



Exploring Preschool Teachers' Perspectives on Pedagogical Integration of Coding in Early Childhood Classrooms

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Abstract

Purpose – This study aims to explore preschool teachers' perspectives on the pedagogical integration of coding in early childhood classrooms. As coding is increasingly introduced as part of early digital literacy, understanding teachers' perspectives is essential for designing developmentally appropriate and context-sensitive practices in Indonesian early childhood education.

Design/methods/approach – This study employed a qualitative descriptive design to capture teachers' experiences, interpretations, and classroom considerations regarding coding integration. Five ECE (Early Childhood Education) teachers were selected through purposive sampling based on teaching experience, exposure to digital learning activities, and willingness to participate. Data were collected through semi-structured interviews and analyzed using thematic analysis through transcription, open coding, categorization, and theme development. Trustworthiness was strengthened through member checking, repeated reading of transcripts, and analytic memoing.

Findings – The analysis generated eight interrelated themes. Three core findings emerged. First, teachers showed conceptual ambiguity in defining coding, indicating that coding is still understood unevenly in ECE settings. Second, teachers experienced pedagogical tension between digital learning demands and principles of child development, which led to a strong preference for unplugged and play-based coding activities. Third, structural constraints, including limited facilities, insufficient training, and the absence of clear curriculum guidance, restricted consistent implementation. Despite these constraints, teachers recognized coding as potentially beneficial for children's logical thinking, creativity, problem-solving, and collaboration.

Research implications/limitations – This study contributes empirical insight from a developing-country context in which coding in early childhood education remains underexplored. However, the small number of participants and the interview-based design limit broader transferability. Further studies involving more diverse settings, classroom observations, and comparative contexts are needed.

Practical implications – The findings underline the need for sustained teacher professional development, accessible teaching resources, and contextual curriculum guidance for play-based coding integration. In low-resource contexts, unplugged coding can function as a realistic pedagogical entry point before the gradual use of digital tools.

Originality/value – This study contributes to the discourse on early childhood coding education by foregrounding teachers' perspectives in the Indonesian ECE context. It positions coding not merely as a technological innovation, but as a pedagogical practice negotiated through developmental considerations and structural limitations.

Keywords: Coding, Early childhood education, Teacher perspectives, Digital age, Pedagogical integration

Paper type Research paper

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Received: 28 October 2025; Revised: 26 December 2025; Accepted: 30 December 2025

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DOI: <http://dx.doi.org/10.14421/al-athfal.2025.112-10>

1. Introduction

Coding has increasingly entered global discussions on early childhood education as part of digital literacy, computational thinking, and future-oriented learning. This shift also reflects broader changes in how early childhood institutions respond to the pressures of education in the digital age (Harini et al., 2023). At the same time, recent international studies show that teachers' conceptual understanding of coding and computational thinking in early childhood settings remains uneven, and that coding is still frequently interpreted through narrow or overly technical assumptions (Ari et al., 2022; Avci & Deniz, 2022; Zeng et al., 2023). Yet its place in preschool classrooms remains conceptually and pedagogically unsettled. On the one hand, coding is frequently promoted as a promising pathway for developing logic, creativity, problem-solving, and early digital competence. On the other hand, early childhood education is grounded in principles of play, concrete experience, social interaction, and developmental appropriateness. The resulting tension is not trivial. It raises a central question for early childhood pedagogy: how is coding translated into forms that are educationally meaningful for young children rather than merely imported as a simplified version of school-age digital instruction?

In early childhood settings, coding should not be reduced to formal programming. Rather, it can be understood as a set of structured activities, both digital and unplugged, that introduce children to foundational concepts such as sequencing, patterns, simple logic, symbolic representation, and problem-solving. From this perspective, coding becomes relevant not because preschool children are expected to master technical programming, but because coding-related activities may support broader developmental processes when designed in age-appropriate ways. Existing scholarship has shown that coding in early childhood can be connected to computational thinking, persistence, creativity, collaboration, and exploratory learning when it is mediated through play, storytelling, manipulatives, robotics, and guided activity rather than abstract instruction alone (Bati, 2021; Mulyati, 2023; Pollarolo et al., 2024; Woo & Falloon, 2025; Zeng et al., 2023). Comparative evidence further suggests that both unplugged and plugged modalities may support young children's computational thinking, although unplugged approaches are often more developmentally accessible in early childhood settings, while digital and robotics-based activities usually demand greater material support (Ching & Hsu, 2023; Wei et al., 2024). This broader orientation is consistent with work emphasizing fun learning and play as foundational to early childhood pedagogy, including efforts to strengthen critical thinking and child engagement through playful educational experiences (Tukly et al., 2025; Wathon, 2024).

However, the pedagogical legitimacy of coding in preschool cannot be assumed. Developmental theory suggests that the introduction of coding in early childhood must be carefully mediated, because young children learn through action, concrete experience, and the gradual formation of symbolic understanding, while cognitive development is also shaped through social interaction, language, and guided participation (Piaget, 1952; Vygotsky, 1978). Read together, these perspectives suggest that coding is pedagogically meaningful in preschool only when it is translated into concrete, playful, and socially mediated forms. This means that the key issue is not simply whether coding should be introduced early, but how it is interpreted, adapted, and justified within the developmental logic of early childhood education.

This pedagogical question becomes even more important when viewed from the position of teachers. Preschool teachers do not merely implement externally defined innovations. They interpret curriculum demands, evaluate developmental suitability, mediate children's participation, and decide whether particular activities are feasible within their classrooms. In the ECE literature more broadly, this role is closely related to pedagogic competence, personality-related professionalism, and the capacity to design learning experiences that also support creativity and social interaction (Husna & Nasron, 2025; Ranikasari, 2019; Wijayanti, 2024). In this sense, coding integration is not only a matter of digital content or learning tools, but also a matter of teacher judgment. Prior studies have shown that teacher readiness for digital learning is shaped by uneven technological knowledge, pedagogical confidence, access to institutional support, and broader processes of professional competence development (Aleksieva, 2025; Fitria & Lestari, 2024; Timotheou et al., 2023; Warmansyah et al., 2022). More specifically, research on

coding and digital integration in early childhood teacher education indicates that sustained professional learning and practice-based support are crucial if teachers are expected to move beyond limited awareness toward pedagogically meaningful implementation (Kulaksız & Toran, 2022; Masoumi, 2020; Warmansyah et al., 2022). In low-resource early childhood settings, these issues may become more acute because teachers must negotiate digital innovation alongside limited infrastructure, concerns about screen exposure, and the continuing priority of play-based learning (Timotheou et al., 2023; Xiang et al., 2022).

Although research on coding in early childhood education has expanded, much of the literature has focused on children's learning outcomes, computational thinking interventions, digital tools, or innovation models (Başaran et al., 2024; Bati, 2021; McCormick & Hall, 2021). This body of work is important, but it leaves a critical gap. It tells us relatively little about how teachers themselves make sense of coding as a pedagogical practice, especially in contexts where curriculum guidance is limited and digital inequality is pronounced. In Indonesia, existing studies have discussed digital literacy, media integration, and computational thinking in early childhood education in broader terms (Abni et al., 2024; Fadillah Ajeng Ningrum et al., 2024; Mulyati, 2023; Rahmawati, 2023), while other works have reported training programs, curriculum innovation efforts, or coding-related implementation initiatives in specific settings (Lamatokan et al., 2025; Lim & Wardrip, 2026; Munawar et al., 2023; Stanis Ratusah Alubuaman Kempirmase, 2025). Yet these studies have not sufficiently explained how preschool teachers interpret coding, how they negotiate its fit with child development, and how structural limitations shape the forms of coding that become pedagogically acceptable in everyday practice.

This unresolved issue matters theoretically and practically. Theoretically, it suggests that coding in early childhood should be understood not as a neutral technological innovation, but as a pedagogical practice negotiated at the intersection of developmental theory, teacher mediation, and institutional constraint. Practically, it matters because policies or curriculum initiatives that promote coding without understanding teachers' perspectives risk producing superficial, inconsistent, or developmentally inappropriate implementation. In contexts such as Indonesian ECE, where infrastructure remains uneven and coding has not yet become a clearly institutionalized curricular domain, teachers' perspectives are central for understanding how coding is actually translated into classroom practice.

This study therefore explores preschool teachers' perspectives on the pedagogical integration of coding in early childhood classrooms. It asks how teachers understand coding, how they perceive its developmental value, how they evaluate its developmental appropriateness, what challenges they encounter in implementation, and what forms of support they consider necessary. By focusing on teachers' meaning-making in the Indonesian ECE context, this study contributes to current debates by positioning coding as a pedagogically and structurally negotiated practice rather than as a straightforward educational innovation.

2. Methods

2.1. Research Design

This study employed a qualitative descriptive design to explore teachers' experiences, understandings, and perceptions regarding the pedagogical integration of coding in early childhood classrooms. A qualitative descriptive approach was selected because the study aimed to produce a practice-near and context-sensitive account of how coding is understood, judged, and adapted in everyday ECE settings, rather than to test predefined variables or generate formal theory. This design was appropriate to the study's focus on teachers' perspectives because it allowed attention to participants' own language, practical reasoning, and classroom-based considerations while still supporting interpretive analysis of recurring patterns.

2.2. Participants and Research Context

The participants were five ECE teachers selected through purposive sampling. Selection was based on three criteria: teaching experience in early childhood settings, prior exposure to digital learning or coding-related activities, and willingness to participate in an in-depth interview.

Although the number of participants was small, the sampling sought information-rich cases rather than numerical representation. The participants reflected variation in teaching settings and access to digital resources, which was important because the study aimed to understand how teachers interpret coding under uneven institutional conditions.

To protect anonymity, teachers are identified only by initials in the findings section. The study was conducted within the Indonesian ECE context across differing institutional backgrounds. Because confidentiality was prioritized, the manuscript does not name specific schools or localities. Instead, the context is described in analytic terms as an early childhood education setting marked by uneven digital access, limited curricular formalization of coding, and differing levels of institutional readiness. This level of contextual description was intended to preserve participant confidentiality while still enabling readers to assess the situated nature of the findings.

2.3. Data Collection

Data were collected through individual semi-structured interviews conducted either face-to-face or online, depending on participant availability and access. Semi-structured interviewing was chosen because it allowed the researcher to address common domains across participants while also probing experiences, examples, and concerns in greater depth. The interview guide was developed from the research objectives, literature on early childhood coding and digital pedagogy, and the conceptual lens of developmental appropriateness and teacher mediation.

The interview domains focused on teachers' understanding of coding, experiences with implementation, perceived benefits, concerns related to child development and screen exposure, infrastructural and policy challenges, and forms of support considered necessary for practice. Follow-up prompts were used to clarify meanings, invite examples, and explore tensions within participants' responses. All interviews were audio-recorded with participants' consent and transcribed for analysis. Field notes were written after the interviews to capture contextual remarks, emphases, and initial analytic reflections that could not be fully preserved in the transcript alone.

2.4. Data Analysis

The data were analyzed using thematic analysis. The analytic process involved repeated reading of transcripts to achieve familiarity with the dataset, followed by initial open coding of segments related to teachers' understandings, classroom judgments, constraints, and support needs. Codes with conceptual similarity were then grouped and compared across participants in order to identify broader patterns. From this process, candidate themes were developed, reviewed against the full dataset, and refined until they captured distinct but interrelated dimensions of teachers' perspectives.

The analysis was primarily inductive in that themes were derived from recurring patterns in the interview data rather than imposed as fixed categories from the outset. At the same time, interpretation remained sensitized by the study's conceptual concern with developmental appropriateness, teacher mediation, and structural conditions. This balance allowed the analysis to remain grounded in participants' accounts while also moving beyond surface description. Analytic memoing was used throughout the process to record emerging interpretations, compare contrasting cases, and document reasons for merging, separating, or renaming themes.

2.5. Trustworthiness and Researcher Reflexivity

To strengthen trustworthiness, the study used repeated engagement with the data, analytic memoing, member checking, and reflexive attention to interpretation. Transcripts and preliminary interpretations were revisited several times to ensure that the emerging themes remained consistent with participants' accounts. Member checking was used to confirm that the researcher's summaries and early interpretations were reasonably aligned with participants' intended meanings. Rather than functioning as a mechanical validation step, member checking was treated as a way to reduce interpretive misrepresentation.

The study also incorporated researcher reflexivity through analytic notes written during

coding and theme development. Because this study relied on interpretive analysis of teachers' perspectives, reflexive note-taking was important for monitoring how assumptions about digital learning, child development, and pedagogical appropriateness could shape the reading of the data. Accordingly, transparency in analytic decision-making was prioritized over claims of objectivity or broad generalizability.

2.6. Ethical Considerations

This study obtained ethical approval from the relevant ethics committee, and all participants provided informed consent before data collection. Participants were informed about the purpose of the study, the voluntary nature of participation, the use of anonymized reporting, and their right to withdraw from the study. No identifying information about individual teachers or institutions is disclosed in this manuscript. In presenting the findings, contextual description was therefore balanced with confidentiality so that the study remained methodologically transparent without exposing participants or schools to unnecessary identification.

3. Result

The thematic analysis generated eight interrelated themes describing how ECE teachers understand, evaluate, and negotiate coding in early childhood classrooms. To strengthen the analytical clarity of the findings, the results are organized into five subsections that foreground the main empirical patterns emerging from the interviews. Across these subsections, three recurrent tendencies stand out: conceptual uncertainty, pedagogical negotiation, and structural constraint. At the same time, the data also show that teachers did not position coding in uniformly negative terms. Rather, they moved between cautious recognition of its potential and hesitation about its practical and developmental fit.

3.1. Teachers' Conceptual Uncertainty about Coding

A first major pattern concerns the unevenness of teachers' understanding of coding itself. Across the interviews, coding was often recognized as something important or increasingly visible, yet not always understood as a stable pedagogical concept. This pattern appears in participants' own admissions of partial familiarity, such as teacher H's statement, "Yes, I've heard of coding," and teacher T's remark, "I know, but only a little." These responses suggest that coding has entered teachers' awareness without yet becoming a fully shared or clearly operationalized concept in ECE practice.

The data also indicate that this uncertainty was not merely a matter of vocabulary. It shaped how teachers imagined what coding would look like in the classroom. For some participants, coding was associated with digital devices, applications, or formal programming ideas. For others, it was interpreted more broadly as sequencing, structured play, or logic-based activity. The pattern that emerges is therefore not total unfamiliarity, but conceptual fragmentation. Teachers were aware of coding, yet they did not begin from the same pedagogical understanding of what counted as coding in early childhood education. This variation is important because it influenced subsequent judgments about feasibility and appropriateness. When teachers started from different definitions, they also differed in the forms of implementation they considered acceptable. In this sense, conceptual uncertainty was not a peripheral issue. It formed part of the empirical basis on which teachers evaluated coding in relation to classroom practice.

3.2. Pedagogical Tensions between Coding and Child Development

A second pattern concerns teachers' efforts to reconcile coding with the developmental principles of early childhood learning. The interviews show that participants did not simply divide into supporters and opponents of coding. Instead, they often positioned themselves conditionally, accepting coding only if it could be aligned with children's developmental stage, play needs, and learning standards. This conditional acceptance appears in teacher L's statement, "It is suitable if it is adapted to STPPA."

At the same time, hesitation emerged when coding was imagined in highly digital or screen-based forms. teacher Y commented, "It is not suitable, children need concrete ones." This response

is important because it shows that resistance was directed less toward the idea of coding in general than toward forms of coding perceived as too abstract, insufficiently sensory, or detached from the concrete and playful nature of early childhood learning.

Taken together, these responses reveal a pedagogical tension rather than a simple rejection. Teachers evaluated coding through an early childhood lens in which developmentally appropriate practice remained the primary reference point. In this context, unplugged coding emerged as a mediating solution. It allowed teachers to engage with coding-related ideas while preserving concrete learning, play, and teacher-guided interaction.

3.3. Structural Gaps and Practical Adaptations

A third major finding concerns the role of structural conditions in shaping teachers' choices. Across participants, coding was discussed not only as a pedagogical issue, but also as a matter of policy clarity, resource availability, and institutional support. Teacher L stated, "There is no specific curriculum yet, so it needs guidance," indicating uncertainty at the level of formal direction. Resource limitations were also mentioned explicitly, including comments such as "Only one school computer" and "Facilities are very minimal, only TV." These statements suggest that coding was being evaluated within a materially constrained environment rather than under ideal conditions of implementation.

The findings also show that teachers responded to these limitations through practical adaptation rather than complete withdrawal. A small number of participants referred to limited experimentation with coding-related activities, such as the use of Code.org or unplugged tasks. However, these practices appeared occasional and context-dependent rather than institutionalized. This pattern indicates that implementation was possible, but not yet routine, systematic, or evenly supported.

Importantly, the preference for unplugged coding should therefore be read through two lenses at once. It reflected developmental considerations, but it also reflected feasibility under constrained conditions. The data suggest that what appeared pedagogically appropriate was often inseparable from what was materially possible.

3.4. Perceived Benefits and Children's Responses

Although teachers expressed uncertainty and caution, the interviews did not portray coding as an unwanted innovation. A recurring pattern was that participants acknowledged its potential benefits, especially when coding was interpreted in child-friendly rather than technical terms. Teachers linked coding with the development of logical thinking, creativity, problem-solving, and cooperation. Teacher H referred to coding as a way to "practice critical thinking," while teacher T associated it with "problem-solving, creativity, [and] cooperation." These responses suggest that teachers' reservations coexisted with an awareness of possible developmental value.

However, these positive views were often conditional rather than unqualified. The potential benefits of coding were typically recognized when activities were imagined as playful, concrete, and developmentally adapted. In other words, teachers did not present coding as inherently beneficial in all forms. Instead, they saw its value as dependent on how it was introduced and mediated in the classroom.

A similar pattern appears in teachers' descriptions of children's responses. Participants who had tried coding-related activities reported positive engagement when the activity was enjoyable and appropriately designed. Teacher H noted, "The children are happy," while teacher D added, "The child feels challenged." These responses indicate that enthusiasm was associated with the character of the activity rather than with the technological label of coding itself. Children appeared responsive when activities were experienced as enjoyable, concrete, and slightly challenging, not simply because they were digital.

3.5. Readiness, Support Needs, and Future Orientation

The final major pattern concerns the gap between teachers' recognition of coding's importance and their sense of readiness to implement it. Across interviews, participants repeatedly emphasized the need for more knowledge, practical models, and training. Teacher H stated, "I still need training," while teacher T referred to the importance of "seminars or training." These statements suggest that teacher readiness was not framed primarily as personal unwillingness, but as insufficient preparation.

This sense of limited readiness was further intensified by unequal conditions of access. One participant stated, "Not ready, especially in the regions," indicating that readiness was experienced differently across contexts and was tied to broader disparities in infrastructure and opportunity. The data therefore show that readiness was not only an individual matter of confidence, but also a contextual issue shaped by institutional and regional conditions.

At the same time, teachers did not dismiss coding as irrelevant. Teacher T explicitly stated that "Coding is important to prepare children for the future." This future-oriented view is significant because it shows that teachers' caution did not stem from indifference to digital change. Rather, they positioned coding as something that should be introduced gradually, selectively, and with stronger pedagogical and institutional support.

Table 1. The Dynamics of the Meaning of Coding According to Early Childhood Education Teachers

Main Themes	Key Findings	Sample Quotes
Conceptual Uncertainty	Understanding of coding is still diverse and inconsistent	H: "Yes, I've heard of coding"; T: "I know, but only a little"
Pedagogical Tension	Plugged coding is seen as needing adaptation to child development and STPPA	Y: "Not suitable, the child needs something concrete"; L: "Suitable if adjusted to STPPA"
Structural Gaps	Limited policies, facilities, and training shape implementation	L: "Only one school computer"; D: "Very minimal facilities, only TV"
Limited Experimentation and Adaptation	Coding-related activities are tried selectively through unplugged tasks and occasional digital platforms	D: "I have used unplugged activities"; H: "I have tried Code.org"
Child Response	Children show enthusiasm when activities are concrete, playful, and challenging	H: "The children are happy"; D: "The child feels challenged"
Teacher Readiness	Teachers feel they still need competence strengthening and practical guidance	H: "I still need training"; T: "Important seminars or trainings"
Potential for Skill Development	Coding is associated with critical thinking, logic, creativity, problem-solving, and cooperation	H: "Practice critical thinking"; T: "Improve problem-solving, creativity, cooperation"
Future Orientation	Coding is seen as increasingly important for children's future competence	T: "Coding is important to prepare children for the future"

4. Discussion

The findings indicate that coding in early childhood classrooms should not be understood as a straightforward educational innovation that can simply be transferred from broader digital discourse into preschool practice. Rather, coding is interpreted through the pedagogical grammar of early childhood education, where play, concreteness, developmental appropriateness, and teacher mediation remain central. This helps explain why teachers in this study did not respond to coding in uniformly affirmative or negative ways. Their responses were marked by a recurring tension: coding was recognized as potentially valuable for logic, creativity, and problem-solving, yet its legitimacy depended on whether it could be translated into forms that remained compatible with children's developmental characteristics. In this sense, the study suggests that the central issue is not merely the introduction of coding, but the conditions under which coding becomes pedagogically intelligible within ECE.

This pattern also clarifies why unplugged coding emerged so strongly in the findings. Unplugged activities were not preferred only because teachers lacked devices, nor only because

they valued play-based learning. More importantly, unplugged coding functioned as a negotiated pedagogical form through which teachers could reconcile digital learning discourse with the concrete, sensory, and socially mediated nature of early childhood education. This point matters because it shifts interpretation away from a deficit view in which unplugged coding is treated merely as a fallback caused by technological scarcity. The findings instead show that unplugged coding occupies an ambiguous but analytically significant position: it is at once a developmentally grounded pedagogy and a practical response to unequal infrastructure. What appears pedagogically appropriate is therefore inseparable from what is institutionally feasible, a pattern that also echoes research showing how unplugged approaches become especially salient under constrained educational conditions (Liu & Hu, 2024).

The study further shows that teacher readiness should be interpreted as a structurally situated condition rather than as an individual matter of competence alone. The participants' uncertainty was shaped not only by limited familiarity with coding, but also by the absence of clear curriculum guidance, restricted opportunities for training, and uneven access to technological resources. This extends previous discussions of teacher readiness for digital learning by indicating that readiness in early childhood contexts is filtered through additional layers of pedagogical responsibility and professional competence development (Aleksieva, 2025; Fitria & Lestari, 2024; Warmansyah et al., 2022). Recent international studies likewise emphasize that early childhood teachers' preparedness for coding and digital integration depends heavily on sustained professional development, pedagogical support, and institutional conditions rather than on individual willingness alone (Kulaksız & Toran, 2022; Masoumi, 2020; Warmansyah et al., 2022). Teachers are not merely deciding whether they can use digital tools; they are deciding whether such tools can be justified within a developmental framework that prioritizes play, interaction, and child protection. As a result, hesitation toward coding should not be reduced to conservatism or technological resistance. It is more accurately read as a form of professional judgment exercised under conditions of conceptual ambiguity and structural limitation (Timotheou et al., 2023; Warmansyah et al., 2022).

Taken together, these findings support a more critical reading of coding in early childhood education. Much of the broader literature tends to frame coding through the language of innovation, intervention, or future competence, often emphasizing learning potential, tool design, or implementation models (Metin et al., 2025; Mulyati, 2023; Pollarolo et al., 2024; Woo & Falloon, 2025). However, recent international reviews also caution that teacher misconceptions, pedagogical tension, and uneven school conditions remain central bottlenecks in early childhood coding education (Avcı & Deniz, 2022; Başaran et al., 2024). Evidence comparing programming modalities further suggests that unplugged approaches tend to be more developmentally accessible, while plugged and robotics-based approaches may be effective but usually require stronger material support and instructional preparation (Ching & Hsu, 2023; Wei et al., 2024). The present study does not reject the broader innovation literature, but it shows that such framings remain incomplete if they do not account for how coding is pedagogically translated by teachers in low-resource and developmentally sensitive settings. Within the Indonesian ECE context, coding becomes meaningful only when teachers can reinterpret it in ways that align with local curricular expectations, available resources, and child-centered pedagogies. The analytical value of this study therefore lies in showing that coding is not simply adopted or resisted. It is selectively recontextualized through teachers' meaning-making, through the institutional limits they face, and through their efforts to preserve the pedagogical integrity of early childhood learning.

4.1. Research Contribution

This study contributes to the literature in three related ways. Empirically, it foregrounds preschool teachers' perspectives in an area of research that has more often emphasized child outcomes, technological tools, or intervention models than teacher meaning-making. Conceptually, it reframes coding in early childhood education as a pedagogically and structurally negotiated practice rather than as a neutral or linear innovation. The study also contributes contextually by

showing how the Indonesian ECE setting, marked by uneven infrastructure, limited curriculum formalization, and strong commitments to play-based learning, reshapes the terms under which coding can be considered legitimate and feasible. In doing so, the article extends current debates by positioning teacher judgment, rather than technology alone, as a central site in the translation of coding into early childhood practice.

4.2. Limitations

This study has several limitations that should be acknowledged. The number of participants was small, and the findings were generated primarily from interview data, which means that the analysis reflects teachers' reported perspectives more than direct observation of classroom practice. The context was also intentionally anonymized to protect participants and institutions, which limits the level of contextual specificity that could be provided in the manuscript. For these reasons, the findings should be read as a situated interpretation of how coding is understood and negotiated in one segment of the Indonesian ECE context rather than as a generalized representation of all early childhood settings.

4.3. Suggestions

Future research should extend this study by involving more varied institutional and regional contexts, combining interviews with classroom observations, and examining how teachers' understandings of coding evolve through professional development, mentoring, or collaborative pedagogical design. For practice and policy, the findings suggest that coding should be introduced gradually through developmentally appropriate and play-based entry points, especially in low-resource settings where unplugged approaches may provide the most feasible starting point. This also implies the need for contextual curriculum innovation that does not merely import digital agendas, but reworks them into child-centered pedagogical forms suited to early childhood settings (Lim & Wardrip, 2026; Tukly et al., 2025). Training programs, contextual curriculum guidance, and practical teaching materials are therefore needed not simply to increase technological adoption, but to support teachers in translating coding into forms that remain pedagogically meaningful in early childhood education.

5. Conclusion

Coding enters ECE not as a settled pedagogical category, but as a contested and still unstable object of interpretation. The teachers in this study do not speak from a single conceptual ground, and this lack of shared meaning shapes how coding is imagined, filtered, and enacted in classroom practice. What is often framed in policy and public discourse as educational innovation is experienced by teachers through a different lens, namely the need to protect the developmental logic of early childhood education from forms of learning perceived as overly abstract, technical, or premature. Their preference for unplugged and play-based approaches should therefore not be reduced to limited digital competence or resistance to change. It reflects a pedagogical judgment that any new learning agenda must first be made compatible with children's ways of learning, rather than simply aligned with technological trends.

This places the question of coding in Indonesian ECE on a more fundamental terrain. The issue is not merely whether coding can be introduced, but under what pedagogical and institutional conditions it can become educationally legitimate. Limited facilities, insufficient training, and the absence of clear curriculum guidance do more than slow implementation; they shape the very possibilities through which coding can be translated into meaningful practice. Coding, in this sense, does not travel into early childhood classrooms as a neutral innovation. It is reworked through teacher mediation, material constraints, and local judgments about what counts as appropriate learning for young children. Although the study is necessarily bounded by its small-scale and interview-based design, it points to a broader implication: coding in early childhood education will remain fragile if it is pursued primarily as a marker of technological readiness, and it will become sustainable only when it is recontextualized within the pedagogical realities that structure children's everyday learning.

Declarations

Author contribution statement

Sari Gusmawanti: Conceptualization, Methodology, Supervision, Project Administration, Writing - Review & Editing.

Euis Kurniati: Investigation, Data Curation, Formal Analysis, Writing - Original Draft.

Rita Mariyana: Validation, Resources, Writing - Review & Editing.

Funding statement

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Data availability statement

The dataset generated and analyzed during the research is available from the corresponding author upon reasonable request.

Declaration of interests statement

All authors declare that they have no financial or personal interests that could influence the work presented in this manuscript.

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