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From Playful Inquiry to Problem Solving: Developing Preschool Children's Thinking Ability Through Project-based Learning

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Abstract

Project-based learning (PBL) provides a promising pedagogical path to foster early-age thinking competencies in preschool education. In many early-childhood classrooms, learning activities still tend to be teacher-directed, product-oriented and imitation-based, where children are often expected to reproduce pre-set models rather than actively explore, question and adjust their own ideas. This pattern may leave limited room for children to experience genuine problem-solving, which is particularly important during the period when thinking develops mainly through action, play and social interaction. Its core educational value does not lie in requiring young children to conduct formal, adult-like academic research, but in creating repeated, situated opportunities for children to reason through concrete, life-oriented practical problems. Preschool children's thinking ability is largely embodied in observable actions: perceiving practical difficulties, raising exploratory questions, comparing material properties, trying tentative solution plans, revisiting strategies after failure, negotiating ideas with peers, and verbally or non-verbally explaining observed changes. Drawing on existing empirical studies concerning early-childhood project-based learning, inquiry-oriented project practice, project-approach science education, guided play and responsive teacher scaffolding, this paper explores how PBL can facilitate preschool children's problem-solving capacity and critical-thinking development when organized as a complete playful-inquiry cycle. It also responds to a practical gap: while many educators recognize the concept of project-based learning, they still lack clear, age-appropriate guidance on how to translate it into daily preschool practice without turning it into complicated formal tasks or decorative craft work. This study argues that high-quality preschool project practice should originate from real-life and familiar puzzling situations for children, supply abundant open-ended manipulable materials, protect sufficient unrushed exploration time, encourage iterative testing and idea revision, support peer dialogue and collaborative reasoning, and implement responsive teacher scaffolding without usurping children's independent thinking space. Emotional safety, accessible material conditions and gentle adult support are equally necessary, because children are more willing to take thinking risks when mistakes are treated as learning evidence rather than failure. Furthermore, this paper constructs practical process-based observation indicators for front-line preschool teachers, which can help educators capture children's thinking trajectories rather than merely evaluating final project artifacts. It also reflects on common implementation risks, such as over-emphasis on decorative craft outputs, excessive teacher intervention, fixed answer expectations, and neglect of children's exploratory failure as valuable learning evidence. The paper concludes that well-designed project-based learning can effectively nurture early thinking dispositions when children are granted sufficient opportunities to act, test alternatives, engage in peer conversation, and carry out age-appropriate reflection. The findings may offer actionable theoretical reference and practical guidance for preschool teachers, curriculum designers and early-education researchers to start with small-scale, child-centered playful inquiry-driven project activities and gradually build more supportive classroom environments.

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Keywords

Problem solving; Critical thinking; Playful inquiry; Project-based learning; Preschool education; Teacher scaffolding.

1. Introduction

Preschool children meet problems every day. A tower falls before it becomes tall. Water does not flow where they expected. A paper roof cannot stay on a cardboard house. Two children want the same material. A seedling bends because the soil is too loose. These problems are small from an adult point of view, but they are real thinking situations for young children. In such moments, children begin to ask what happened, what could be changed, what else might work, and how others can help.

Project-based learning gives these ordinary problems an educational structure. In a preschool classroom, a project does not need to be long or technically complex. It may be a class garden, a water pathway, an animal home, a bridge, a weather corner, a market, or a recycling station. What matters is that children encounter a meaningful question, explore materials, make decisions, test possible solutions, revise their ideas, and share what they have learned.[1]

This paper focuses on problem solving and thinking ability rather than on creativity alone. Creativity is important, but the second question under the preschool PBL theme is how children learn to reason through action. Recent early-childhood studies have used indicators such as identifying problems, making plans, carrying out solutions, revisiting results, asking questions, and solving problems with less dependence on the teacher. These indicators fit preschool development because they do not require children to think like older students. They ask whether children can notice, try, compare, discuss, and explain.

The argument of this paper is that project-based learning can develop preschool children's thinking ability when projects are organized as playful inquiry cycles. The word "playful" is important. Preschool children should not be pushed into formal academic tasks. They need concrete experiences, safe materials, peer interaction, teacher encouragement, and enough time to test ideas. The word "inquiry" is equally important. A project should not become a decorative craft with a fixed answer. It should invite children to wonder, test, revise, and make meaning.

2. Thinking Ability in Preschool: Small Problems, Real Reasoning

Thinking ability in preschool is often expressed through movement, speech, gesture, drawing, building, and play. A child may not say, "I am comparing the stability of two structures." The child may simply put a heavier block at the bottom and say, "This one will not fall." A child may not formally explain cause and effect. The child may pour water again and notice that it moves faster when the path is lower. These are not small events in learning. They are early forms of reasoning.[2]

For this reason, preschool thinking ability should be defined in observable and developmentally appropriate terms. It includes noticing a difficulty, describing what is wrong, suggesting possible solutions, choosing a plan, trying it, watching what happens, changing the plan, and explaining the result. This view is close to the indicators used in recent preschool problem-solving studies. Some studies observe whether children can identify problems, find alternative solutions, and solve problems more independently. Others look at whether children understand a problem, make a plan, execute the plan, and revisit the result.

These indicators are useful because they protect preschool education from two opposite mistakes. The first mistake is to underestimate young children and assume that they are only playing without thinking. The second mistake is to overestimate them and demand abstract

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reasoning too early. A project-based approach avoids both mistakes when it treats play as a serious medium for thinking. The child is still playing with blocks, water, leaves, boxes, or clay, but the play contains a problem to be solved.[3]

For example, when children build a bridge for toy animals, the thinking process may include many steps. They notice that the animal cannot cross the gap. They choose materials. They compare long and short pieces. They test whether the bridge can hold weight. They see it fall. They add support. They ask a peer for another block. They explain that the bridge needs "legs." In adult language, this is a cycle of problem identification, hypothesis, testing, revision, and explanation. In preschool language, it is simply meaningful play with a purpose.

3. The Project Inquiry Cycle: From Question to Testable Idea

A strong preschool project begins with a question that children can understand and act on. The question should be close to their experience: How can we help our class plants stand? How can we make a road for the cars? What kind of home does a rabbit need? How can water move from here to there? How can we make a shop where everyone knows what to buy? A good question is open enough for different answers, but concrete enough for children to begin.[4]

Once a question is shared, children need time to explore. Exploration is not a waiting stage before the "real" lesson. It is the place where thinking begins. Children touch materials, compare size and texture, imitate peers, ask questions, and discover limits. A cardboard tube may roll away. A paper wall may bend. Stones may hold a plant label in place. Through this exploration, children begin to see what the problem requires.

The next step is idea generation. Preschool children may offer ideas that seem incomplete, unrealistic, or repetitive. The teacher's task is not to correct every idea immediately. It is often better to help children make the idea testable. If a child says, "Use more tape," the teacher can ask, "Where should we put the tape?" If another child says, "Make it bigger," the teacher can ask, "Which part needs to be bigger?" Such questions help children move from a vague wish to a concrete plan.[5]

Testing is the heart of the inquiry cycle. A project becomes intellectually rich when children can see whether their plan works. The bridge either holds the toy or falls. The water either reaches the bucket or spills. The sign either stands or bends. This does not mean the teacher should turn the classroom into a laboratory. It means the project should include visible consequences. Children learn from the result because the material world responds to their choices.

Revision then becomes natural. Instead of treating failure as embarrassment, the project treats failure as information. "It fell" can become "What made it fall?" "It is too short" can become "What could make it longer?" "The water is leaking" can become "Where is the hole?" Inquiry project-based learning studies suggest that young children can become more active in asking questions, discussing, and showing enthusiasm when they are placed in exploratory learning situations. The practical message is clear: children think more when they are allowed to try again.

The final step is sharing and reflection. Preschool reflection does not need to be a formal written report. Children can explain by speaking, pointing, drawing, showing before-and-after pictures, or demonstrating the project to another group. The teacher can ask, "What problem did you solve?", "What did you try first?", "What changed?", or "What would you do next time?" These questions help children connect action with thought.[7]

4. Materials, Science Projects, and Problem-Solving Opportunities

Materials matter because young children think with their hands as well as with words. Open-ended materials make problems visible. Blocks invite balance and stability. Tubes invite

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direction and flow. Cloth invites covering and wrapping. Sticks invite length, support, and connection. Leaves, soil, and seeds invite observation of change. Recycled boxes invite transformation. When materials can be used in more than one way, children must decide what each material can become and what it can do.

Science-related projects are especially helpful for problem-solving development because they bring children into contact with observable change. A project on plant growth can involve light, water, soil, and support. A water-path project can involve slope, speed, leakage, and direction. A shadow project can involve light position and shape. A weather project can involve collecting, comparing, and recording observations. These topics allow children to predict, test, and revise in concrete ways.[8]

Evidence from project approach-based science education is useful here. In one quasi-experimental study, preschool children participated in a project approach-based science education program over several weeks, and the program was reported to have a positive effect on children's problem-solving skills. The importance of this evidence is not only that the scores improved. It also shows why science projects fit preschool thinking: they give children problems that can be observed, manipulated, and revisited.

However, materials should not be treated as magic. A basket of blocks or recycled objects does not automatically create thinking. The teacher must connect materials with a question, a purpose, and a chance to test. If every child is told to make the same object in the same way, the materials may become only decoration. If children can choose, compare, combine, and revise, the same materials can become tools for thinking.

The learning environment should therefore be organized for access and return. Children need to see what is available, choose safely, use materials without constant adult permission, and put them back after testing. This organization supports both problem solving and responsibility. It also helps teachers observe children's thinking because the process becomes visible: what the child chose, what the child changed, what the child repeated, and what the child explained.[9]

5. Teacher Scaffolding Without Taking Over

The teacher's role in preschool PBL is delicate. If the teacher gives every answer, children may produce a neat project but have little chance to think. If the teacher gives no support, the project may become chaotic or frustrating. The goal is not teacher absence. The goal is scaffolding that helps children continue thinking.

Good scaffolding begins with observation. Before asking a question, the teacher watches what children are trying to do. Is the child stuck because the material is too hard to use? Is the group arguing about roles? Is the plan unclear? Is the child repeating the same failed action without noticing why it fails? Different situations require different support. Sometimes the teacher names the problem: "The roof is sliding." Sometimes the teacher offers a choice: "Would you like to test tape or string?" Sometimes the teacher invites peer help: "Who has another idea?"[10]

Open-ended questions are the most useful tools. "What do you notice?" helps children attend to evidence. "What else could work?" helps them generate alternatives. "How can we test it?" moves them from talk to action. "What changed?" supports comparison. "How did you know?" invites explanation. These questions do not turn preschool children into formal researchers, but they do make the thinking process more conscious.

Teacher scaffolding also includes slowing down. In many classrooms, adults want to fix problems quickly so the activity can continue. But if the adult immediately tapes the roof, rebuilds the tower, or settles every disagreement, the child loses a thinking opportunity. A small pause can be educational. The teacher can give children time to look again, ask a peer, or try one more solution. The pace of project work should leave room for thought.[11]

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Peer interaction is another form of scaffolding. Children often learn from seeing how another child solves a similar problem. One child may discover that a wide base makes a tower stronger. Another may borrow the idea and adapt it. Group project work can create social reasoning: children explain why their plan matters, negotiate materials, divide roles, and revise a shared design. This is why problem solving in preschool PBL is not only individual cognition. It is also social participation.

Assessment and reflection complete the scaffolding process. Teachers can take photos of stages, record children's words, collect drawings, and revisit the project with the class. These records help children see that thinking develops over time. They also help teachers avoid judging only the final product. A project that looks simple may contain rich problem solving if the child tried alternatives and explained a choice.[12]

6. Observing Problem Solving in Project Work

Because preschool thinking is often visible in process, teachers need practical observation indicators. The purpose is not to turn every project into a test. The purpose is to help teachers notice ability development while children are working. Process-based observation is especially important because a polished final object may hide adult control, while a rough object may show strong child thinking.

The following framework can guide teachers' observation during preschool project work.

Table 1. Observable Problem-Solving Behaviors in Preschool Project-Based Learning

Project stage	Child thinking behavior	Teacher prompt	Evidence to observe
Problem noticing	Points out a difficulty, need, or question	What do you notice?	Child names, gestures toward, or demonstrates the problem
Idea generation	Suggests one or more possible ways forward	What else could work?	Child offers alternatives, uses peer ideas, or changes materials
Planning	Chooses materials, roles, or steps	What do we need first?	Child selects resources and explains a simple order
Testing	Tries a material, arrangement, or action	How can we test it?	Child compares what happened before and after
Revision	Changes the plan after seeing the result	What changed?	Child modifies a structure, path, role, or method
Explanation	Tells or shows why something worked or failed	How did you know?	Child uses words, drawing, gesture, or demonstration

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This framework reflects the logic of recent preschool PBL studies without importing adult assessment language into the classroom. It allows teachers to ask: Did the child recognize a problem? Did the child try more than one way? Did the child become less dependent on adult rescue? Did the child use evidence from the material? Did the child explain the result in any meaningful form?[13]

The indicators also help teachers plan balanced projects. If children only make products, the project may need more testing. If children only explore materials, it may need a clearer question. If children ask many questions but never revise, the teacher may need to build in a second attempt. If one child dominates the group, roles may need to be adjusted. Observation therefore connects assessment with teaching decisions.[14]

At the same time, teachers should be careful not to over-measure young children. Preschool project assessment should remain humane, flexible, and descriptive. A child who quietly watches peers may still be thinking. A child who cannot explain in full sentences may explain through action. A child who becomes frustrated may need emotional support before cognitive scaffolding. The teacher's notes should help children grow, not label them too early.[15]

7. Conclusion

Project-based learning can develop preschool children's thinking ability because it gives them repeated chances to meet real-world problems embedded within playful, concrete, age-appropriate contexts. When children engage in hands-on building, material testing, comparative exploration, peer discussion, iterative revision and meaning-making explanation, they continuously practice the foundational forms of problem-solving and critical-thinking skills that lay important groundwork for their later cognitive development. The core educational value of project-based learning is not to turn preschool children into miniature researchers who complete formal academic investigations like older students. Instead, it respects the unique cognitive characteristics of early childhood: young children construct understanding primarily through physical action, open-ended materials, social relationships and verbal or non-verbal reflection, rather than abstract logical reasoning and written reports.

The empirical evidence reviewed in this paper suggests that thoughtfully implemented project-based learning, inquiry-oriented project activities, and project-approach science education can create rich learning opportunities to promote preschoolers' problem-solving and critical-thinking capacities. Nevertheless, these research findings should be interpreted with caution. Many existing empirical studies on early-childhood PBL adopt relatively small sample sizes, one-group pre-post experimental designs, or include participants across broad early-age ranges, which limits the generalizability of their conclusions. Some classroom practices also risk distorting the essence of project-based inquiry: projects may be reduced to decorative handicraft activities with predetermined final products; teachers may intervene excessively and replace children's independent thinking for neat learning outcomes; or playful exploration may be overlooked in pursuit of visible knowledge gains. All these deviations prevent PBL from exerting its full potential for fostering children's thinking dispositions.

For front-line preschool educational practice, this study delivers several practical implications. Powerful project-based learning does not depend on large-scale, resource-consuming themes. Small-scale, everyday projects such as building a miniature bridge, designing a water transportation path, making supportive structures for class plants, or constructing shelters for small animals can trigger high-level thinking, so long as children are provided with genuine puzzling questions, sufficient freedom of choice, observable material consequences of their actions, and safe opportunities to articulate and demonstrate their ideas. Playful inquiry and problem-solving are not two separate educational components; playful inquiry constitutes the

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very pathway through which preschool children learn to identify, analyse and attempt to change practical problems.

Teacher practice stands as the decisive factor for high-quality playful-inquiry-driven projects. Educators should prioritize process-oriented observation over judging only finished artifacts. The observation framework proposed in this paper enables teachers to track children's thinking trajectories during project work, identify developmental needs in problem-solving, and adjust scaffolding strategies accordingly. Effective scaffolding requires careful observation, open-ended questioning, appropriate waiting time and peer-interaction support, while avoiding taking over children's reasoning processes. Failure and repeated attempts ought to be regarded as valuable learning resources instead of undesirable outcomes. In addition, teachers need to recognise diverse expressions of children's thinking: some children demonstrate reasoning through verbal narration, while quiet children may show their understanding via gestures, drawing and hands-on operation. Emotional support should be offered when children encounter frustration in exploration.

This study also has certain limitations. It mainly synthesises existing international empirical literature and constructs an observational framework from theoretical analysis, without carrying out original empirical data collection in local preschool classrooms. Future research can conduct field investigations and intervention experiments in real preschool settings, further revise and validate the process-based observation indicators. Subsequent studies can also explore how factors including class size, material conditions and teachers' professional training influence the implementation quality of playful-inquiry project-based learning. Long-term follow-up research is also worthy of attention, to examine whether problem-solving abilities cultivated through early-years PBL can produce sustained influences on children's later learning and development. Overall, when guided by child-centred educational ideas, project-based learning can serve as a valuable pedagogical tool to nurture preschool children's independent thinking and problem-solving competence.

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