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Designing an Integrated Information System for Collaborative Quality Assurance in Early Childhood Education: A Systematic Literature Review

[1]*Wildan Saugi; [2]Azainil; [3]Haeruddin; [4]Muhammad Ramli Buhari
[1] Sultan Aji Muhammad Idris State Islamic University Samarinda Indonesia; [2-4] Mulawarman University Samarinda Indonesia
[1]w.saugi@uinsi.ac.id; [2]azainil@fkip.unmul.ac.id; [3]haeruddin@fkip.unmul.ac.id; [4]m.ramli@fkip.unmul.ac.id
* Corresponding Author

ABSTRACT: This study aims to identify and analyze the design of an integrated information system that supports the quality assurance of early childhood education (PAUD) collaboratively. Using a Systematic Literature Review (SLR) approach, the study screened and examined 12 scientific articles from the Scopus database published between 2015 and 2025. The study process follows the PRISMA 2020 guidelines with the stages of identification, screening, feasibility assessment, and inclusion. The results of the thematic analysis show five main themes in the integration of the quality and information system of early childhood education, namely: institutional technical efficiency, information security and risk management, documentation social practices, institutional collaboration, and ethical and environmental dimensions. This study found that most PAUD information systems are still administrative and do not fully support participation, pedagogical reflection, and collaborative governance. This research contributes to the development of an integrative, participatory, and contextual information system-based quality management model of early childhood education. These findings are expected to serve as a basis for policy and practice development at the institutional and government levels, as well as open up space for further research based on local implementation.
KEYWORDS: collaboration, quality management, early childhood education, information systems

INTRODUCTION

Early Childhood Education (PAUD) is a strategic foundation in the national and global education system because early childhood is a crucial period for children's intellectual, emotional, social, and moral development (Hahn & Barnett, 2023). In the framework *Sustainable Development Goals* (SDGs), PAUD is included in the fourth goal, namely inclusive and equitable quality education (Nair et al., 2023). However, in various countries, including Indonesia, challenges to the quality of early childhood education services are still an issue that continues to emerge. Various studies show that the quality of PAUD services is greatly influenced by the management system used by educational institutions, as well as institutional support in ensuring data-based evaluation, monitoring, and decision-making processes (Kinkead-Clark, 2024; Raikes dkk., 2021). In this context, information systems and quality management are two crucial elements that are interrelated and determine the success of PAUD institutions in achieving the

expected quality standards. Carlbaum & Rönnberg (2024) shows that global education companies such as Scandinavia-based EducaCorp have disseminated the quality assurance model to various countries through the *ideational power*, namely by forming a way of thinking and quality standards based on international standards. Consequently, the definition of quality in early childhood education tends to follow an international framework that emphasizes efficiency and accountability, but does not take into account local needs. This kind of quality model often ignores the social and cultural aspects inherent in early childhood education practices in each region, thus risking creating a mismatch between quality policies and local realities.

The urgency of this research arises from the gap between the implementation of the quality system and the use of information systems that support collaborative, ethical, and participatory educational practices. Most of the information systems implemented in early childhood education institutions are still administrative and fragmented, not yet integrated into a comprehensive quality framework. Zheng (2024) developing an efficiency evaluation model for PAUD institutions using the *Data Envelopment Analysis* (DEA) which focuses on comparing inputs and outputs quantitatively. While this approach is useful in assessing technical efficiency, the model has not yet described how information systems can be used to support pedagogical reflection processes or encourage community participation in improving the quality of education. Similar findings were also found in the Knauf study (2017), which shows that children's portfolios that should be used to encourage participation are more often used as an image tool for PAUD institutions, with the dominance of narratives from teachers and institutions. In addition, Solberg (2024) highlight the ethical aspects of family information collection practices in early childhood education institutions, which are often done without adequate consideration of parental privacy rights. These findings indicate that information systems in the context of early childhood education do not only function as technological or administrative tools, but also represent social practices that are loaded with dynamics of power relations and potential exclusion for certain groups, such as parents or children themselves. In addition, the results of the study show that the quality management system and information system still tend to run separately and have not been integrated reflectively. In fact, the integration of the two is crucial to creating early childhood education services that are not only technically efficient, but also ethically safe, contextually relevant, and socially inclusive.

Other research highlights the dimensions of crisis management and information security that are also part of the quality of education. Kjellgren et al. (2022) suggests that cases of child abuse in early childhood education institutions in Sweden require a rapid and system-based institutional response, in which information systems and quality management systems are intertwined to maintain public trust. Meanwhile, Song (2022) offers a cybersecurity management system

design for early childhood education institutions with a multi-layered approach and intelligent agents, which is particularly relevant in the post-COVID-19 pandemic era of education digitalization. The system includes data protection, encryption, user training, and risk management of children's information. However, this kind of system is still conceptual and has not been widely implemented in the context of early childhood education at large, especially in developing countries. All these findings indicate the need to develop information systems that are not only secure, but also support quality pedagogical and managerial practices. In the institutional context, Yenpiam et al. (2019) revealed that collaboration between local government organizations in the management of early childhood education is significantly influenced by regulatory constraints and budget limitations. The study also emphasizes that the success of collaboration is highly dependent on the existence of an effective information system, which is able to facilitate data exchange between sectors and support transparency and accountability in the governance of PAUD institutions as a whole.

Based on the results of previous studies that have been compiled systematically, there is a need to develop an integrated information system design that supports collaborative quality assurance of early childhood education. This system is expected to bring together various modules such as pedagogical documentation, risk management, staff training, communication with parents, data-based evaluation, and child information protection. This integrative model has not been widely found in previous studies, which generally only discuss one aspect of the quality system or information system separately. Sousa & Pimenta (2018) even stated that in Brazil, most cities do not have a standardized and comprehensive quality evaluation system for early childhood education, and there are still many weaknesses in institutional management that have an impact on the quality of educational services. These findings are in line with conditions in Indonesia, where many PAUD institutions face similar challenges, including a lack of responsive reporting systems, unintegrated data, and the dominance of administrative approaches in quality evaluation (Hidayat et al., 2024; Indrawati et al., 2021; Sulaeman, 2021; Won & Adriany, 2020). Thus, an information system model is needed that is not only functional and efficient, but also participatory, ethical, and reflective of local needs as well as the social and cultural realities of early childhood education institutions.

This study aims to conduct *a systematic literature review* (SLR) to identify and analyze the design of an integrated information system that supports collaborative quality assurance in early childhood education. The main focus of this study is to synthesize various quality system and information system approaches that have been implemented in various countries, analyze the weaknesses and strengths of each approach, and formulate relevant system design principles to be applied in the Indonesian context. Thus, this research contributes to the development of a conceptual and practical framework in building an adaptive,

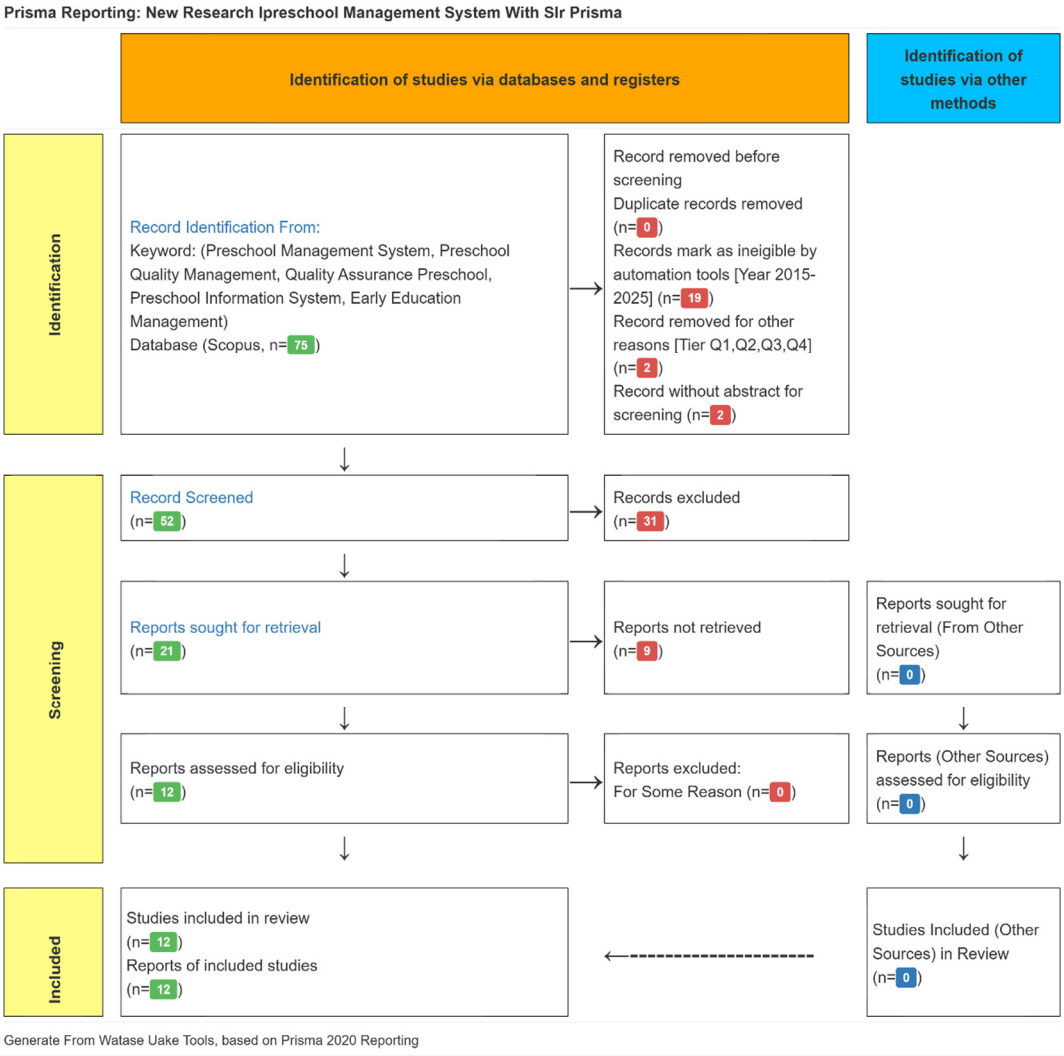
accountable, and child-oriented PAUD quality system. This research is also expected to answer the need for the integration of information technology, institutional policies, and social practices in the implementation of quality and sustainable early childhood education. In addition, the findings of this study will also provide input for policy makers, managers of early childhood education institutions, and educational technology developers in building information systems that are able to bridge administrative and pedagogical needs.

Based on this background, this research is focused on designing an integrated information system to support the quality assurance of early childhood education collaboratively. This study is directed to answer three main focuses, namely: first, identifying the key components that must be possessed by the information system in supporting the improvement of the quality of early childhood education; second, examine how the pattern of collaboration between educational actors such as teachers, parents, the government, and institutional managers can be facilitated through the information system; and third, examining the challenges and strategies that can be applied in the implementation of integrated information systems in the PAUD environment. Through a systematic literature review, this study aims to formulate a conceptual model that is contextual, collaborative, and inclusive, and relevant to the need to strengthen the quality of technology-based early childhood education that is safe and reflective.

METHOD

This study applies the Systematic Literature Review (SLR) approach as the main method to identify, evaluate, and synthesize scientific studies that discuss the integration of information systems and quality management in the context of Early Childhood Education (PAUD). The study process is carried out systematically with reference to the PRISMA 2020 framework, which includes four main stages: identification, screening, eligibility, and final inclusion. To support the planning and documentation of each stage in a more structured manner, the Watase Ueka application is used through the Research Plan SLR feature. This application is also used to help manage references, record the elimination process, and create PRISMA flowcharts automatically and neatly. This study did not use any other data sources outside the main database, and all systematic process documentation was compiled based on the PRISMA workflow as shown in the compiled PRISMA diagram.

Figure 1.
Literature Review Process



Literature data was collected from the Scopus database, using a combination of keywords: "Preschool Management System", "Preschool Quality Management", "Quality Assurance Preschool", "Preschool Information System", and "Early Education Management". The search was limited to publications in the period 2015 to 2025 to ensure the timeliness and relevance of the study. Of the 75 articles identified at the initial stage, 19 articles were automatically eliminated because they were outside the specified publication year limit, 2 articles were removed because they did not meet the classification of reputable journals (non-Q1–Q4), and the other 2 articles did not have a filterable abstract. The screening process resulted in 52 articles, which were then manually checked by their titles and abstracts. Of these, 31 articles were eliminated because they were not relevant to the focus of the study on the integration of information systems and quality management in PAUD.

Furthermore, 21 articles were further selected to assess the feasibility of the in-depth analysis, but only 12 articles were fully accessible and met the inclusion criteria. These criteria include: (1) studies that explicitly discuss early childhood

education, (2) contain aspects of the quality system or information system both conceptually and implementively, and (3) present empirical data or conceptual models that can be evaluated. The main instrument in this study is a data extraction sheet, which is used to record information about the author, year of publication, research objectives, methods, country context, as well as key findings related to the integration of quality systems and information systems. The data collected were analyzed using a *thematic synthesis* approach, with groupings based on substantial themes such as actor participation, technical-informative dimensions, data ethics, institutional governance, and child protection. The validity of the process is maintained through triangulation between researchers, to ensure objectivity and traceability in each stage of analysis.

RESULT

This study identified and analyzed 12 articles that met the eligibility criteria out of a total of 75 articles found through the Scopus database with the keywords: *Preschool Management System, Preschool Quality Management, Preschool Quality Assurance, Preschool Information System,* and *Early Education Management*. The selection process is carried out based on the PRISMA 2020 standard, which includes the stages of identification, screening, retracing, feasibility assessment, and final inclusion. Of the initial 75 articles, 23 articles were eliminated at the initial stage (19 because they were outside the 2015–2025 range, 2 were not classified in Q1–Q4 journals, and 2 were without abstracts). Of the 52 articles that were manually screened, 31 did not meet the relevance of the study focus, and 9 were not fully obtained. A total of 12 articles that were successfully downloaded and thoroughly studied were used in the thematic synthesis analysis. Based on the results of data extraction from the 12 articles, it was found that five main themes consistently emerged as critical dimensions in the integration of information systems and quality management in PAUD institutions.

Emphasis on Efficiency and Technical Evaluation

Three articles underline the importance of measuring technical efficiency as a foundation for quality assurance for PAUD institutions. Zheng (2024) explained the use of the Data Envelopment Analysis (DEA) model to assess the efficiency of PAUD institutions based on the input-output ratio, with the average combined technical efficiency above 0.65. This model is used to identify suboptimal resource allocation and forms the basis for evidence-based planning. In a study by Köse et al. (2021), efficiency is also shown in the spatial context, where the use of GIS allows the allocation of PAUD institutions in a more equitable and effective manner, with a reduction in the average distance traveled by children by >600 meters.

Information Security and Risk Management

Two articles highlight the importance of secure information systems, especially in the context of increasing digitalization in the early childhood education environment. Song (2022) Developing a concept *Cybersecurity Management System* Intelligent agent-based and multi-layered architecture that includes encryption, network segmentation, user training, and internal risk policies. Meanwhile, Hua et al. (2020) shows weak preparedness for medical risks such as anaphylaxis at ECEC institutions in Australia. Only 51.4% of institutions have AAI training tools and 37% keep them in locked conditions. This study confirms that training information systems and risk reporting should be part of the quality system.

Social Practice in Documentation and Relations

Two articles document how information systems are used not only as an administrative tool, but also as a medium of social relations between teachers, children, and parents. Knauf (2017) analyzed 25 portfolios from early childhood education centers in Germany and found that 61% of the content was curated by teachers, with an emphasis on the institution's image as a quality institution. The participation of children and parents in portfolio documents is relatively low, indicating the dominance of institutional narratives. On the other hand, Solberg (2024) shows that teachers' communication practices in parent conferences contain norms of visibility and ethical ambivalence in the excavation of personal information. Information systems in this context are more representative of power relations and social representation strategies.

Collaboration and Institutional Governance

Three articles discuss the importance of information systems in supporting institutional collaboration and cross-sectoral decision-making. Yenpiam et al. (2019) Using the model *Structural Equation Modeling* (SEM) to examine collaboration between government agencies in Thailand. It was found that only legal and financial aspects had a direct effect on collaboration, while social networks and the role of bureaucrats had an indirect effect. Sousa & Pimenta (2018) said that most cities in Brazil do not have a standardized quality evaluation system for early childhood education. Reliance on local politics and weak managerial capacity exacerbate inefficiencies. These studies confirm that information systems must be able to bridge the legal, administrative, and relational dimensions in early childhood education governance.

Dimensions of Ethics, Environment, and Children's Health

Two articles expand the dimension of quality and information systems to environmental and ethical aspects. Quaranta et al. (2020) use GIS to link environmental conditions and the prevalence of childhood asthma in Head Start programs in the U.S. They found that areas with older building age and high pollution levels correlated significantly with asthma incidence, even when those areas covered only 1% of service areas. This study shows the importance of integrating spatial and health information systems in early childhood education quality management. Other studies by Carlbaum & Rönnberg (2024) highlights

how global quality systems such as EducaCorp's shape a quality narrative that prioritizes efficiency and accountability, but ignores local processes and cultural values.

Table 1.
Relevant Articles on Information System Integration and Quality Management in Early Childhood Education

Yes	Author (Year)	Research Location	Study Focus	Key Contributions
1	Carlbaum & Rönnberg (2024)	Sweden	Global quality ideology and transnational narratives	Efficiency ignores local values and social processes
2	Zheng (2024)	China	Technical efficiency evaluation (DEA)	Efficiency of data-based early childhood education institutions
3	Solberg (2024)	Norway	Information ethics in parenting conferences	Visibility norms and power relations in information systems
4	Knauf (2017)	Germany	Portfolio as an information system	Dominance of teacher narratives, child and parent participation is low
5	Kjellgren et al. (2022)	Sweden	Crisis management and child protection	Quality system integrated with crisis management system
6	Jing Song (2022)	China (conceptual)	Intelligent agent-based cybersecurity system	Children's data protection and institutional digital resilience
7	Köse et al. (2021)	Turkey	GIS in the equitable distribution of PAUD locations	Efficiency of access and spatial justice of early childhood education services
8	Quaranta et al. (2020)	United States	Environment and health of PAUD children	Integration of spatial information systems and asthma risk
9	Hua et al. (2019)	Australia	Anaphylactic risk preparedness in ECEC	Inequality of training, need for reporting systems
10	Yenpiam et al. (2019)	Thailand	Local government collaboration in early childhood education	Legal and budgetary aspects affect the effectiveness of collaboration
11	Sousa & Pimenta (2018)	Brazil	Evaluation of the quality of early childhood education in small towns	Weak managerial capacity and evaluation system
12	Akdağ & Haser (2016)	Turkey	Classroom management strategy for beginner PAUD teachers	Reflective and relational approaches based on teacher experience

The presentation of the table shows the diversity of focus and geographical context in research on information systems and quality management of early childhood education. Each study contributes a unique perspective, from technical efficiency to ethical issues and institutional collaboration. However, comprehensive

integration between information systems and quality assurance is still rare. For this reason, an in-depth analysis will be carried out in the discussion section to examine the patterns, relationships, and potential for the development of integrative models.

DISCUSSION

The results of this systematic study show that the information system and quality management in early childhood education are two entities that cannot be separated in realizing quality, safe, and adaptive early childhood education to social changes and technological advances. In general, the results of this study identify five main interrelated themes: technical efficiency, information security, documentation social practices, institutional collaboration, and the ethical-environmental dimension. The five themes show that the approach to the quality of early childhood education cannot be done in a sectoral or technocratic manner alone, but requires multidimensional integration involving managerial, pedagogical, social, and technological aspects simultaneously. This reinforces the findings of the previous literature that states that information systems in early childhood education not only function as an administrative tool, but also as a medium for reflection, communication, and empowerment of educational actors.

One of the important contributions of this study is to confirm that the integration of information systems and quality has not been carried out comprehensively in the context of early childhood education. Study by Zheng (2024) For example, emphasizing the importance of efficiency evaluation through the *Data Envelopment Analysis* (DEA) to measure the balance of inputs and outputs of PAUD institutions objectively. However, this approach is technical and quantitative, and does not yet reach the aspects of participation, ethics, or pedagogical reflection. Meanwhile, a narrative approach like that taken by Knauf (2017) It shows that documentation systems such as portfolios are more used to build the image of institutions than to be participatory tools that encourage the active involvement of children and families in the learning process. This imbalance reinforces the finding that the integration between technical and social dimensions in the early childhood education quality system remains a major challenge.

In a study by Solberg (2024), information systems actually show the dimension of power in the practice of documentation. Family information gathered in parent conference forums is often done without a clear ethical framework, creating social pressure and ambiguity in the teacher-parent relationship. This makes it clear that information systems in early childhood education are not only technological entities, but also social practices that risk creating exclusion and narrative domination. Thus, the design of the information system to be developed must consider the principles of ethics, equal participation, and information fairness, as affirmed in the approach *ethics of care* (Crispin P. Noguerra, Jr., 2023; Maio, 2018; Smith, 2016).

Furthermore, the study of Köse et al. (2021) and Quaranta et al. (2020) Extending the understanding of quality systems to spatial areas and environmental health. GIS has proven to be an instrument that helps plan PAUD locations more evenly and based on data, while the integration of spatial information with environmental conditions is also able to map children's susceptibility to respiratory diseases such as asthma. The implications of these findings confirm that information systems are not only internal to the institution, but must also be able to function as a tool to read external contexts and aid decision-making at the policy level.

When it comes to child protection and data security, Song's findings (2022) dan Kjellgren dkk. (2022) shows that the ideal PAUD quality system must incorporate a sophisticated information security system as well as a responsive crisis management mechanism. In the post-pandemic context, cybersecurity systems and incident preparedness are an inseparable part of the quality of PAUD services. However, as shown in the study of Hua et al. (2020), many ECEC institutions do not yet have the managerial and technical readiness to systematically manage medical risks. This underscores the urgent need to design an information system that is not only capable of recording, but also integrating crisis training, reporting, and decision-making functions quickly and accountably.

The theoretical contribution of this study lies in strengthening the idea that quality management and information systems in early childhood education must be approached holistically, participatoryly, and contextually. In contrast to the conventional approach that separates the technical and social aspects, this research presents an integrative framework that combines data efficiency, cultural sensitivity, and ethical responsibility in a single system design. This is in line with the findings of researchers who invite the PAUD community to build an education system that not only measures, but also reflects the values and experiences of children and their communities (Hawkes, 2023; Kroflič & Turnšek, 2018; Read, 2020).

In terms of practical contribution, the results of this research can be an important reference for local governments, managers of early childhood education institutions, and educational technology developers in building information systems that support quality comprehensively. In Indonesia, the conditions of PAUD management that are still diverse in capacity, resources, and regulations, make this finding very relevant. As expressed by Sousa & Pimenta (2018), managerial and political weaknesses in the management of early childhood education often hinder standardized and sustainable quality evaluation. By building an information system that contains structural indicators, processes, and results, PAUD institutions can have tools to reflect and improve quality in a sustainable manner.

Scientifically, this study expands the horizon of early childhood education management studies by emphasizing that the integration of information systems and quality is an urgent need, not an additional option. In the context of education

management, this contribution adds a reflective dimension to the technocratic approach that has dominated the quality discourse. The study also shows that to build an effective quality system, it takes courage to combine quantitative, narrative, spatial, and ethical approaches in one flexible conceptual framework.

However, this study has some limitations that need to be noted. First, although it included 12 relevant international articles, the results of this study were still limited to articles available in the Scopus database and were fully accessible. Therefore, these findings do not reflect the full spectrum of approaches that may have been applied in other local or developing contexts. Second, most of the articles analyzed came from countries with relatively strong institutional capacity, such as Sweden, Norway, and Germany. This poses a challenge in generalizing the findings to countries such as Indonesia which have more varied infrastructure conditions and education policies. Third, the systematic approach used in this study has not been equipped with field validation or triangulation of real practices in Indonesian PAUD institutions.

Nevertheless, this research still has strong implications in building the foundation for the development of an early childhood education quality system that is more relevant to local needs. In the future, follow-up research can develop information systems models designed based on these findings and tested on a limited basis in several areas. In addition, collaboration between technology developers, policy makers, and early childhood education practitioners is important to ensure that the system built is truly able to respond to challenges and realities on the ground.

CONCLUSION

This study concludes that the integration between information systems and quality management in early childhood education (PAUD) is still not widely carried out, even though both support each other in realizing quality, safe, and adaptive educational services. The findings of the 12 articles that were systematically reviewed show that most of the information systems applied in PAUD are still functioning administratively, technically, or fragmented, not yet a reflective and collaborative instrument that supports sustainable quality improvement. Emerging themes include technical efficiency, data protection, social documentation, institutional collaboration, and information ethics, each of which presents its own potential and challenges. This study contributes theoretically in expanding the perspective of education quality management towards a more integrative and context-based approach, and practically offers a basis for designing an early childhood education information system that is participatory, ethical, and responsive to local needs.

As a suggestion for further research, this study recommends the development of an information-quality system model designed based on the principles found in this study and tested contextually in various regions of

Indonesia. Follow-up research can also involve a hands-on analysis of actors, including teachers, parents, and institutional managers, to enrich their understanding of their practices and expectations of information systems in supporting the quality of early childhood education. In addition, cross-sector collaboration between educational technology developers and policy makers needs to be strengthened so that the system developed is truly implementable and sustainable.

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