation, and continuous improvement, culminating in learning innovation.

Descriptively, Deming's theory provides a framework for understanding digital transformation as a process that takes place through a repeated cycle. The Plan stage explains how schools set a direction and identify needs. The Do stage describes the translation of plans into practice. The Check stage explains how schools obtain information about successes and problems in implementation. The Act stage then shows how the information obtained is used as the basis for improvement. Explanatorily, the theory explains why the availability of technological devices in schools does not necessarily produce sustained innovation. The difference lies in the organization's capacity to run and manage the entire cycle consistently. Predictively, the findings point to the proposition that the sustainability of learning innovation is more likely when schools have evaluation and follow-up mechanisms capable of linking implementation experience with the planning process in the next stage.

The findings of this study extend previous research. Studies on technology integration in early childhood education have widely shown the importance of teacher competence,

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organizational support, training, and policy (Çelik et al., 2026; Tunç Genç & Göğüş, 2026). Studies on digital leadership also emphasize the role of leadership and organizational culture in building adaptive capacity (Haryanto et al., 2024; Okunlola et al., 2024). Meanwhile, research on the application of PDCA in education shows the benefits of the cycle of planning, implementation, evaluation, and improvement in supporting improvements in learning quality (Candra & Nurfitriyanti, 2024). This study integrates these three perspectives in the context of early childhood education through a comparative case study. The main contribution of the study lies in explaining that PDCA functions as a linking mechanism, not merely a quality procedure, between the management of digital transformation and the emergence of learning innovation.

7. Theoretical and Practical Implications

Theoretically, this study strengthens the position of Continuous Improvement as a perspective that can be used to explain the process of digital transformation in educational organizations. Digital transformation is not adequately understood if it is seen only as technology-related change. The process also involves organizational change that requires learning, evaluation, adaptation, and the institutionalization of practices judged to be good. The findings further show that the application of PDCA is contextual and not mechanistic. Organizational culture, school vision, teacher competence, resource availability, learner characteristics, and relationships with parents all influence the form of application at each stage. Therefore, digital transformation models in early childhood education need to maintain the basic structure of PDCA while providing adequate room for adaptation according to the characteristics and needs of each institution.

Practically, principals need to position digital transformation as part of the agenda for improving educational quality, not merely as a device procurement program. The planning stage needs to begin with mapping teachers' needs and competencies. The implementation of digital transformation needs to be supported through training and mentoring. This need is in line with Undheim's (2022) review, which found that early childhood teachers often lack the knowledge to integrate technology into play-based pedagogy. The evaluation process needs to draw on multiple sources of evidence from supervision, children's responses, teacher reflection, and parental input. Evaluation results then need to be translated into concrete actions in the form of refining learning media, teaching modules, teacher competence, infrastructure, and school programs. This sequence is consistent with the findings showing that the success of digital transformation is influenced by leadership, teachers, training, collaboration, devices, and

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internet connectivity. Meanwhile, the main barriers relate to competence, connectivity, device availability, and time.

CONCLUSION

This study concludes that the management of digital transformation at TK Kartika XIX-34 Purwakarta and TKAT Miftahul Huda Purwakarta followed the pattern of the Plan-Do-Check-Act cycle, although the form of its application differed according to the institutional characteristics of each. At the Plan stage, both institutions set the direction of digital transformation based on learning needs through observation, discussion, evaluation, and work meetings involving teachers, with devices added gradually. At the Do stage, technology was translated into learning practice through training, mentoring, and supervision. TK Kartika XIX-34 made greater use of simple applications and short videos, whereas teachers at TKAT Miftahul Huda developed their own digital media adapted to the theme and Qur'anic values.

At the Check stage, evaluation was not merely administrative but drew on classroom supervision, teacher reflection, children's responses, and parental input, especially at TKAT Miftahul Huda. At the Act stage, evaluation results were used to revise teaching modules, media, training schedules, and infrastructure at TK Kartika XIX-34, and to improve media and standardize practices judged to be good at TKAT Miftahul Huda. Through the interconnection of these four stages, PDCA functions as a mechanism linking the management of digital transformation with the emergence of learning innovation. This innovation was evident in more varied and interactive learning and in increased child engagement when digital media were used briefly and accompanied by teacher interaction.

The factors supporting digital transformation at both institutions included leadership, teachers, training, collaboration, devices, and internet access, while the barriers related to teacher competence, internet connectivity, limited devices, and time. The main difference between the two institutions lay in their management emphasis. TK Kartika XIX-34 stood out more in infrastructure development, direct supervision, and the use of various digital applications, whereas TKAT Miftahul Huda placed greater emphasis on feedback, joint evaluation involving parents, media development, and the standardization of good practices aligned with the institution's Qur'anic culture. These differences show that the application of PDCA in early childhood digital transformation is contextual.

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This study is limited to two early childhood education institutions in Purwakarta Regency using a qualitative approach, so its findings are not intended to be generalized statistically, and the proposed conceptual model remains tentative. Practically, kindergarten principals are advised to position digital transformation as part of the quality improvement agenda through needs mapping, teacher training and mentoring, evaluation that draws on children's responses and parental input, and documented follow-up. Future research could involve more early childhood education units with diverse characteristics and use a longitudinal design to examine the sustainability of innovation generated through the PDCA cycle.

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