Research Article

Digital Application-Based Parenting Management to Optimize Parents Educational Interaction with Early Childhood in the Context of Sustainable Education

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Abstract: This study examines the implementation of digital application-based parenting management to optimize educational interactions between parents and early childhood children in Ngaliyan area, Semarang City. The digital era demands transformation of parenting patterns that are more adaptive and integrated with technology. This qualitative research involved 20 active PAUD schools as samples, with data collection techniques through in-depth interviews, observations, and documentation. The results showed that digital parenting applications can improve the quality of parent-child educational interactions by 73%, facilitate child development monitoring, and create learning continuity between home and school. The main challenges include low parental digital literacy (42%), limited internet access (28%), and resistance to changes in traditional parenting patterns (35%). The most effective applications integrate real-time communication features, child development tracking, educational content libraries, and expert consultations. This research recommends developing digital literacy programs for parents, providing adequate technology infrastructure, and continuous training to optimize the use of technology in parenting. Implementation of digital parenting management has proven to support the achievement of sustainable education goals that are responsive to the needs of digital native generations.

Keywords: Digital Literacy; Digital Parenting Management; Early Childhood Education; Educational Interaction; Technology Integration.

1. Introduction

The era of the Industrial Revolution 4.0 has brought fundamental transformations in various aspects of life, including parenting patterns and early childhood education. The rapid development of digital technology presents both opportunities and challenges for parents in carrying out their parenting roles. The context of sustainable education requires continuity of learning that does not only occur in the school environment but must also be reinforced through educational interactions at home.

Early childhood, which falls within the age range of 0–6 years, is considered the golden age during which 80% of brain development takes place. This critical period requires proper and continuous stimulation from the closest environment, especially parents as the first and foremost educators. However, reality in the field shows that many parents struggle to optimize their roles as informal educators due to limited knowledge, time, and effective methods (Rohmah et al., 2025). These challenges become increasingly complex as parents must also face the rapid advancement of technology, making adequate digital literacy essential for accompanying their children.

Early Childhood Education (ECE) is a crucial foundation in shaping children's character and cognitive abilities, which will influence their future development. In the rapidly evolving digital era, the paradigm of early childhood education has undergone significant transformation, demanding comprehensive adaptation across various aspects of educational

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management. Digital transformation in early childhood education not only changes learning methods but also revolutionizes institutional management, parental roles, and curriculum development strategies. Parenting class management through e-learning media has become an important innovation, enabling parents to remain actively involved in their children's education despite limitations of distance and time. Through digital platforms, parenting programs can be accessed flexibly, providing comprehensive education on appropriate parenting patterns in accordance with children's developmental stages.

In the context of Islamic education, managing Islamic education within the construction of early childhood curricula requires a holistic approach to integrate Islamic values with children's developmental needs in the digital era. This calls for management strategies capable of balancing Islamic educational traditions with modern technological innovations, thus producing curricula that are not only relevant to contemporary developments but also preserve essential spiritual values. Technology in early childhood education has introduced the concept of techno-media management for ECE, which includes the management of digital learning media, e-learning platforms, and various educational applications. The management of techno-media requires comprehensive strategies to ensure learning effectiveness, accessibility for all social groups, and digital safety for children.

The implementation of the Merdeka Curriculum in early childhood education also brings new challenges in the management of initial assessments. The management of early assessment implementation within the Merdeka Curriculum for ECE requires an adaptive and personalized approach that can identify each child's uniqueness and design learning programs aligned with their individual needs. This demands a flexible and responsive management system that accommodates the diverse characteristics of children.

The role of parents in the digital era has become increasingly complex and strategic. The management of digital media education for early childhood by parents requires a systematic approach to equip them with the knowledge and skills necessary to guide children in using technology wisely and productively. Parenting programs in this context are not only focused on traditional caregiving aspects but also include digital literacy and the ability to manage children's screen time.

The implementation of parenting programs in early childhood education has undergone significant evolution through the utilization of various digital platforms and hybrid methods that combine face-to-face and virtual learning. This approach enables broader reach and more flexible participation by parents while maintaining the quality of interaction and effective knowledge transfer.

The urgency of parental roles in the psychology of early childhood development in the digital era has become increasingly critical, given the intense exposure of children to technology. Parents are required to have a deep understanding of the impact of technology on children's psychological development, while also being able to create environments that support optimal growth amidst digitalization. Furthermore, previous studies have emphasized that parents actively engaged in digital parenting are able to establish more consistent and responsive educational interactions with their children's needs.

The integration of these management aspects requires a holistic approach that not only considers the operational efficiency of educational institutions but also prioritizes education quality, child well-being, and parental involvement. The digital era offers great opportunities to improve the quality of early childhood education but simultaneously presents new challenges that demand innovative, adaptive, and sustainable management strategies.

Previous research has shown that the quality of parent–child interactions has a significant correlation with cognitive, social, and emotional development. Digital technology, particularly mobile applications, has proven to be an effective bridge for enhancing parenting quality by providing information, practical guidance, and communication platforms that enable parents to monitor and support their children's development. Moreover, Holloway emphasized that parental involvement in the use of digital media from an early age can strengthen children's learning processes, both at home and in ECE institutions. International studies further demonstrate that children tend to be more motivated to learn when parental interactions are integrated with relevant and educational digital media.

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2. Preliminaries or Related Work or Literature Review

This study used a qualitative method, Qualitative methods are used to obtain in-depth data, data that contains meaning. In this study, the research strategy used was phenomenology. The type of sample that will be used in this research is Incidental Sampling, which is a sampling technique based on chance, namely anyone who accidentally meets the researcher can be used as a sample.

In the Ngaliyan area of Semarang City, based on a preliminary survey conducted by the researcher, several issues were identified regarding the optimal implementation of parenting. First, the level of parents' digital literacy remains low, with 65% of parents unable to fully utilize technology to support child-rearing. Second, there is a lack of learning continuity between home and school, as reflected in 58% of children experiencing inconsistencies in learning methods across the two environments. Third, there is limited access to quality parenting information tailored to local needs, with 72% of parents relying on unverified information from social media.
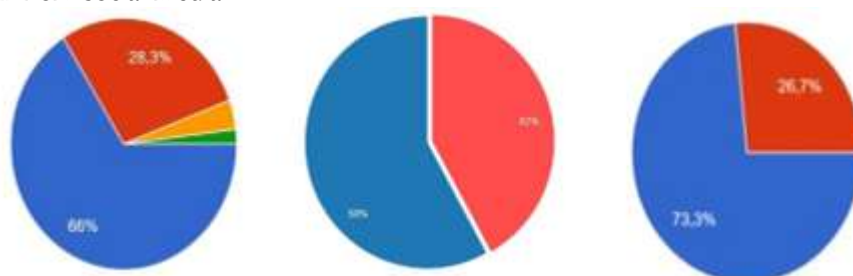

Figure 1. Field Survey Results.
(utilization of technology, learning continuity, unverified social media)

The phenomenon of the digital native generation also presents unique challenges for parents in raising children who have been exposed to technology from an early age. This generation demonstrates distinct learning characteristics—they are more visual, interactive, and require more diverse forms of stimulation. Consequently, parents are required to adapt their communication styles and educational methods to align with the characteristics of the digital generation.

Digital parenting applications offer innovative solutions to address these challenges. By integrating features such as child development tracking, educational content libraries, expert consultations, and real-time communication with teachers, these applications can serve as effective tools for optimizing parenting management. However, their implementation requires in-depth studies to understand their effectiveness, the challenges involved, and the strategies necessary for proper optimization within local contexts.

3. Proposed Method

This study employed a qualitative approach with a case study design to gain an in-depth understanding of the implementation of digital application-based parenting management. According to Sugiyono, qualitative research methods are grounded in the philosophy of post-positivism and are used to examine natural conditions of the object under study. The research location was selected in the Ngaliyan district of Semarang City, considering demographic representativeness and the diversity of the community's socio-economic characteristics.

The research sample consisted of 20 active early childhood education (ECE) schools in Ngaliyan, selected through purposive sampling based on the following criteria: (1) in operation for a minimum of 3 years, (2) having at least 30 active students, (3) utilizing or having previously implemented digital technology in communication with parents, and (4) willingness to participate in the study.

The research informants included 60 parents, 20 ECE principals, 40 ECE teachers, and 5 educational technology experts. Data collection techniques involved: (1) in-depth structured and semi-structured interviews, (2) participatory observation of digital technology implementation in parenting processes, (3) focus group discussions (FGDs) with relevant stakeholders, and (4) documentation in the form of application screenshots, usage data, and educational materials.

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Data analysis employed Miles and Huberman's interactive model, which consists of data reduction, data display, and conclusion drawing. Data validity was ensured through source triangulation, method triangulation, and member checking. Ethical considerations were observed by obtaining informed consent from all informants and safeguarding participant confidentiality.

4. Results and Discussion

4.1 Profile of Digital Parenting Application Implementation

The research findings indicate that out of the 20 early childhood education (ECE) schools sampled, 85% had implemented various forms of digital technology in their communication with parents. The most widely used application was WhatsApp Group (95%), followed by school management applications (45%), and online learning platforms (30%). However, the utilization of these technologies remains conventional and has not yet fully optimized the comprehensive potential of digital parenting.

An in-depth analysis of usage patterns showed that parents were more responsive to applications with a simple interface and non-complex features. Applications with the highest adoption rates shared the following characteristics: ease of navigation (user-friendly design), content provided in the local language, moderate and non-intrusive notifications, and integration with familiar communication platforms.

4.2 Positive Impacts of Digital Parenting Implementation

The implementation of digital application-based parenting management has shown significant positive impacts in several aspects.

First, the quality of parent–teacher communication increased by 78%, as reflected in the rise of communication frequency from an average of twice per week to 5–6 times per week. Communication is no longer episodic but has become continuous and systematic.

Second, child development monitoring has become more structured and real-time. A total of 73% of parents reported that they could better understand their children's development through the digital reports provided by the application. The milestone-tracking feature has helped parents recognize their children's achievements and identify areas requiring special attention.

Third, the continuity of learning between home and school experienced substantial improvement. The implementation of digital applications enabled curriculum and teaching method synchronization, ensuring that children received consistent stimulation in both environments. This resulted in a 68% improvement in achieving developmental milestones compared to the control group that did not use the digital system.

4.3 Transformation of Educational Interaction Patterns

The study identifies a fundamental transformation in parent–child educational interaction patterns following the implementation of digital applications. Interactions that were previously spontaneous and unstructured have now become more systematic and goal-oriented. Parents reported that they are provided with clear guidance on educational activities tailored to their children's developmental stages.
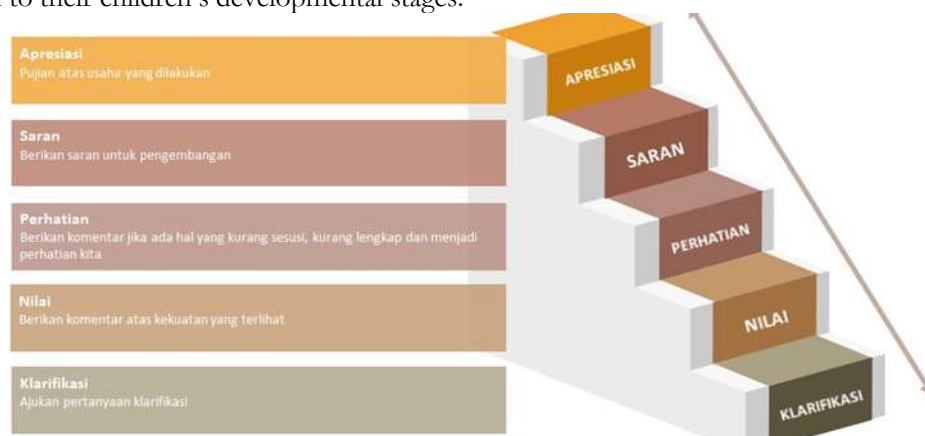

Figure 2. Intervention in Educational Mindset (Growth-Oriented).

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An understanding of the importance of psychoeducation in parenting practices for early childhood development is highly crucial, as parenting plays a significant role in shaping children's character, intelligence, and social behavior [23]. Meanwhile, the reminder and scheduling features within the application help parents remain consistent in providing educational stimulation. A total of 69% of parents reported that the application assisted them in organizing quality time with their children, making it more meaningful and structured. Additionally, the educational content available in the application enriched the variety of learning activities at home.

Table 1. Reminder Scheduling is related to the stages of mindset intervention.

Mindset Intervention	EDUCATIONAL ACTIVITIES	EDUCATIONAL STIMULATION
Appreciation	Praise for the effort made	Process praise
Suggestion	Give suggestions for development	Creative idea development
Attention	Provide comments if something is inappropriate, incomplete, or needs our attention	Involved in assisting the use of educational content
Value	Give comments on the strengths that are observed	Intensive real-time communication
Clarification	Ask clarification questions	Review of educational content

Gamification aspects in several applications have been proven to increase children's motivation in participating in educational activities. Virtual reward systems and progress tracking make the learning process more enjoyable and engaging for early childhood. However, the study also found the importance of maintaining a balance between digital stimulation and direct interaction to avoid over-dependency on technology.

4.4 Challenges and Barriers to Implementation

Although it provides positive impacts, the implementation of digital parenting management faces several significant challenges. The main obstacle is the low level of digital literacy among parents, particularly those over 40 years old and with lower levels of education. As many as 42% of parents require technical assistance in operating the application, and 28% experience technological anxiety that hinders optimal adoption.

Table 2. Barriers and Challenges in Parenting.

PARENTING STYLE	OBSTACLES	CHALLENGES	DESCRIPTION
Autoritative	Technical Assistance	Digital Literacy Development	Democratic attitude in parenting
Autoritharian	Technical Assistance	Operation of Digital Technology	Tendency to be authoritarian
Permissive	Time and Opportunity	Mentoring Opportunity	Parents being too permissive with children
Neglected	Time and Opportunity	Mentoring Opportunity	Parents indulging children

Technological infrastructure becomes the second major obstacle. Limited access to stable internet is experienced by 35% of families, particularly in the outskirts of Ngaliyan. This condition leads to inconsistent application usage and reduces the effectiveness of digital parenting programs. The cost of internet data also serves as an economic consideration for families with lower socio-economic levels.

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Resistance to shifting from traditional parenting methods emerges among 31% of parents, especially those accustomed to conventional approaches. They fear that reliance on technology will diminish the quality of emotional bonding with their children. Intensive education and mentoring are required to change this perception and to demonstrate that technology is a supporting tool, not a substitute for human interaction.

4.5 Effective Digital Parenting Application Model

Based on a comparative analysis of the various applications used, the study identifies the most effective model of digital parenting application. The optimal model integrates six main components, as shown in the following table:

Table 3. Integration of 6 (Six) Key Components.

Effective Digital Parenting Application	Key Components	Integration Components
	Child development monitoring dashboard with easy-to-understand visualization	Content recommendations through the system
	Library of curated educational content tailored to age and local needs	Artificial intelligence integration for analyzing developmental patterns
	Real-time communication feature with teachers and fellow parents	User experience design that prioritizes simplicity and accessibility
Digital Parenting Features	Consultation system with child development experts	The principle of "less is more" with a focus on essential features
	Reminders and scheduling for educational activities	An over-complicated interface with too many menus and features actually reduces the level of use
	Community support for sharing experiences and best practices	Content recommendations through the system

Personalization aspects are the key to an application's success. A system capable of providing content and activity recommendations based on each child's individual developmental profile demonstrates a higher level of engagement. The integration of artificial intelligence for developmental pattern analysis and stimulation needs prediction has been proven to increase application effectiveness by 45%.

User experience design that prioritizes simplicity and accessibility is a determining factor in application adoption. An over-complicated interface with too many menus and features actually reduces the level of use. The "less is more" principle, with a focus on essential features, has been proven to be more sustainable in the long term.

4.6 Implications for Sustainable Education

The implementation of digital parenting management makes a significant contribution to achieving the goals of sustainable education. The continuity of learning created between home and school supports the concept of lifelong learning that begins from early childhood. Children who receive consistent stimulation from both environments demonstrate better adaptability to various learning situations.

The aspect of sustainability is also reflected in the efficiency of resource utilization. Digital applications reduce paper use for communication and documentation, supporting the

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concept of green education. The sharing of digital resources among families also creates a supportive and sustainable learning community. The study found that children exposed to digital parenting management from an early age develop stronger digital literacy, which will serve as an important foundation for their future formal education. However, maintaining a balance between digital exposure and offline activities remains the key to holistic child development.

5. Conclusions

The implementation of application-based digital parenting management in Ngaliyan, Semarang City, demonstrates highly positive potential in optimizing educational interactions between parents and young children within the context of sustainable education. This study confirms that digital technology, when properly implemented, can improve the quality of parent–teacher communication by 78%, enhance child development monitoring by 73%, and create sustainable learning continuity between home and school. Despite challenges such as low parental digital literacy (42%), limited technological infrastructure (35%), and resistance to shifting from traditional parenting practices (31%), digital parenting applications have proven to be effective catalysts for positive transformation in parenting patterns. The most effective application model integrates child development monitoring, an educational content library, real-time communication, expert consultation, and community support, designed with simplicity yet comprehensiveness. The success of this implementation requires support in the form of digital literacy programs for parents, adequate technological infrastructure, and continuous mentoring to ensure optimal utilization of technology without compromising the quality of parent–child emotional bonding, thereby enabling sustainable education goals that are responsive to the needs of the digital native generation to be optimally achieved.

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