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LEARNING INNOVATIONS IN INDONESIAN EARLY CHILDHOOD EDUCATION UNDER THE MERDEKA CURRICULUM: A SYSTEMATIC LITERATURE REVIEW

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Abstrak

Penelitian tentang inovasi pembelajaran pendidikan anak usia dini (PAUD) di Indonesia berkembang pesat sejak Kurikulum Merdeka diberlakukan, tetapi kajian sistematis yang ada hanya membahas satu jenis inovasi. Kajian ini bertujuan memetakan jenis inovasi pembelajaran yang diterapkan di satuan PAUD, capaian perkembangan yang dilaporkan beserta cara pengukurannya, dan kondisi yang mendukung atau menghambat penerapannya. Tinjauan pustaka sistematis ini mengikuti pedoman PRISMA 2020. Penelusuran dilakukan melalui basis data Crossref dan penelusuran web terarah untuk artikel jurnal terbitan 2022–2026. Dari 100 rekaman basis data dan 12 laporan tambahan, 32 studi memenuhi kriteria dan dianalisis secara tematik. Inovasi yang diteliti meliputi pembelajaran berbasis proyek dan P5, STEAM, *loose parts* dan media konkret, media digital dan AI, pendekatan berdiferensiasi dan pembelajaran mendalam, serta inovasi kurikulum kontekstual. Semua studi melaporkan hasil positif, terutama pada karakter, kreativitas, pemecahan masalah, dan kemandirian. Namun, 17 studi bersifat kualitatif, hanya enam yang memakai kelompok pembanding, dan sebagian besar memakai lembar observasi buatan guru. Kendala utama adalah kompetensi guru, keterbatasan bahan dan waktu, serta kesulitan asesmen. Bukti tentang inovasi pembelajaran PAUD masih menjanjikan tetapi belum kuat, sehingga dibutuhkan pengembangan profesional guru dan penelitian yang lebih ketat.

Kata kunci: Inovasi pembelajaran, pendidikan anak usia dini, Kurikulum Merdeka, pembelajaran berbasis proyek, tinjauan pustaka sistematis

Abstract

Research on learning innovation in Indonesian early childhood education has grown quickly since the introduction of the Merdeka Curriculum, but existing systematic reviews examine one type of innovation at a time. This review aimed to map the learning innovations implemented in early childhood settings, the developmental outcomes reported and how they were measured, and the conditions that support or constrain implementation. The review followed the PRISMA 2020 guideline. Searches were conducted in the Crossref database and through targeted web searching for journal articles published in 2022–2026. Of 100 database records and 12 additional reports, 32 studies met the eligibility criteria and were analysed thematically. The innovations comprised project-based learning and the Pancasila Student Profile project, STEAM, loose parts and concrete media, digital and AI media, differentiated and deep learning approaches, and contextual curriculum innovations. All studies reported positive results, mainly in character, creativity, problem solving, and independence. However, 17 studies were qualitative, only six used a comparison group, and most relied on teacher-made observation sheets. The main constraints were teacher competence, limited materials and time, and difficulties in assessment. The evidence is promising but not yet strong, which calls for teacher professional learning and more rigorous research.

Keywords*: Learning Innovation, Early Childhood Education, Merdeka Curriculum, Project-Based Learning, Systematic Literature Review*

Introduction

Early childhood is widely recognised as the period in which the foundations of later learning, social competence, and well-being are laid, and the quality of the learning experiences that young children receive has a lasting influence on their development (Golinkoff & Hirsh-Pasek, 2016; Whitebread et al., 2019). Play-based, child-centred learning is regarded as the most appropriate way to support this development, because it allows children to explore, make

choices, solve problems, and work with others in meaningful contexts (Bruce et al., 2017; Fleer, 2021). Good early childhood practice is therefore intentional rather than accidental: teachers plan activities, materials, and interactions that extend what children can do on their own (Bredekamp, 2019; Kostelnik et al., 2018).

In Indonesia, these principles have been placed at the centre of national policy. The Merdeka Curriculum, introduced in 2022 and later established as the national curriculum for early childhood, primary, and secondary education, emphasises play-based and child-centred learning, flexible learning objectives, and the Pancasila Student Profile as the graduate profile (Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi, 2022, 2024). Early childhood teachers have broadly welcomed the curriculum because it gives room for children's interests and talents, but they also recognise that it requires new competences in designing learning (Jannah & Harun, 2023). Its implementation has therefore been accompanied by a wave of experimentation with learning innovations, including project-based learning and the Pancasila Student Profile project (*Projek Penguatan Profil Pelajar Pancasila*, P5), STEAM, loose parts, digital media, and differentiated learning.

The research literature on these innovations has grown rapidly. Indonesian early childhood journals now publish many studies that describe or test new models, media, and approaches in kindergartens, Islamic kindergartens, and playgroups (Arianto et al., 2026; Hasibuan et al., 2026; Widiastuti et al., 2024). Several systematic reviews have begun to consolidate this work, but each has examined a single type of innovation or a single learning area. Recent reviews have synthesised Indonesian studies on early numeracy (Hakiki et al., 2026) and on artificial intelligence literacy in early childhood education (Khosibah et al., 2025), and international reviews have examined loose parts play (Cankaya et al., 2025) and the effects of information and communication technology on young learners (Zuo et al., 2025). These reviews report positive but fragmented findings and repeatedly note that the empirical evidence is limited.

What is missing is a synthesis across types of innovation. Without it, it is difficult to know which innovations have actually been implemented in Indonesian early childhood classrooms since the Merdeka Curriculum was introduced, which developmental outcomes they are said to improve, how those outcomes have been measured, and under what conditions the innovations work. This gap matters for practice and policy. Teachers and institutions must choose among many innovations with limited time and resources, and decisions about teacher training and learning materials depend on knowing which innovations rest on solid evidence and which rest mainly on description. A cross-innovation review can also show whether the field is producing evidence that is strong enough to guide such decisions, a question that single-topic reviews cannot answer.

This study therefore systematically reviews empirical research published between 2022 and 2026 on learning innovations in Indonesian early childhood education. It addresses three questions: (1) which learning innovations have been implemented in Indonesian early childhood settings, and with what research designs; (2) which developmental outcomes do the studies report, and how were these outcomes measured; and (3) which conditions support or constrain the implementation of the innovations. The unit of analysis is the published empirical study. A learning innovation is understood here as an instructional model or approach, a learning medium, or a project or curriculum programme that a teacher or institution introduces to improve children's learning beyond established routines.

The remainder of the article is organised as follows. The Research Method section describes the review protocol, information sources, eligibility criteria, screening, data extraction, appraisal, and synthesis. The Results section presents the characteristics of the included studies, the types of innovation, the reported outcomes and their measurement, and the conditions for implementation. The Discussion section interprets these findings in the light of previous research, examines the quality of the evidence, proposes a conceptual model, and outlines implications and limitations. The Conclusion answers the review questions and identifies directions for future research.

RESEARCH METHOD

This study used a systematic literature review design reported in accordance with the PRISMA 2020 statement (Page et al., 2021). A systematic review was chosen because the aim was to identify, appraise, and synthesise all eligible empirical studies on clearly defined questions rather than to select studies selectively (Booth et al., 2022; Gough et al., 2017). Because the included studies used qualitative, experimental, classroom-based, and developmental designs, the review combined a descriptive mapping of study characteristics with a thematic synthesis of findings, an approach suited to a heterogeneous body of evidence (Braun & Clarke, 2022). The searches, screening decisions, and reasons for exclusion were recorded in a search log, which serves as an audit trail for the review.

The review questions were framed around the setting, the intervention, and the outcomes. The setting was Indonesian early childhood education, including kindergartens (TK), Islamic kindergartens (RA), playgroups (KB), and community-based early childhood units serving children of about three to six years. The intervention was a specific learning innovation, defined as an instructional model or approach, a learning medium, or a project or curriculum programme. Studies were eligible if they reported child outcomes or data on classroom implementation. To focus on the period in which the Merdeka Curriculum shaped early childhood practice, only articles published from 2022 onwards were considered. The eligibility criteria are summarised in Table 1.

Table 1. Eligibility criteria of the review

Criterion	Inclusion	Exclusion
Setting	Indonesian early childhood education units (TK, RA, KB, community PAUD) serving children of about three to six years	Primary schools, special schools, and teacher education programmes
Intervention	A specific learning innovation: an instructional model or approach, a learning medium, or a project or curriculum programme	General curriculum implementation, management, planning, policy, perceptions, or readiness without a specific innovation
Outcome	Child outcomes or classroom implementation data (process, supports, constraints)	Expert validation, document analysis, or product description without classroom data
Design	Empirical studies of any design (qualitative, experimental, classroom-based, mixed, survey, development with classroom try-out)	Conceptual papers, literature and library studies, critiques
Publication	Journal articles published 2022–2026 in Indonesian or English	Proceedings, community service reports, theses, and issues dated outside 2022–2026

Source: Review protocol of the present study.

Table 1 shows that the criteria were inclusive with respect to design but strict with respect to the innovation and the setting. Qualitative, experimental, classroom-based, development, mixed-method, and survey studies were all eligible, because much of the Indonesian evidence on early childhood learning is produced in these designs. At the same time, studies of general curriculum implementation, management, teacher perceptions, or readiness were excluded unless they examined a specific innovation, and literature or library studies were excluded because they do not report primary data. Studies in primary schools were excluded because the developmental meaning of learning outcomes differs from that in early childhood settings.

The main information source was Crossref, a bibliographic database that indexes journal articles registered with DOIs, including most Indonesian journals published through Open Journal Systems. The planned direct access to the OpenAlex and Crossref interfaces from the research environment was refused by the network proxy, so the Crossref database was queried through its public interface on 29 October 2026. The query combined the terms *inovasi pembelajaran*, *anak usia dini*, and *kurikulum merdeka*, restricted to journal articles published from 2022. Crossref ranks results by relevance and reports partial matches, so its total count is not a meaningful denominator; the first 100 relevance-ranked records were exported, and the request for the next page was refused by a rate limit. To reduce the risk of missing relevant studies, the database search was supplemented by targeted web searching with Indonesian and English search strings on loose parts, STEAM, deep learning, digital and artificial intelligence media, and local wisdom in early childhood education. These searches identified 12 additional reports.

Screening took place in two stages. In the first stage, the titles and, where needed, the abstracts of the 99 database records that remained after one duplicate was removed were screened against the eligibility criteria. Records concerning primary or special schools, general curriculum implementation, conceptual or literature studies, and proceedings or service reports were excluded at this stage. In the second stage, the full reports of the remaining records and of the additional web reports were sought and assessed for eligibility. Reports whose landing pages could not be accessed were recorded as not retrieved, and each exclusion at the second stage was assigned a single main reason.

Data were extracted into a structured form covering bibliographic details, the innovation, the research design, the participants and setting, the outcomes and instruments, the main findings, and the supporting and constraining conditions reported by the authors. Most information was extracted from the abstracts and article pages of the journals; full texts were used where they were accessible. Numerical results were recorded exactly as reported. Where the reported statistics were incomplete or internally inconsistent, this was noted rather than corrected, so that the synthesis would not overstate the strength of the evidence.

The quality of the included studies was appraised with design-specific questions adapted from common appraisal practice in mixed-methods reviews (Booth et al., 2022). For experimental and quasi-experimental studies, the questions concerned the presence of a comparison group, the reporting of sample size, the description and validity of the instrument, and the completeness of statistical reporting. For qualitative studies, they concerned the description of participants, data sources, and analysis. The appraisal was used to judge the strength of the evidence rather than to exclude studies.

The synthesis proceeded in three steps. First, the characteristics of the studies were tabulated and counted by year, type of innovation, design, and outcome. Second, the innovations

were grouped inductively into types according to their main mechanism, and the outcomes, instruments, and implementation conditions were coded within each type, following the reflexive phases of familiarisation, coding, theme development, and review (Braun & Clarke, 2022; Kuckartz & Rädiker, 2023). Third, the patterns across types were compared and brought together in a conceptual model. Trustworthiness was supported by explicit criteria, the search log, the exact recording of reported results, and the comparison of findings across designs (Creswell & Poth, 2018; Miles et al., 2020). The flow of records through the review is shown in Figure 1.

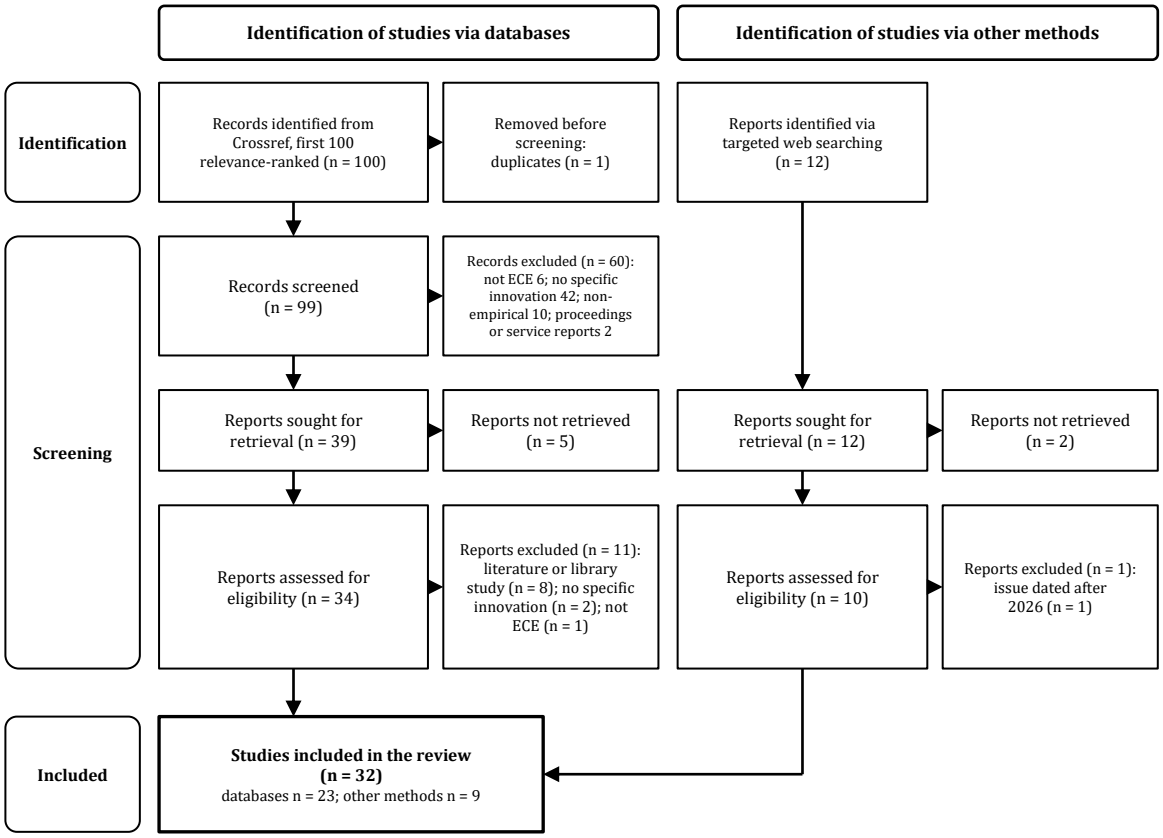


Figure 1. PRISMA 2020 flow diagram of study selection

Source: Adapted from Page et al. (2021), with data from the present review.

Figure 1 summarises the selection process. In the database stream, 39 of the 99 screened records were judged potentially eligible, five of which could not be retrieved; 11 of the 34 assessed reports were excluded, most often because they were literature or library studies, leaving 23 studies. In the web-searching stream, two of the 12 reports could not be retrieved and one was excluded because its issue was dated after 2026, leaving nine studies. In total, 32 studies were included in the synthesis. The figure also shows the limits of the search, namely the single database page that could be exported and the seven reports that could not be retrieved, which are taken into account in the interpretation of the findings.

RESULTS

Characteristics of the Included Studies

The 32 included studies were published between 2022 and 2026, with one study from 2022, seven from 2023, nine from 2024, six from 2025, and nine from 2026. They appeared in 20 journals, of which *Jurnal Obsesi* published 13. Where the setting was reported, the studies

came from Java, Sumatra, Kalimantan, Sulawesi, and Nusa Tenggara, including one kindergarten in Batang Hari, Jambi (Arianto et al., 2026). Most were conducted in a single kindergarten, Islamic kindergarten, or playgroup; only one study involved several institutions and a comparison group (Hasibuan et al., 2026), and one surveyed 101 teachers across a subdistrict (Putri & Efastri, 2025). Table 2 summarises the characteristics and main findings of all included studies.

Table 2. Characteristics and main findings of the included studies (n = 32)

Study	Innovation	Design	Participants and setting	Main finding
Al Wahfiyah & Pamungkas (2023)	*Segitiga Cinta Maiyah* values in the curriculum	Qualitative descriptive	Teachers, TKIT Alhamdulillah; children aged 4–6	Spiritual, moral, and social character described as positive; not yet optimal
Anggraini et al. (2026)	AI-based mathematics medium "Kiko Kancil"	Development (ADDIE) with experimental and control groups	TK Santa Maria Surabaya; n not reported	Groups differed ($t = 4.271$, $p < .001$); independence and participation described
Arianto et al. (2026)	STEAM with an exploration, simulation, and authentic experience sequence	Qualitative descriptive	One TK, Batang Hari; principal and two teachers; children aged 4–5	Contextual behaviours such as naming, counting, turn-taking, and collaboration observed
Aslina & Hidayah (2025)	Problem-driven iterative adaptation (PDIA)	Qualitative case	Six principals, six teachers, one supervisor; IKN area	More effective, locally designed learning; weak training and digital literacy
Aulina & Nurdiana (2024)	Project-based learning two to three days a week on local themes	Qualitative descriptive	TK PKK IV Gempol	Critical thinking, creativity, and cooperation described
Cahyaningrum & Diana (2023)	P5 project through play outside the classroom	Qualitative case	PAUD institution	Six profile dimensions shown; assessment and documentation difficult
Fitriana et al. (2026)	Locomove path carpet medium	One-group pre–post	24 children aged 4–5	Gross motor skills improved (Wilcoxon $Z = -4.331$, $p < .001$)
Fitroh et al. (2023)	Ronggosukowati Educorner in a P5 batik project	Posttest-only control group	40 children aged 5–6	Knowledge of Madura batik higher in Educorner classes
Hasibuan et al. (2026)	STEAM learning model	Development (ADDIE) with pre–post control group	60 children aged 4–6, four PAUD units, Binjai; 12 teachers	Creative thinking 47.97 to 80.10 (N-gain 0.68, $d = 1.54$); control unchanged
Jadidah et al. (2024)	Interactive approach with games, stories, and discussion	Quasi-experiment with control group	Not reported	Explanation skills improved significantly
Karisma et al. (2022)	Loose parts media	One-group pre–post	KB Az-Zahra, Pagaralam; children aged 5–6	Cognitive score 57.6 to 88.7

Study	Innovation	Design	Participants and setting	Main finding
Klaramita et al. (2025)	P5 learning of the Pancasila Student Profile	Qualitative descriptive	Principal and one teacher, TK Paramata Bunda Palopo	Character values integrated into daily learning
Laili & Trianggono (2025)	Local-wisdom project-based learning	One-group pre–post	10 children, KB Al Mustajab	Creativity 1.725 to 3.375
Lestari et al. (2024)	Nature-based learning	Qualitative descriptive	Group A, TK Ekasari, Madiun	Intellectual development stimulated
Masnipal (2023)	Book-based play for mathematics	One-group pre–post over one semester	Not reported; parents' home checklist	Interest in mathematics rose on three indicators
Meiroati & Kuswanto (2025)	Augmented reality for gross motor learning	Quasi-experiment, AR and conventional classes	RA Ismaria Al-Quranniyyah, Rajabasa; children aged 4–5	Posttest means 92.11 and 47.19 ($p < .001$)
Meo et al. (2026)	Loose parts media	Pre-experiment with qualitative analysis	25 children aged 5–6, TKK Regina Pacis Bajawa	Problem-solving behaviours observed
Mulya et al. (2024)	Playful science and mathematics	Qualitative case	Not reported	Learning independence described
Nadlifah & Latif (2024)	STEAM approach	Qualitative case	RA Fun Islamic School; educators, parents, administrators	Problem solving, creativity, collaboration; limited resources and training
Nugraheni et al. (2024)	Loose parts media	One-group pre–post	20 children aged 5–6, Magelang	Problem solving 47.85 to 63.70 ($p < .001$)
Pusparini et al. (2026)	Clay-play interactive medium with character values	Qualitative descriptive	Not reported	Engagement, creativity, fine motor skills, and character values
Putri & Efastri (2025)	Loose parts in project-based learning	Descriptive survey	101 PAUD teachers, Pekanbaru	Teacher-reported benefits; limited materials, time, and training
Putri et al. (2026)	STEAM project-based learning	Quasi-experiment, non-equivalent control group	30 children aged 5–6 (15 and 15)	Creativity higher in the STEAM group
Rahayu & Wahyuni (2025)	P5 for love of the homeland	Qualitative descriptive	TK Sartika Bojong	Most children rated "very well developed"
Rasmani et al. (2023)	Management of project-based learning and P5	Qualitative descriptive	TK Al Khoir Surakarta	Structured implementation; parental involvement a strength
Rofiah (2024)	Digital flipbook module with video	Qualitative case with pre–post test	TK Al-Qodiri Jember	Achievement rose by 47.5; claimed better than picture media
Shalihah et al. (2023)	Differentiated learning for religious-moral values	One-group pre–post	Not reported	Gains claimed; reported $p = .062$ conflicts with the claim of significance

Study	Innovation	Design	Participants and setting	Main finding
Suniati et al. (2026)	Deep learning by doing for literacy and numeracy	Qualitative descriptive	TK Yaa Buannya, Bima	Engagement and basic literacy and numeracy; limited media
Syisva et al. (2024)	Differentiated learning model	Qualitative	Not reported	Motivation, independence, and confidence claimed
Valensi et al. (2026)	Child-centred, play-based curriculum innovation	Qualitative case	PAUD PKBM Habibie dan Hatta	Confidence, creativity, communication, and independence
Wahyuningsih et al. (2023)	Project method	Qualitative descriptive over six months	Not reported	Independence; method easy for teachers
Widiastuti et al. (2024)	Class projects and school (P5) projects	Qualitative descriptive	Principal, teachers, and children in one PAUD unit	Responsibility, communication, and cooperation improved

Source: Data extracted from the included studies. P5 = Projek Penguatan Profil Pelajar Pancasila; PAUD = early childhood education; TK = kindergarten; KB = playgroup; RA = Islamic kindergarten.

Table 2 shows that the evidence base consists largely of small, single-site studies that describe how an innovation was implemented or test it with one group of children. Fourteen studies had a quantitative component, but in seven of them the number of children was not reported or was unclear (Anggraini et al., 2026; Jadidah et al., 2024; Karisma et al., 2022; Masnipal, 2023; Meiroati & Kuswanto, 2025; Rofiah, 2024; Shalihah et al., 2023). Where samples were reported, they ranged from ten children (Laili & Trianggono, 2025) to 60 children (Hasibuan et al., 2026). The distribution of the studies by type of innovation and by research design is shown in Figure 2.

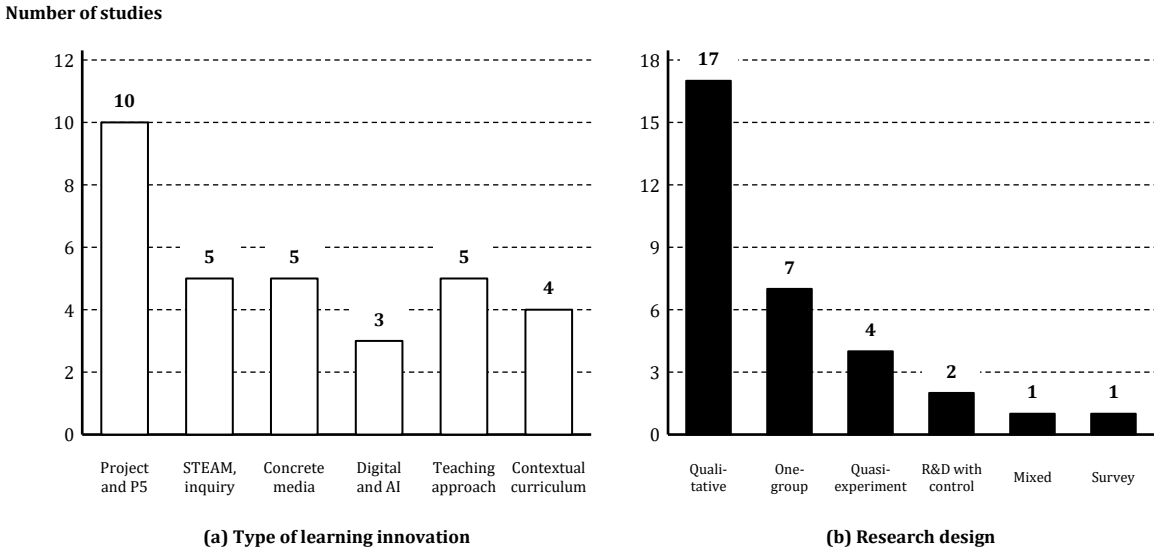


Figure 2. Distribution of the included studies by type of innovation and research design (n = 32)

Source: Data extracted from the included studies (see Table 2).

Figure 2 shows two clear patterns. The first panel indicates that project-based learning and the P5 project form the largest group of innovations, followed by STEAM and inquiry, loose parts and concrete media, and differentiated, interactive, and deep learning approaches,

whereas digital and artificial intelligence media were the least studied. The second panel shows that qualitative descriptive and case designs dominate the evidence base, followed by one-group pre-experimental designs. Only six studies used a comparison or control group, and only two of these combined development with a controlled trial. The evidence is therefore broad in the range of innovations it covers but thin in its ability to establish effects.

Types of Learning Innovation

The first and largest type is project-based learning, including the P5 project (10 studies). Teachers used class projects and school projects to develop character values such as responsibility, communication, and cooperation (Widiastuti et al., 2024), ran project-based learning two to three days a week on themes drawn from the children's surroundings (Aulina & Nurdiana, 2024), and organised P5 projects through play outside the classroom (Cahyaningrum & Diana, 2023). Projects were also used to build independence (Wahyuningsih et al., 2023), love of the homeland (Rahayu & Wahyuni, 2025), knowledge of regional batik (Fitroh et al., 2023), and creativity through local wisdom (Laili & Trianggono, 2025). Two studies examined how projects were planned and managed (Klaramita et al., 2025; Rasmani et al., 2023), and a survey examined how teachers integrated loose parts into projects (Putri & Efastri, 2025).

The second type is STEAM and inquiry-based learning in science and mathematics (five studies). One kindergarten integrated STEAM within a transportation theme through a sequence of exploration, simulation, and authentic experience (Arianto et al., 2026), and an Islamic kindergarten used building activities and the combination of art and mathematics to encourage problem solving (Nadlifah & Latif, 2024). Two studies tested STEAM against conventional instruction (Hasibuan et al., 2026; Putri et al., 2026), and one described playful science and mathematics activities that left children room to explore (Mulya et al., 2024).

The third type is loose parts and other concrete media (five studies). Three studies used loose parts to develop problem solving and cognitive ability (Karisma et al., 2022; Meo et al., 2026; Nugraheni et al., 2024). Others used a movement carpet to develop gross motor skills (Fitriana et al., 2026) and clay play into which character values were deliberately integrated (Pusparini et al., 2026). The fourth type is digital and artificial intelligence media (three studies): augmented reality for gross motor learning (Meiroati & Kuswanto, 2025), a digital flipbook module with embedded video (Rofiah, 2024), and an AI-based mathematics medium that adjusted difficulty to each child and gave immediate feedback (Anggraini et al., 2026).

The fifth type comprises pedagogical approaches rather than materials (five studies). Two studies examined differentiated learning (Shalihah et al., 2023; Syisva et al., 2024), one an interactive approach based on games, stories, and discussion (Jadidah et al., 2024), one book-based play for mathematics (Masnipal, 2023), and one "deep learning by doing" for early literacy and numeracy (Suniati et al., 2026). The sixth type is contextual curriculum innovation at the level of the institution (four studies). These included a child-centred, play-based curriculum in a community learning centre (Valensi et al., 2026), nature-based learning (Lestari et al., 2024), the integration of religious and social values into the curriculum (Al Wahfiyah & Pamungkas, 2023), and the use of problem-driven iterative adaptation to implement the curriculum in kindergartens in the new capital region (Aslina & Hidayah, 2025).

Reported Outcomes and How They Were Measured

All 32 studies reported positive outcomes. The most frequently reported child outcomes were character and values, including responsibility, cooperation, religious and moral values, and love of the homeland (Al Wahfiyah & Pamungkas, 2023; Rahayu & Wahyuni, 2025; Widiastuti et al., 2024); creativity and creative thinking (Hasibuan et al., 2026; Laili & Trianggono, 2025; Putri et al., 2026); problem solving and cognitive ability (Karisma et al., 2022; Meo et al., 2026; Nugraheni et al., 2024); independence (Anggraini et al., 2026; Mulya et al., 2024; Wahyuningsih et al., 2023); motor skills (Fitriana et al., 2026; Meiroati & Kuswanto, 2025); and early language, literacy, and numeracy (Jadidah et al., 2024; Masnipal, 2023; Suniati et al., 2026).

The measurement of these outcomes was, however, uneven. In the qualitative studies, outcomes were inferred from observation, interviews, and documentation, usually without a description of the indicators used. In the quantitative studies, the most common instrument was an observation sheet or checklist developed by the researchers or teachers. One study relied on a checklist completed by parents at home (Masnipal, 2023), and one reported outcomes mainly as the share of children in the "very well developed" category of the national developmental scale (Rahayu & Wahyuni, 2025). Only one study used an adapted standardised instrument, a rubric based on the Torrance Tests of Creative Thinking, and reported inter-rater reliability ($\kappa = 0.82$) and an effect size ($d = 1.54$) alongside a control group whose scores did not change (Hasibuan et al., 2026).

Among the studies that reported numerical results, the size of the reported gains varied widely. Mean scores rose from 57.6 to 88.7 for cognitive ability after loose parts play (Karisma et al., 2022), from 47.85 to 63.70 for problem solving (Nugraheni et al., 2024), and from 1.725 to 3.375 for creativity in a group of ten children (Laili & Trianggono, 2025). The augmented reality class scored 92.11 against 47.19 in the conventional class (Meiroati & Kuswanto, 2025). Some reports contained statistical inconsistencies, such as degrees of freedom that did not match a one-group design (Karisma et al., 2022) and a reported significance value of .062 alongside a claim of significance below .05 (Shalihah et al., 2023). These problems limit the confidence that can be placed in the reported effects.

Conditions for Implementation

The studies also described the conditions under which the innovations were implemented. The most frequently reported support was collaboration with parents and the community, which strengthened project learning and curriculum adaptation (Aslina & Hidayah, 2025; Klaramita et al., 2025; Rasmani et al., 2023). Principal support, teacher training, and collaboration among teachers were also reported as enablers (Klaramita et al., 2025; Putri & Efastri, 2025). In settings with limited resources, teachers adapted STEAM by using pictures, symbol cards, cardboard, loose parts, and handmade materials, and used the surrounding environment as a learning resource (Arianto et al., 2026). Teacher modelling and daily habituation were reported as the means by which character values were internalised through concrete activities (Pusparini et al., 2026).

The constraints were remarkably consistent across types of innovation. Limited teacher understanding and training were reported for loose parts, STEAM, deep learning, and curriculum adaptation (Aslina & Hidayah, 2025; Nadlifah & Latif, 2024; Putri & Efastri, 2025). Limited materials and media were reported for STEAM, loose parts, and deep learning (Arianto

et al., 2026; Putri & Efastri, 2025; Suniati et al., 2026), and the availability of local materials received the lowest practicality rating in the most rigorous STEAM study (Hasibuan et al., 2026). Limited time for planning, exploration, and reflection was another recurring theme (Arianto et al., 2026; Klaramita et al., 2025). Teachers also found it difficult to assess and document children's progress in projects, and the common view that early childhood education is mainly about reading and writing persisted (Cahyaningrum & Diana, 2023). Digital literacy and infrastructure were mentioned as constraints in the implementation of the curriculum (Aslina & Hidayah, 2025), although none of the three digital media studies examined access to devices or teachers' digital competence.

Synthesis by Type of Innovation

Bringing these findings together, the types of innovation differ in the outcomes they target, in the strength of their evidence, and in the conditions they require. Table 3 synthesises the outcomes, evidence base, supports, and constraints for each type.

Table 3. Outcomes, Evidence, And Implementation Conditions By Type Of Innovation

Innovation type (n)	Outcomes reported	Evidence base	Supports	Constraints
Project-based learning and P5 (10)	Character and profile values, independence, creativity, cooperation, cultural knowledge	Seven qualitative, one control-group, one one-group, one teacher survey	Parents, local themes, school support and training	Assessment and documentation, materials, planning time, staffing
STEAM and inquiry (5)	Creativity and creative thinking, problem solving, collaboration, independence	Three qualitative, one quasi-experiment, one development study with control group	Low-cost materials, project activities, teacher collaboration	Media for technology and engineering, training, time, local materials
Loose parts and concrete media (5)	Problem solving, cognition, motor skills, character values	Four one-group or pre-experimental, one qualitative	Inexpensive open-ended materials, play	Rarely reported; no control groups
Digital and AI media (3)	Gross motor skills, achievement, independence	Two with comparison groups, one mixed	Interactivity, feedback, video	Devices and digital literacy not examined; samples unreported
Differentiated, interactive, and deep learning (5)	Religious-moral values, explanation skills, literacy and numeracy, interest, motivation	Two one-group, one quasi-experiment, two qualitative	Games, stories, contextual activities	Teachers' design skills, media, varied abilities
Contextual curriculum innovation (4)	Confidence, creativity, intellectual development, character	Four qualitative	Parents and community, local potential	Training, human resources, digital literacy

Source: Authors' synthesis of the included studies.

Table 3 indicates that the types of innovation share a common profile. Each targets several developmental domains at once, each is supported mainly by qualitative or one-group studies, and each depends on teachers' competence, adequate materials, and time. Project-based learning and the P5 project have the largest number of studies but the weakest designs, whereas STEAM and digital media, though less frequently studied, include most of the studies with comparison groups. Loose parts studies report consistent gains but without control groups, and contextual curriculum innovations are documented only through qualitative case studies. The relationships among the types of innovation, their mechanisms, the reported outcomes, and the conditions that sustain them are interpreted in the Discussion.

DISCUSSION

This review set out to map the learning innovations implemented in Indonesian early childhood education since the introduction of the Merdeka Curriculum, the outcomes they are reported to produce, and the conditions under which they are implemented. The results show that innovation is widespread and varied, that every study reports positive outcomes, and that the same conditions support or constrain implementation across very different innovations. They also show that the strength of the evidence lags behind the breadth of practice. This section interprets these findings in the light of previous research, examines the quality of the evidence, proposes a conceptual model, and considers implications and limitations.

Innovation Types in Light of Previous Research

The dominance of project-based learning and the P5 project reflects the place that projects occupy in the Merdeka Curriculum (Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi, 2024). It is also consistent with the long tradition of the project approach in early childhood education, which treats extended investigations of children's questions as a way to integrate knowledge, skills, and dispositions (Helm & Katz, 2016; Hedges, 2022). The reviewed studies, however, used projects mainly to develop character values and profile dimensions, and only rarely to examine children's inquiry or knowledge, which suggests that the Indonesian adoption of projects has been shaped as much by values education as by the inquiry tradition.

The findings on STEAM and loose parts agree with international evidence. A recent systematic review of 25 quantitative studies found that play with open-ended materials resembling loose parts was often associated with problem solving, creativity, and mathematics, but noted that few studies tested loose parts directly and that designs were mostly cross-sectional (Cankaya et al., 2025). The Indonesian loose parts studies in this review tested loose parts directly and reported gains in problem solving and cognition, but without control groups, so they extend the evidence in scope but not in strength. The STEAM studies, in turn, reported gains in creativity that are consistent with research on early mathematics and play-based curricula, which emphasises hands-on exploration and the integration of subjects (Clements & Sarama, 2021; Saracho, 2021). The most rigorous study in the review, a STEAM model tested against a control group in four institutions, reported a large effect on creative thinking (Hasibuan et al., 2026), which suggests that well-designed STEAM activities can produce measurable change when implementation is structured.

The digital media studies reported positive effects on motor skills, achievement, and independence. A recent meta-analysis of experimental and quasi-experimental studies found a moderate positive effect of information and communication technology on young children's

learning, with larger effects for subject knowledge than for social-emotional development and with significant effects only for interventions lasting six to 18 weeks (Zuo et al., 2025). The Indonesian digital studies were short, rarely reported sample sizes, and did not examine access to devices, which limits comparison. A review of Indonesian studies on artificial intelligence literacy in early childhood likewise found that practice was concentrated in institutions with strong digital infrastructure and digitally literate educators (Khosibah et al., 2025), and recent work has proposed quality assurance frameworks for AI educational technology in low-resource settings, which underlines that the quality of such tools must be assured rather than assumed (Haditia et al., 2026). The promise of digital and AI media in Indonesian early childhood education therefore depends on conditions that the current studies do not yet examine.

The studies of differentiated, interactive, and deep learning approaches show that innovation is not only a matter of new materials but also of new ways of teaching. Differentiated learning responds to the diversity of children's readiness, interests, and learning profiles (Tomlinson, 2017), and deep learning emphasises meaningful, reflective, and connected learning (Fullan et al., 2018). Recent work has also examined how deep learning can enhance the effectiveness of the Islamic religious education curriculum in madrasahs (Idham et al., 2026). The early childhood studies in this review, however, described these approaches mostly in general terms and reported their effects with inconsistent statistics, which makes it difficult to identify what teachers actually did differently.

Evidence Quality as the Central Gap

The most important finding of this review is the gap between the breadth of innovation and the strength of evidence. More than half of the studies were qualitative descriptions, one-group designs formed most of the remainder, only six studies used a comparison group, and only one reported an effect size and the reliability of its instrument. This pattern is not unique to a single innovation. It parallels the conclusion of a review of Indonesian early numeracy research that the evidence is diverse but not yet integrated (Hakiki et al., 2026). It is also consistent with research methodology texts, which warn that one-group pretest-posttest designs cannot separate the effect of an intervention from maturation, repeated testing, or the novelty of the activity (Cohen et al., 2018). Because young children develop rapidly, a gain over several weeks without a comparison group cannot be attributed to the innovation alone.

The reliance on teacher-made observation sheets raises a related problem. Observation is appropriate for young children and is central to authentic assessment in early childhood education (Bredekamp, 2019), but without shared indicators, defined rating levels, and evidence of reliability, the scores produced in different studies cannot be compared or combined. Syntheses of educational research depend on outcomes that are measured comparably and reported fully, because only then can the size and consistency of effects be judged (Hattie, 2023). The constraints that teachers themselves reported, especially the difficulty of assessing and documenting progress in projects (Cahyaningrum & Diana, 2023), suggest that weak measurement is not only a research problem but also a practical problem in classrooms.

A Conceptual Model of Learning Innovation

Despite these limitations, the reviewed studies point to common mechanisms across the types of innovation. The innovations that reported the clearest outcomes shared three features:

active, hands-on play with open-ended or concrete materials; meaningful contexts drawn from local culture, nature, and daily life; and responsive teaching that offered choice, scaffolding, and reflection. These features correspond to principles of play-based pedagogy and children's interests that are well established in early childhood theory (Fleer, 2021; Hedges, 2022; Smith & Roopnarine, 2018). The relationships among the types of innovation, these mechanisms, the reported outcomes, and the conditions that sustain them are brought together in the conceptual model in Figure 3.

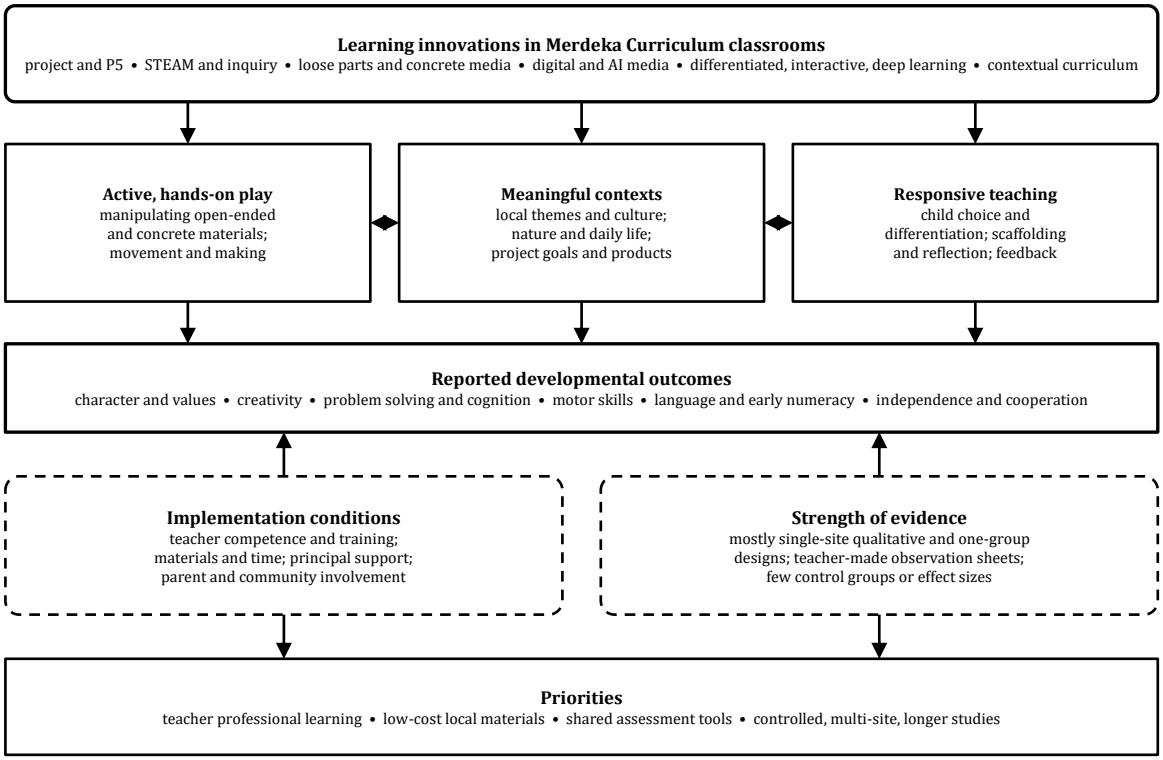


Figure 3. Conceptual model of learning innovation in Indonesian early childhood education
Source: Authors' synthesis of the review findings.

Figure 3 should be read from top to bottom. The six types of innovation do not act directly on outcomes; they work through the shared mechanisms of active play, meaningful contexts, and responsive teaching. These mechanisms are associated with outcomes across several developmental domains, which explains why studies of very different innovations reported similar benefits. The model places two layers beneath the outcomes. Implementation conditions, including teacher competence, materials, time, principal support, and parent and community involvement, determine whether the mechanisms can operate. The strength of the evidence determines how confidently the outcomes can be attributed to the innovations. The priorities at the bottom of the model follow from these two layers: the effectiveness of an innovation depends less on its label than on whether teachers can implement its mechanisms and whether its effects are assessed in ways that can be trusted.

Implications for Practice and Policy

The findings have several implications. First, because the same constraints recur across innovations, investment in teachers' professional learning is likely to support many innovations at once. Teachers need support not only in using particular materials but also in designing projects, scaffolding inquiry, and assessing children's progress, a need that early childhood teachers recognised when the Merdeka Curriculum was introduced (Jannah & Harun, 2023).

Research on curriculum development in madrasahs has similarly reported that teachers struggled to vary their methods and that project-based learning was limited by time and resources (Azizah et al., 2025). Educational change research suggests that such capacity is built most effectively through sustained, collaborative learning focused on a few coherent priorities rather than through many separate initiatives (Fullan, 2016).

Second, the use of low-cost and local materials deserves systematic support. Several studies showed that teachers could implement STEAM and loose parts with cardboard, natural materials, and handmade media (Arianto et al., 2026; Putri & Efastri, 2025), and that local culture and nature provided meaningful contexts (Laili & Trianggono, 2025; Lestari et al., 2024). Collections of locally available materials and examples of activities could therefore make innovation more equitable across institutions with different resources. Third, shared assessment tools are needed. Simple, validated observation rubrics for creativity, problem solving, cooperation, and independence, aligned with the learning outcomes of the curriculum, would help teachers document progress and would allow studies to be compared and combined. Finally, digital and AI media should be introduced with attention to access, teacher competence, and the quality of the tools, rather than on the assumption that technology is beneficial in itself (Haditia et al., 2026; Kucirkova, 2018).

For researchers, the review suggests a clear agenda. Future studies should use comparison groups wherever possible, report sample sizes and the content of the intervention, use instruments with evidence of validity and reliability, report effect sizes, and follow children for longer periods. Studies conducted across several institutions, as in the strongest study in this review (Hasibuan et al., 2026), would also show whether innovations work in settings with different resources.

Limitations of the Review

This review has several limitations. The database search relied on Crossref, and only the first 100 relevance-ranked records could be exported because of a rate limit; the supplementary web search reduced but could not remove the risk that relevant studies were missed. Seven potentially eligible reports could not be retrieved. Data were extracted mainly from abstracts and article pages, so details reported only in full texts may have been missed. The search was limited to Indonesian and English terms and to journal articles, which excludes theses and reports that may contain relevant evidence. Finally, the grouping of innovations into types involved judgement, and some studies could reasonably have been placed in more than one type.

CONCLUSION

This systematic review of 32 studies published between 2022 and 2026 shows that learning innovation in Indonesian early childhood education has expanded rapidly since the introduction of the Merdeka Curriculum. In answer to the first question, the innovations implemented in early childhood settings fall into six types, namely project-based learning and the P5 project, STEAM and inquiry, loose parts and concrete media, digital and artificial intelligence media, differentiated, interactive, and deep learning approaches, and contextual curriculum innovations, and they have been studied mostly through qualitative and one-group designs. In answer to the second question, all studies reported positive outcomes, especially in character, creativity, problem solving, independence, motor skills, and early literacy and

numeracy, but these outcomes were measured mostly with teacher-made observation sheets, rarely against a comparison group, and only once with a reliable instrument and an effect size. In answer to the third question, implementation was supported by collaboration with parents and communities, principal support, teacher training, and the creative use of low-cost local materials, and it was constrained by limited teacher competence, materials, and time, and by difficulties in assessment. The evidence on learning innovation in Indonesian early childhood education is therefore promising but not yet strong, and its further development depends on sustained professional learning for teachers, accessible local materials, shared assessment tools, and more rigorous research. Future studies should test innovations with comparison groups in several institutions, use valid and reliable instruments, report effect sizes, and follow children over longer periods, so that teachers and policymakers can know with greater confidence which innovations improve young children's learning and under what conditions.

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