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The Role of Educators in Encouraging Problem-solving Skills in Ealy Childhood

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ABSTRACT

Background/purpose. Problem-solving is a foundational early childhood competency, yet the specific ways educators cultivate this capacity remain fragmented across contemporary theoretical and empirical traditions. This review examines how early childhood educators support problem-solving skills among children aged approximately three to six years. **Materials/methods**. The article uses a conceptual narrative literature review, synthesizing sociocultural, constructivist, play-based, STEM/STEAM, digital-learning, and cognitive-developmental perspectives with empirical studies and reviews published between 2015 and 2025. **Results.** The synthesis identifies six interrelated educator roles: scaffolder, facilitator of guided play, intentional questioner, designer of the learning environment, supporter of executive function, and mediator of technology-enhanced problem solving. Evidence indicates that adult mediation, rather than play materials or technology alone, determines whether problem-solving experiences produce developmental gains. **Conclusion.** Sustained, context-responsive professional development and classroom cultures that tolerate productive struggle are essential for strengthening educators' capacity to nurture children's problem-solving dispositions.

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1. INTRODUCTION

Problem-solving is widely regarded as one of the core competencies children need not only to succeed academically but also to navigate the everyday demands of social life, from negotiating a shared toy to figuring out why a tower of blocks keeps collapsing. Recent early childhood literature positions problem-solving alongside communication, collaboration, creativity, computational thinking, and scientific reasoning as a foundational competency that can be nurtured through play, inquiry, STEM/STEAM experiences, and technology-rich exploration (Clements & Sarama, 2016; DeJarnette, 2018; Fusaro & Smith, 2018; Hollenstein, Thurnheer, & Vogt, 2022; Rodrigues-Silva & Alsina, 2023). Unlike many academic skills introduced through direct instruction, problem-solving in early childhood develops largely through embodied and socially mediated experience: children build towers that collapse, disagree over how to share a material, test whether a ramp will make a car move faster, or debug a simple coding sequence. How adults respond to these moments, whether they intervene immediately, withdraw entirely, or offer carefully calibrated support, shapes whether the experience becomes a genuine learning opportunity or a source of frustration and disengagement (Granone & Pollarolo, 2025; Skene et al., 2022; Weisberg et al., 2016).

Early childhood educators occupy a uniquely influential position in this process. They are neither passive bystanders nor directive instructors in the traditional sense; rather, contemporary studies describe educators as active mediators who create the conditions, pose the questions, and provide calibrated support that allows children's independent problem-solving capacities to emerge (Acar, Hong, & Wu, 2017; Bodrova & Leong, 2018; Pyle & Danniels, 2017). Despite broad consensus about the importance of this mediating role, the specific practices through which educators enact it remain fragmented across disciplinary traditions. These include research on guided play and playful learning (Skene et al., 2022; Zosh et al., 2017), executive function and self-regulation (Madanipour, Garvis, & Cohrssen, 2025; Muir, Howard, & Kervin, 2023; Zelazo, Blair, & Willoughby, 2016), intentional questioning and critical thinking (Liu & Yoon, 2025; O'Reilly, Devitt, & Hayes, 2022; Salmon & Barrera, 2021), and digital or computational problem-solving (Bers, 2019, 2020; Chu, Paatsch, Kervin, & Edwards, 2024; Relkin, de Ruiter, & Bers, 2020).

This article addresses that fragmentation by offering an integrative conceptual review of the educator's role in fostering problem-solving skills among children in the preschool and kindergarten years. Specifically, the review addresses three guiding questions: first, how is problem-solving conceptualized within early childhood education research published between 2015 and 2025; second, through which specific pedagogical roles and practices do educators cultivate problem-solving

dispositions in young children; and third, what contextual, institutional, and professional factors constrain or enable educators in performing these roles. By synthesizing contemporary theoretical and empirical literature, the review aims to provide early childhood teacher educators, curriculum developers, and practitioners with a coherent account of evidence-informed, educator-mediated problem-solving pedagogy and to identify where further empirical work, particularly outside Western, English-speaking contexts, is needed.

2. LITERATURE REVIEW

2.1 Defining Problem-Solving in Early Childhood

In early childhood, problem-solving is rarely an isolated cognitive exercise performed on a worksheet; it is typically embedded within play, social interaction, inquiry, and everyday classroom routines. A young child attempting to balance an uneven stack of blocks, negotiate turn-taking with a peer, work out why a toy car stalls, or identify how to program a robot to reach a destination is engaging in the same fundamental process that underlies later formal problem-solving: recognizing a gap between a current state and a desired state, generating possible actions, testing them, and evaluating the outcome (Fusaro & Smith, 2018; Granone & Pollarolo, 2025; Hollenstein et al., 2022). What distinguishes early childhood problem-solving from its later academic counterpart is less the underlying cognitive structure and more the context in which it unfolds, namely playful, socially mediated, often collaborative, and materially supported settings rather than abstract, individually completed tasks (Pyle & Danniels, 2017; Weisberg et al., 2016; Zosh et al., 2017).

Scholars have further emphasized that problem-solving in the early years is inseparable from social, emotional, and executive-function competencies. Learning to solve the problem of sharing, waiting, or resolving disagreement calls on impulse control, flexible thinking, working memory, and goal-directed persistence, the same underlying capacities that support cognitive problem-solving in early mathematics, block construction, scientific inquiry, and computational thinking (Muir et al., 2023; Schmitt, Korucu, Napoli, Bryant, & Purpura, 2018; Zelazo et al., 2016). For this reason, this review treats problem-solving broadly, encompassing cognitive, social, STEM-related, and technology-mediated forms of problem-solving, while recognizing that much empirical work in the field has concentrated on mathematics, spatial reasoning, constructive play, executive function, and digital-learning contexts (Bers et al., 2023; Clements & Sarama, 2016; Chu et al., 2024; Relkin et al., 2020).

2.2 Flashcards as Visual Learning Media in Early Childhood Education

Four overlapping contemporary theoretical traditions inform the understanding of how educators support problem-solving in young children. The first is constructivist and inquiry-oriented

pedagogy, which views children as active meaning-makers who build understanding through exploration, experimentation, and reflection on the consequences of their actions. In this view, the educator's task is to arrange environments rich enough in physical, social, and conceptual affordances that children encounter productive uncertainty and are invited to investigate it (Clements & Sarama, 2016; Fusaro & Smith, 2018; MacDonald, Huser, Sikder, & Danaia, 2020).

The second tradition is sociocultural pedagogy, particularly as operationalized in contemporary accounts of scaffolding, sustained interaction, and educator-guided play. Recent literature emphasizes that problem-solving first becomes visible in shared activity before it is internalized as more independent strategy use. Educators therefore support children by diagnosing what they can already do, offering prompts or models, and gradually reducing assistance as competence grows (Acar et al., 2017; Bodrova & Leong, 2018; Muir et al., 2024; Pyle & Danniels, 2017).

The third tradition is playful and progressive pedagogy, which frames problem-solving as inseparable from meaningful experience. Rather than treating problems as decontextualized exercises, this tradition highlights guided play, pretend play, STEM/STEAM exploration, and teacher-supported discovery as contexts in which children learn to test ideas, revise strategies, and communicate reasoning (DeJarnette, 2018; Hollenstein et al., 2022; Skene et al., 2022; Weisberg et al., 2016; Zosh et al., 2017).

The fourth tradition draws on cognitive-developmental and executive-function research, which examines the working memory, inhibitory control, and cognitive flexibility that provide the mental architecture for deliberate problem-solving. This literature reframes the educator's role as one of deliberately strengthening the cognitive conditions that make problem-solving possible, not simply providing opportunities to practice it (Etokabeka, 2025; Madanipour et al., 2025; Muir et al., 2023; Zelazo et al., 2016). Together, these traditions converge on a shared conclusion: problem-solving skill in early childhood is not simply maturational but is shaped by the quality of adult mediation, environmental design, professional knowledge, and social interaction children experience (Egert, Fukkink, & Eckhardt, 2018; Egert, Dederer, & Fukkink, 2020; Granone & Pollarolo, 2025).

3. METHODOLOGY

This article adopts a conceptual, narrative literature review methodology rather than a systematic review following PRISMA-type protocols. This approach was chosen because the aim of the review is to synthesize and integrate insights across disciplinary traditions, namely developmental psychology, sociocultural pedagogy, guided and play-based learning, STEM/STEAM education, executive-function research, and digital early childhood learning, rather than to exhaustively catalogue

and statistically aggregate all available primary studies on a narrowly defined intervention. This form of review is well suited to building conceptual frameworks and generating propositions for future empirical testing, though it is correspondingly more vulnerable to selection bias than a systematic review, a limitation discussed further in Section 4.3.

Relevant literature was identified through iterative searches of Scopus-indexed and other major academic databases, including Web of Science, ERIC, PubMed, ScienceDirect, SpringerLink, Taylor & Francis Online, SAGE Journals, and Google Scholar, using combinations of the search terms "problem-solving," "early childhood," "preschool," "educator" or "teacher," "scaffolding," "guided play," "executive function," "critical thinking," "STEM," "STEAM," "digital play," and "computational thinking." The review was restricted to literature published from 2015 to 2025. Foundational theories were discussed only through contemporary sources that rearticulated, applied, or empirically examined those theories within early childhood contexts during this period. Priority was given to peer-reviewed journal articles, systematic reviews, meta-analyses, and high-quality institutional research reports. Studies were included if they addressed, either as a primary or secondary focus, the role of adult educators, caregivers, or teachers in supporting problem-solving, critical thinking, executive function, guided play, STEM/STEAM learning, or technology-mediated reasoning in children approximately three to six years of age.

4. FINDINGS

The reviewed literature converges on six interrelated, though analytically distinct, roles through which early childhood educators shape children's development of problem-solving skills. These roles are not mutually exclusive; in practice, a single classroom interaction may draw simultaneously on several of them.

4.1 The Educator as Scaffolder and More Knowledgeable Other

The most theoretically developed account of the educator's role centers on scaffolding: the provision of temporary, calibrated support that enables a child to attempt a task or problem that would be difficult to complete independently. Contemporary early childhood studies show that scaffolding includes several concrete moves: assessing what a child can already do, breaking a complex problem into smaller steps, modeling a strategy without taking over the task, using prompts that redirect attention, and fading assistance when the child gains competence (Acar et al., 2017; Bodrova & Leong, 2018; Pyle & Danniels, 2017). Scaffolding is only developmentally productive when it supports agency; assistance that is never withdrawn risks creating dependency rather than fostering self-regulated problem-solving.

Empirical work suggests that educators can be deliberately trained to scaffold self-regulation and problem-solving more effectively. Muir, Howard, and Kervin (2024), for instance, evaluated a purpose-designed professional learning program targeting self-regulation and executive functioning in preschool settings. Children whose educators completed the training achieved better outcomes across self-regulation and executive-function measures than children in comparison classrooms, while educators reported greater confidence and a broader repertoire of strategies. This finding is significant because it indicates that scaffolding is not merely an innate disposition some educators happen to possess, but a teachable professional skill that can be strengthened through sustained professional learning (Egert et al., 2018; Egert et al., 2020).

The Tools of the Mind curriculum, described by Bodrova and Leong (2018), offers a further illustration of contemporary sociocultural scaffolding in practice. By structuring make-believe play so that children plan scenarios, sustain roles, use external mediators such as picture plans, and practice self-regulation, the curriculum is designed to build precisely the executive and self-regulatory foundations that underlie flexible problem-solving. Related evidence also indicates that structured play can support executive-function development when educators intentionally organize play episodes, model strategies, and maintain children's active participation (Etokabeka, 2025; Madanipour et al., 2025; Schmitt et al., 2018).

4.2 The Educator as Facilitator of Guided and Play-Based Learning

A second, closely related role concerns the educator's facilitation of play itself. Play-based learning has long been championed in early childhood pedagogy because it provides a naturally motivating context for problem-solving; however, recent literature distinguishes between free play, guided play, games, playful instruction, and direct instruction rather than treating play as a single category (Pyle & Danniels, 2017; Weisberg et al., 2016; Zosh et al., 2017). The most rigorous evidence currently available on this question comes from a systematic review and meta-analysis by Skene, O'Farrelly, Byrne, Kirby, Stevens, and Ramchandani (2022), who synthesized intervention studies on guided play and found advantages for several early learning outcomes, including early mathematics, shape knowledge, cognitive flexibility, and spatial vocabulary.

These findings carry a clear pedagogical implication: the presence of play alone does not guarantee problem-solving gains. Rather, it is the adult's light-touch but intentional guidance within play, for instance, posing a provocative question, adjusting the difficulty of materials, introducing a challenge, or drawing children's attention to an unnoticed feature of a problem, that appears to make the difference (Pyle & Danniels, 2017; Skene et al., 2022; Weisberg et al., 2016). Play is particularly

powerful when it is meaningful, socially interactive, iterative, joyful, and actively engaging, qualities identified in contemporary syntheses of learning through play (Liu et al., 2017; Zosh et al., 2017).

4.3 The Educator as Intentional Questioner

A third role, closely intertwined with scaffolding and guided play, is the educator's use of questioning to prompt children's thinking. Questioning helps make children's reasoning visible, allowing both child and adult to notice gaps, contradictions, or unexplored possibilities in the child's current thinking (Liu & Yoon, 2025; Salmon & Barrera, 2021). Salmon and Barrera's (2021) analysis of Reggio Emilia-inspired classrooms found that when educators engaged in structured, reflective cycles of examining and refining their questioning practice, the quality of children's articulated reasoning improved, suggesting that intentional questioning is a skill that can be deliberately developed through professional reflection.

A systematic review of critical thinking pedagogy in preschool classrooms by O'Reilly, Devitt, and Hayes (2022) similarly identified classroom dialogue and questioning as central mechanisms through which educators scaffold children's higher-order thinking. Notably, the review complicates the assumption that open-ended questions are always superior to closed questions: in some contexts, a deliberate combination of open and closed questions can support children's verbal reasoning more effectively than a rigid reliance on one question type. Complementary evidence from preschool storytelling in Central China shows that educators use varied question types to prompt children's thinking, but also require structured preparation to calibrate questions to children's responses and developmental levels (Liu & Yoon, 2025).

4.4 The Educator as Designer of the Learning Envioronment

A fourth role positions the educator not only as a direct interlocutor but also as an architect of the physical, social, and material conditions in which problem-solving unfolds. Open-ended materials such as blocks, loose parts, ramps, natural objects, and simple mechanical toys invite children to generate and test hypotheses, while tightly scripted materials tend to elicit imitation rather than independent strategy use. Contemporary STEM/STEAM literature further shows that young children can engage meaningfully with mathematics, science, engineering, technology, and the arts when educators provide developmentally appropriate materials and frame problems as authentic investigations (Clements & Sarama, 2016; DeJarnette, 2018; MacDonald et al., 2020; Rodrigues-Silva & Alsina, 2023).

Contemporary studies extend this environmental role into digital and technological contexts. Granone and Pollarolo (2025), for example, examined how kindergarten teachers mediated children's

use of a screen-free coding toy during collaborative, play-based problem-solving activities. Their study identified specific mediation strategies, including multimodal communication, pacing, humor, and reflective questioning, that enabled children to articulate their thinking and sustain engagement with an unfamiliar technical problem. Broader research on digital play and computational thinking similarly indicates that the technological tool alone is insufficient; its pedagogical value depends on how educators structure, interpret, and extend children's engagement with it (Bers, 2019, 2020; Bers et al., 2023; Chu et al., 2024; Relkin et al., 2020; Sullivan & Bers, 2016).

4.5 The Educator as Supporter of Executive Function and Self-Regulation

A fifth role concerns the educator's contribution to the underlying cognitive capacities, collectively termed executive function, that make deliberate problem-solving possible in the first place. Executive function is generally understood to comprise at least three core, interrelated abilities: working memory, the capacity to hold and manipulate information in mind; inhibitory control, the capacity to suppress an automatic response in favor of a more deliberate one; and cognitive flexibility, the capacity to shift thinking between different rules, perspectives, or strategies (Muir et al., 2023; Zelazo et al., 2016). These capacities develop rapidly during the preschool years and are associated with school readiness, social competence, and later academic learning.

Rather than treating executive function as a fixed trait, recent research demonstrates that it can be strengthened through structured educator practices, including rule-switching games, block play, dramatic play requiring planning and role adherence, guided reflection, and explicit coaching in managing frustration or delaying gratification (Etokabeka, 2025; Madanipour et al., 2025; Schmitt et al., 2018). The SOWATT professional learning program evaluated by Muir et al. (2024) is instructive because it equipped educators with classroom-embedded strategies targeting self-regulation, working memory, attention, and flexible thinking, and produced measurable improvements in children's outcomes relative to comparison classrooms.

4.6 The Educator as Mediator of Technology-Enchanced Problem Solving

A sixth and increasingly relevant role concerns the educator's function in mediating children's problem-solving within technology-rich or computational-learning environments. Coding toys, tablets, robotics kits, unplugged computational thinking tasks, and digital pretend-play settings can support problem-solving only when educators help children notice patterns, test sequences, debug errors, articulate reasoning, and reflect on alternative solutions (Bers, 2019; Bers et al., 2023; Hollenstein et al., 2022; Relkin et al., 2020; Sullivan & Bers, 2016). Granone and Pollarolo's (2025) study of a screen-free coding toy illustrates this point clearly: teachers' verbal and non-verbal

mediation, rather than the technological affordances of the toy alone, determined whether children communicated about and solved the coding challenges presented to them. This has direct implications for programs investing in digital resources: without parallel investment in educators' pedagogical mediation, technology risks becoming a novelty rather than a genuine problem-solving opportunity (Chu et al., 2024; Hirsh-Pasek et al., 2015).

5. DISCUSSION

5.1 Challenges Educators Face in Fostering Problem-Solving

Despite the consistency of contemporary theoretical and empirical support for the educator roles outlined above, the literature also identifies substantial and recurring barriers to their consistent enactment in real classrooms. A first challenge concerns educators' own knowledge, confidence, and behavioral repertoire. The knowledge required to bring about meaningful change in children's self-regulation and problem-solving cannot simply be assumed; without deliberate professional learning, educators may default either to over-directive intervention, which forecloses children's independent problem-solving, or to under-supported free play, which forfeits the benefits that intentional guidance can provide (Muir et al., 2024; Pyle & Danniels, 2017; Skene et al., 2022).

A second challenge relates to curricular pressures toward premature formal instruction, sometimes described as the push-down of primary-school pedagogy into preschool settings. Such pressure can crowd out the unhurried, exploratory, and iterative processes through which problem-solving naturally develops. Contemporary STEM/STEAM and play-based learning literature indicates that the strongest early learning environments do not oppose play and instruction; instead, they deliberately combine child agency, meaningful materials, educator guidance, and intentional curricular goals (Clements & Sarama, 2016; DeJarnette, 2018; MacDonald et al., 2020; Weisberg et al., 2016).

A third challenge concerns questioning practice specifically. While the literature is consistent in recommending intentional and flexible use of both open and closed questions, several studies note that many educators have limited structured preparation in how to vary, sequence, and calibrate questions to children's thinking (Liu & Yoon, 2025; O'Reilly et al., 2022; Salmon & Barrera, 2021). As a result, classroom dialogue may remain dominated by recall questions rather than reasoning-oriented prompts that invite children to predict, compare, justify, and evaluate strategies.

A fourth, more structural challenge concerns classroom ratios, time, and workload. Sustained shared thinking, individualized scaffolding, and close mediation of digital or STEM problem-solving require focused educator attention, often with individuals or small groups. Systematic-review evidence indicates that adult-child ratio and group size are important structural conditions shaping process

quality and child outcomes, even though the strength of evidence varies across contexts and outcomes (Dalgaard, Bondebjerg, Klokker, Viinholt, & Dietrichson, 2022). Large group sizes, high child-to-educator ratios, and competing administrative demands can therefore make high-quality mediation difficult to sustain consistently across a full teaching day.

Finally, much of the empirical evidence reviewed here originates from well-resourced or Global North contexts, including Australia, Europe, the United Kingdom, and the United States, with comparatively less empirical documentation of how educator roles are enacted, adapted, or constrained in lower-resource or culturally distinct settings. Studies from China, South Africa, and international STEM/STEAM reviews are important contributions, but broader replication across diverse cultural and economic contexts remains a priority for future research (Etokabeka, 2025; Liu & Yoon, 2025; Rodrigues-Silva & Alsina, 2023).

5.2 Implications for Practice and Professional Development

Several practical implications follow from the preceding synthesis. First, initial teacher education and in-service professional development should treat scaffolding, guided-play facilitation, intentional questioning, executive-function coaching, STEM/STEAM inquiry, and technology mediation not as abstract theoretical content but as concrete, observable, and trainable classroom practices (Egert et al., 2018; Egert et al., 2020; MacDonald et al., 2020; Muir et al., 2024). Evidence consistently suggests that short, one-off training sessions are unlikely to be sufficient; professional learning associated with measurable improvements typically includes sustained implementation, coaching, feedback, and opportunities for educators to refine practice over time.

Second, reflective practice, whereby educators regularly examine recordings, documentation, or peer feedback on their own questioning and scaffolding, appears to be a powerful mechanism for improving practice. The Reggio Emilia-inspired work described by Salmon and Barrera (2021) illustrates how systematic reflection on dialogue can improve the quality of children's reasoning. Embedding structured opportunities for such reflection through peer observation, video-based coaching, or collaborative documentation of children's thinking is a feasible strategy even in resource-constrained settings.

Third, curriculum and policy frameworks should explicitly protect space for guided, open-ended play rather than treating it as a residual activity to be scheduled around formal academic instruction. The convergent evidence from guided-play, learning-through-play, and play-based pedagogy studies indicates that educator-guided play can preserve children's agency while creating

conditions for systematic concept development and problem-solving (Pyle & Danniels, 2017; Skene et al., 2022; Weisberg et al., 2016; Zosh et al., 2017).

Fourth, as digital tools become increasingly common in early childhood settings, investment in technology should be paired with investment in educators' capacity to mediate its use. Educational apps, coding toys, robotics kits, and computational thinking assessments are useful only when adults select developmentally appropriate tools, connect them to meaningful problems, and invite children to explain, revise, and evaluate their strategies (Bers, 2019; Chu et al., 2024; Granone & Pollarolo, 2025; Hirsh-Pasek et al., 2015; Relkin et al., 2020). Researchers and teacher educators working in underrepresented regions, including Indonesia and the broader Southeast Asian context, have a valuable opportunity to contribute context-specific evidence on how these educator roles can be adapted to local cultural norms, resource constraints, and curricular expectations.

5.3 Limitations of This Review

This review is subject to several limitations that should temper the generalizability of its conclusions. As a conceptual and narrative rather than a systematic review, the selection of literature, while conducted iteratively across multiple databases, was not governed by exhaustive, pre-registered search and screening protocols associated with PRISMA-style systematic reviews. The review was deliberately restricted to 2015-2025 literature; therefore, it does not cite earlier foundational works directly, even though several contemporary sources draw on and reinterpret earlier theoretical traditions. In addition, the empirical base underpinning several of the six educator roles is concentrated in relatively well-resourced contexts, limiting confidence in the direct transferability of specific findings to other cultural and economic settings. Future systematic reviews and original empirical studies conducted in underrepresented regions would substantially strengthen the evidence base this article has sought to synthesize.

6. CONCLUSION

This review has argued that early childhood educators play an indispensable, multifaceted role in fostering children's problem-solving skills, one that extends well beyond simply providing opportunities for play or exposure to interesting materials. Across contemporary literature published between 2015 and 2025, from sociocultural scaffolding and guided-play meta-analyses to questioning research, environmental design, executive-function coaching, STEM/STEAM inquiry, and technology mediation, a consistent pattern emerges: it is the quality and intentionality of adult mediation, not the mere presence of play, materials, or technology, that determines whether young children's everyday encounters with difficulty become genuine problem-solving learning experiences. At the same time, educators cannot be expected to enact these demanding roles effectively without

sustained professional support; the evidence reviewed here indicates that scaffolding, questioning, executive-function coaching, and digital mediation are learnable, improvable professional skills. As early childhood systems continue to expand and expectations for children's cognitive readiness increase, ensuring that educators are equipped, supported, and given the classroom conditions necessary to mediate problem-solving thoughtfully should be considered a central priority for early childhood policy, teacher education, and future research.

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