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STEAM Based Activities Through Problem Solving in Early Childhood

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Abstract

This research is motivated by the fact that children have not been able to pour their imagination and critical thinking skills into concrete objects. Problem solving is an abstract thinking activity that requires the application of strategies to enable children to participate actively. The purpose of this study is to enhance children's problem-solving abilities using the STEAM method. The research method used PTK (Classroom action research) with a qualitative approach, and 2 cycles were carried out. Data collection techniques use observation and documentation. The research procedure involves planning, implementing, observing, and reflecting. The data analysis is carried out using percentages on a Likert scale, adjusted to the indicators studied. The results of the study indicate that the success of this study can be seen in cycle 1: 58% have not developed, 78% are starting to develop, and 16% are developing as expected. Improvements are seen in cycle II, namely developing as expected by up to 39% and developing very well by up to 73%, who previously had not been able to develop further. This can occur through children's activities using a digital storybook entitled "Gara-Gara Piko", which describes activities that help children imagine ways to solve the problems it contains. Then the child realizes it by drawing on a piece of paper, inspired by the storybook they have heard previously.

Keywords: *STEAM, Problem Solving, Early Childhood.*

INTRODUCTION

The problem addressed in this study is that children are not yet able to think critically to solve problems. This is because daily learning activities do not yet address the cognitive domain of problem-solving. Based on observations, teachers do not yet understand the meaning of problem-solving in cognitive skills, so their activities do not align with the syntax or learning steps. Problem-solving activities for early childhood require learning methods that facilitate teachers in carrying out activities both inside and outside the Classroom, with the caveat that the learning must align with the steps of the chosen learning method. This prompted researchers to conduct direct research with children on problem-solving using the STEAM method.

The problems faced by young children are certainly different from those faced by adults. For instance, children often encounter difficulties when playing with toys or when observing objects and events that spark their curiosity. However, if adults rush to help children with these problems, it will limit their problem-solving abilities, hindering their ability to grow independently as adults (Putri & Taqiudin, 2022). Recognizing the importance of fostering independence, STEAM specifically offers various benefits in the learning process for young children (Rahayu et al., 2023). Furthermore, not only does STEAM benefit children, but it also makes it easier for teachers to direct the learning process.

STEAM is unique in its implementation, offering teachers significant flexibility in delivering activities related to how young children solve problems. The problem-solving approach involves addressing a story's challenges through the child's own thinking. The teacher, as facilitator, guides the children through activities that can be adapted to existing school media or readily available resources. This study utilized the storybook "Gara-gara Piko" (Because of Piko) in its implementation.

Activities using the STEAM method can be tailored to the child's age. STEAM is not just about showing letter cards or teaching babies and toddlers to count. It is about the practical things children do every day. Some examples of STEAM learning include examining shapes, building cardboard forts, playing "buy and sell," pouring liquids and other materials, filling and emptying containers of various sizes, and mixing paint colors to create new hues. Many everyday activities involve STEAM skills (Hasbi et al., 2021; Komang et al., 2024).

The activities conducted in this study included building a cat house from cardboard in cycle I and mixing several paint colors to create new colors in cycle II. These activities were closely related to the problem-solving skills children engaged in after listening to the story "Because of Piko."

In fact, the children at the school where the study was conducted appeared quite enthusiastic, and their critical thinking skills increased. Their curiosity about a problem and how they could try to solve it was evident in the STEAM method activities. This also affected the children's enthusiasm for the activities, as they are rarely conducted in schools. They have been conducted, but the steps for the activities differed from those outlined in the STEAM activities guidebook. Consequently, the children lacked a clear understanding of the meaning of the activities they were involved in. Therefore, the steps in the learning method must be adjusted to ensure that children more easily grasp the meaning of the activities carried out by teachers and students. STEAM offers numerous benefits in problem-solving, including opportunities for children to foster their natural curiosity, a feeling often "buried" by overly

structured and instructive approaches. STEAM can also be implemented through activities designed to address children's interests (Hasbi et al., 2021).

STEAM itself is a learning method related to literacy skills. The advancement of technology demands that humans master it. Internet use allows information to enter our lives more quickly. This means that information flows more rapidly every day. Therefore, humans need the ability to manage this information. This information will impact socio-cultural life, as the information available is limitless. Literacy is not limited to reading and writing, but also encompasses speaking, reading, and writing, as well as arithmetic, problem-solving, and understanding one's own potential and abilities. Developing literacies include basic literacy, digital literacy, media literacy, library literacy, and visual literacy (Suryawati & Akkas, 2021).

Texley & Ruud (2018) state in their book that STEM activities can be developed through several stages, including explain, elaborate, evaluate, and integrate. The activities conducted are similar to those in this study, with the content used being books.

Problem-solving skills in early childhood can influence creativity and enhance critical thinking. Among the indicators of critical thinking are children's ability to actively question teachers. This indicator demonstrates children's ability to solve problems effectively. Effective problem-solving can be achieved by planning activities and adapting to the child's learning style, as problem-solving requires high levels of concentration, thus avoiding harm to themselves or others (Alucyana & Raihana, 2023; Handayani et al., 2023).

Problem-solving is closely related to children's cognitive development. Cognitive development is related to learning, thinking, and problem-solving. Among the activities that children aged 4-5 can engage in during their cognitive development are naming several colors of objects, describing what happens next in a story, and drawing one or more body parts. In addition to cognitive development, STEAM-based problem-solving activities also require physical development. Among these abilities, children are now able to serve food, pour water for themselves under adult supervision, open buttons, and hold a crayon or pencil between their fingers and thumb (CDC Milestone, 2019).

According to Hidayati & Widadiyah (2024), STEAM activities can also impact cognitive abilities, including problem-solving, critical thinking, reasoning, and decision-making, through batik activities. Furthermore, according to Li & Abdul Talib (2024), STEAM can influence the potential for pedagogical transformation and gender in early childhood. STEAM methods can provide policy guidance and encourage collaboration to foster more innovative education. This aligns with Sudarti et al.'s (2024) view that STEAM-based learning can foster creativity in children aged 5-6 years. This means that STEAM learning for early childhood extends beyond cognitive abilities. In this study, creativity in STEAM activities also emerged in painting activities inspired by children's imagination after hearing stories.

The implementation of the STEAM method provides young children with time to think more broadly in problem-solving during learning activities, enabling meaningful learning experiences through their surroundings. The STEAM method is highly beneficial for young children because it can stimulate natural imagination through direct observation, expanding children's knowledge and creativity. The goal of implementing STEAM-based methods is to foster engaging, enjoyable learning by developing children's reasoning skills and independence throughout the learning process. In this case, educators act as facilitators to develop and implement STEAM methods, explore children's curiosity, and foster habits that train their independence (Septiani & Kasih, 2021).

This problem-solving is the foundation for children's mathematical calculation skills. Furthermore, this study included audio recordings from the teacher's story "Gara-Gara Piko." This relates to research showing that interactive audio learning can help capture children's attention and concentration (Firdausih et al., 2025). This aligns with research on the development of STEAM-based picture story e-books. STEAM itself can also attract children's interest in learning (Mastuinda & Yaswinda, 2023). Therefore, problem based research can be used and aligns with the STEAM method.

Integration into the STEAM method can serve as a thinking process and a habit within a child's environment. STEAM can also develop science and technology-based ideas in problem-solving activities. In addition to supporting early childhood problem-solving, this method helps teachers understand and follow the STEAM method in the independent curriculum (Motimona & Maryatun, 2023). STEAM can also stimulate curiosity and motivate children through higher-order thinking skills, including problem-solving, collaboration, independent learning, project-based learning, and challenge-based learning. In general, introducing STEAM to early childhood is done by creating a safe and enjoyable learning environment. STEAM provides children with opportunities to explore, discover, build, and experiment, as well as seek answers by connecting them to real life. STEAM activities are best carried out with children through an exploratory process, allowing them to try new things (Novitasari, 2022).

Furthermore, STEAM can develop children's critical thinking. In terms of the implications for basic skills in STEAM learning, educators, researchers, and policymakers can conduct this development both indoors and outdoors (Rahayu et al., 2023). This aligns with research by researchers, who found that STEAM involves problem-solving, in which children explore books read to them through their imagination.

STEAM supports children in planning, formulating, and representing problems related to the topic at hand. Problem-solving activities through STEAM are closely related to mathematics, where mathematics allows them to connect mathematical variables, ask questions about themselves in mathematical situations, and reason mathematically (Putra et al., 2023).

According to Vygotsky, preschool children, aged 3-7, experience is influenced by language and awareness, which provide appropriate stimulation for that stage. From late infancy through preschool, children need games such as building blocks, role-play, and doll play. These activities can support problem-solving activities in early childhood. This is related to language development in children. Essentially, children aged 3-4 years will begin to learn to solve problems, doing so according to the social situations they experience in the preschool stage (Langford, 2005).

In preschool aged children (3-6), the critical stage is social development, including problem-solving skills. Essentially, problem-solving skills are synonymous with learning to improve children's life skills. This is what educators should focus on during play activities, where stimulation is provided by focusing on age-appropriate developmental stages (Kolopaking et al., 2019). Improving children's life skills can also be achieved by introducing them to shapes, sizes, colors, and smells. Furthermore, it can also help coordinate body movements, particularly finger movements, a process known as sensory-motor development. This can positively impact children's growth, improving both fine and gross motor skills, as it supports the development of early childhood independence (Alisyia et al., 2025).

Children enter the preoperational stage of cognitive development, aged 2-7. At this stage, children begin to learn to solve simple problems. One way to practice problem-solving and improve early childhood cognition is through magnetic maze games (Ramawati & Komalasari, 2023).

This study differs from previous studies, where researchers observed teachers conducting teaching activities, including telling stories from storybooks. Children then identified problems within the stories they read. With encouragement and support from the storybooks, along with appropriate tools and materials, children were able to understand the stories and solve the problems presented through experiments with simple materials available at school.

METHODS

This study employed a Classroom action research method. The approach employed was qualitative, with 11 children as subjects. The study took place at the At-Ta'Awun Kindergarten (KB At-Ta'Awun) in Cirebon City.

The research was conducted through observations using the research procedures outlined by Kemmis and McTaggart, with the research design a preliminary study to assess the children's ability to express their critical thinking skills in concrete form. After conducting the preliminary study, the researcher analysed the observation results and found a relatively effective way to carry it out, namely by using the STEAM method with problem-solving through the storybook titled "Gara-gara Piko." The researcher planned how to conduct the observations. Starting with implementing the STEAM method to solve problems through the storybook, then reflecting to make field notes, recording, and documenting all findings that emerged during the action process (Hanim et al., 2023).

The Kemmis and McTaggart PTK model used in this study has four components in one cycle with the integration of action and observation, namely (1) planning, (2) action and observation, and (3) reflection. After one cycle is completed, the next cycle continues by revising or redesigning the implementation from the previous cycle (Purnama et al., 2020).

We conducted the data analysis by creating an assessment instrument comprising rubrics and performance assessments aligned with the indicators being studied. There are 8 research indicators: understanding problems, generating ideas, predicting solutions, making decisions, planning problem-solving solutions, implementing solutions, rechecking problem-solving, and concluding. The data collection technique for the intended performance is the assessment process, which involves observing the child's behaviour or performance. Then, the analysis is conducted using a formula that adds the results of the studied indicators to the average, namely the obtained score divided by the maximum score multiplied by 100, yielding the final score (Purnama et al., 2020).

RESULTS AND DISCUSSION

Consistent stimulation enables children to fulfill their developmental tasks and reach a very good stage. Of the 11 children, three were unable to participate due to speech delays and lack of motivation. Prior to the STEAM activities, teachers provided role-playing, image or shape analysis, and retelling activities. They had presented simple problems, such as puzzles, putting on socks, using scissors, and putting on shoes. They had also provided open-ended

questions to stimulate children's ideas. Science experiments had already been conducted before the STEAM approach was implemented.

The children were free to draw based on their initial inspiration, were encouraged to analyze, and listened to stories written on paper. These included objects that children could touch, hold, and manipulate. Besides paper, the children used wooden blocks, Legos, plasticine, beads, and other materials to stimulate STEAM. According to the indicators contained in Suryawati & Akkas (2021), there are indicators for solving problems observed through STEAM, including: (1) understanding problems, (2) generating ideas, (3) predicting solutions, (4) making decisions, (5) planning problem-solving solutions, (6) implementing solutions, (7) re-examining problem solving, (8) concluding.

Indicators achieved include understanding the problem, children can identify the problems faced, children can identify the characters' bad behavior, children can retell the problems that occur, and children can explain the factors that cause the problems in the story. It is expected that children can put forward ideas about solutions that can be implemented to solve the problem. When predicting solutions, children can anticipate the consequences or obstacles of solutions to solve problems. Children can make decisions by choosing the best solution and can provide reasons for their choice. When planning problem-solving solutions, children can look for the tools and materials needed, then make designs for the solutions they find. Implementing solutions, children can implement solutions according to their plans or ideas (how to implement them). Re-examining problem-solving, children can reflect on the solutions applied to the problem and identify evidence and the most effective ways to solve it.

In conclusion, children can determine the problems and solutions based on the problems presented to them in class. These achievement indicators are used to assess children and determine the level of success in STEAM problem-solving. This assessment will help researchers interpret the observation process of events that occur during children's play activities.

The research process involved reading the book "Gara-gara Piko." The book tells the story of Piko, a village painter who has an idea for mixing various colors in a picture. Piko's drawing is very beautiful, but he spills his paint. Confused, Piko finds inspiration in the spilled paint and creates a very impressive, colorful painting. Initially, Piko paints only a carnival train, then paints his entire house and his neighbor's house, known as Bu Gajah, red, and paints the roof tiles yellow. Piko looks for other objects to color until the entire village is painted. Initially, when residents see him, they are very angry and annoyed at Piko for painting all the houses in the village. However, from a hilltop or a higher vantage point, the village where Piko lives is very beautiful. It looks colorful and different because of Piko. The villagers are very happy, and their faces also become colored with joy (Rahmat & Haikal, 2023).

This study shows that children aged 4-5 years gradually become able to solve problems using learning media, including picture storybooks read by teachers. When the teacher asks questions or prompts like "What can you do so Piko can paint?", "What will you make based on Piko's story?" or "How will you do what Piko tells?" These prompts positively impact cognitive development. Children will be able to imagine based on what they have learned from their environment or personal experiences. This ability can develop if the teacher provides the right prompts, in the form of questions or activities, that make this imagination more meaningful.

The prompts provided to the children will undoubtedly elicit a variety of responses. After the researcher obtains answers from the children's thoughts or imaginations, the children and teacher proceed to the next activity, which includes preparing materials such as cardboard/blank paper for drawing animal houses, colored paint, crayons, or colored pencils, and pencils for drawing based on Piko's story. After listening to Piko's story, the children are asked to first create animal houses out of paper or cardboard based on their imagination. Afterward, the children are asked to mix the colors from the previously prepared materials in a container and then color as they imagine. Then the child's imagination, previously built, is expressed through the activity's stages.

In cycle I, children were able to understand problems, generate ideas, and make decisions, but not yet at their full capacity. They were still processing information. The results showed that no children had reached the BSB (very good development) assessment stage. However, improvements were seen in BB (not yet developed), MB (starting to develop), and BSH (developing as expected). This cycle of activities requires critical thinking. According to Alucyana & Raihana (2023), problem-solving activities in early childhood can foster creativity and enhance critical thinking. The following are the results of the observation process that occurred in cycle I:

Table 1. Results of Cycle I

No	**Assessment Indicators**	**Improvement Results**			
		BB	MB	BSH	BSB
1	Understand the problem	3	6	4	
2	Coming up with ideas	3	6	4	
3	Predicting solutions	3	9	1	
4	Make decision	3	8	2	
5	Planning problem solving solutions	8	5		
6	Implement the solution	7	8		
7	Check the problem resolution again	6	7		
8	Conclude	6	7		
	Amount	58	78	17	0

The following are the results of the improvements that occurred in cycle II:

Table 2. Results of Cycle II

No	**Assessment Indicators**	**Improvement Results**			
		BB	MB	BSH	BSB
1	Understand the problem	2	1	1	9
2	Coming up with ideas	2		3	8
3	Predicting solutions	3		3	7
4	Make decision	2	1	5	5
5	Planning problem solving solutions	2	1	7	3
6	Implement the solution	3		7	3
7	Check the problem resolution again	3		5	5
8	Conclude	2	1	2	8
	Amount	25	16	39	73

The total scores from BB, MB, BSH, and BSB in cycles 1 and 2 show that, among all the children, 11 were studied using the STEAM method for problem-solving. The teacher observed the total scores according to the activity indicators based on the activities carried out by the children in cycles 1 and 2. These scores were obtained through daily performance

assessment in cycles 1 and 2. Performance assessment is a data-collection technique that observes ongoing activities to assess children's behavior or performance. This technique is well-suited to skills areas that require direct practice in the field (Purnama et al., 2020). In cycle 1, the activities were conducted over 5 days, and in cycle 2, over 5 days as well. From those five days, the researcher obtained the assessment results on the last day of cycle 1 and the last day of cycle 2. After obtaining the total increase in results, the researcher calculated it using the final score calculation formula.

The results obtained for each indicator in the second cycle illustrate an increase in the use of the STEAM method for problem-solving. The increase occurred because the teacher provided activities that followed the STEAM method steps for the children. However, the increase was not 100 per cent because the school where the research was conducted did not consistently use the STEAM method to enhance children's problem-solving. If done consistently, children would certainly be able to do it more easily, so they become accustomed to engaging in problem-solving activities, including those found in books. The teacher's role from cycle 1 to cycle 2 was to assist the children with activities. In the activities of cycle 2, the activities continued to use the story concept from the book titled 'Gara-gara PIKO.' Still, for the activity of illustrating the story concept in painting form, it became more directed. Previously, children scribbled to find colours and freely doodled.

In the second cycle, the activities were further enhanced from the first to the fifth day, and the children were asked to draw according to the theme. On the first day, they drew and painted according to the theme with one house; on the second day, two houses with a road; on the second day, two houses and a winding road; on the third day, three houses and a straight road; on the fourth day, four houses and a winding road; on the fifth day, five houses and a zig-zag road. These five activities were carried out by developing the eight STEAM achievement indicators.

The activity is carried out by asking children to perform activities according to STEAM indicators, including understanding problems found in storybooks, generating ideas from storybooks that have been read by the teacher, predicting solutions from storybooks that have been read, making decisions about what has been heard, planning problem-solving solutions by adjusting to the theme provided by the teacher, which is by mixing colors because the story listened to is about playing with colors, implementing solutions by observing the colors mixed by the children, reviewing problem-solving by looking at the results of the work, and concluding by telling the results of the work that has been done. This activity is carried out gradually over five days in the second cycle.

The solutions achieved in cycle 2 also varied across children. Children could draw with a variety of colours and shapes. The solutions and solutions to the problems also differed, as evidenced by the colours chosen and the shapes drawn; some drew one shape, while others drew three. By enabling children to apply their ideas in a drawing based on the theme, the achievement related to implementing solutions has been met.

The achievements intended in this study include reviewing problem-solving, where children are already able to explain the problems they face well. They can explain in detail how the process occurs and its relation to the experiments carried out by the children. Children are already able to provide solutions, predict potential problems, and summarise the story as a whole effectively. These activities can also be said to develop creativity, as the activities carried out are similar, such as arranging, shaping, colouring, and even making handicrafts according

to imagination (Azizah et al., 2023). STEAM can provide active engagement for children while also encouraging their cognitive abilities and creativity (Zahro et al., 2024). This research differs in that STEAM activities are carried out through storybooks, with the illustrations used to create artwork in the form of images.

Discussion

The empirical data gathered across the two action cycles highlights a stark contrast in how children process problems and formulate creative solutions. Cycle I Baseline and Structural Barriers: In Cycle I, the cognitive load required for systematic problem-solving was noticeably high for the children. None reached the highest developmental tier (Berkembang Sangat Baik / BSB). Most children were clustered in the "Not Yet Developed" (BB) or "Starting to Develop" (MB) stages, particularly in late-stage operational indicators such as Planning Solutions, Implementing Solutions, Re-examining, and Concluding. This block indicates that while young children can naturally identify a basic problem, structuring a step-by-step resolution requires deliberate, scaffolded guidance.

Cycle II Breakthroughs: By the conclusion of Cycle II, a massive upward migratory shift occurred in the data. The cumulative frequency of children achieving the highest tiers—"Developing as Expected" (BSH) and BSB, surpassed the lower tiers. The Understanding the Problem indicator saw 9 out of 11 children hit the BSB mark. Notably, advanced analytical skills like Concluding (8 children at BSB) and Generating Ideas (8 children at BSB) grew rapidly, proving that 4–5-year-olds are entirely capable of high-level critical thinking when a pedagogical framework supports them consistently.

Rather than presenting abstract engineering or scientific problems, the story of Piko the painter served as a concrete visual and emotional anchor. When the teacher introduced intentional verbal prompts, such as "What can you do so Piko can paint?" it triggered the children's imaginative empathy. This method allowed children to project their own real-world environmental knowledge and personal experiences onto Piko's dilemma. This approach aligns with the theoretical foundations of early childhood cognitive development. By translating the abstract concept of color theory and spatial progression into a narrative arc, the children bypassed the typical intimidation of "problem-solving." Instead, they approached it as an extension of a story-driven play activity.

Out of the initial group of 11 children, three were consistently restricted in their capacity to fully participate due to preexisting speech delays and a lack of intrinsic motivation. Because the early stages of the Suryawati & Akkas (2021) model rely heavily on verbalizing reflections (e.g., retelling problems, explaining causal factors), children with expressive language barriers face an immediate disadvantage that standard STEAM design does not automatically solve. Institutional Consistency: The target school did not routinely employ STEAM methodologies prior to this study, meaning the children had to adapt to an unfamiliar cognitive framework.

This leads to a crucial pedagogical implication: to maximize a child's ability to seamlessly navigate real-world problem-solving, STEAM elements must be embedded consistently across the baseline curriculum, rather than treated as isolated experimental interventions. Furthermore, teachers must adapt non-verbal or tactile feedback loops for children experiencing speech delays, ensuring that a lack of verbal articulation does not mask their true spatial or logical problem-solving capabilities.

CONCLUSION

The STEAM method can facilitate children's problem-solving. The problem-solving approach used in this study was based on books. Children demonstrated significant improvement in the indicators when they correctly implemented the STEAM method steps, with results varying according to their individual abilities. Any work children achieve is valuable and deserves recognition, as problem-solving demonstrates significant improvement in their basic cognitive development. Future research should explore variations in methods or different versions of storybooks, so that children can elaborate on their imaginations through enjoyable, beneficial projects that stimulate their cognitive abilities.

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