

EFFECTIVENESS OF SIMPLE SCIENCE-BASED APE ON EARLY CHILDHOOD CURIOSITY AND OBSERVATION AT TK BUMI BAHARI

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ARTICLE HISTORY

Received : 21-08-2026

Revised : 18-09-2026

Accepted : 30-09-2026

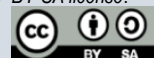
KEYWORDS

*Educational Play
Tools, Curiosity,
Observation Ability*

ABSTRACT

Early childhood is a critical period for developing curiosity and observation skills, yet initial observations at TK Bumi Bahari showed that learning remained conventional, with children passive, rarely asking questions, and inattentive when observing. Objective: This study aimed to determine the effectiveness of simple science-based educational play tools (APE) in improving curiosity and observation ability among early childhood children. Method: A quantitative pre-experimental method with a one-group pretest-posttest design was used in the 2025–2026 academic year, involving seven Group B children who took part in three APE activities: Color Tree, Magic Magnet, and Float or Sink. Data were collected through observation and documentation, then analyzed descriptively and with the Wilcoxon Signed Rank Test. Results: The average curiosity score increased from 57.6 to 83.0, and the average observation score increased from 55.2 to 88.5, with both improvements significant at the 0.05 level, leading to rejection of the null hypothesis. Conclusion/Implication: Simple science-based APE were effective in improving children's curiosity and observation ability in this setting; given the small single-group sample, replication with larger samples and a control group is recommended.

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INTRODUCTION

At TK Bumi Bahari, learning in Group B had initially tended to be conventional and gave children few chances to be physically involved in what they were learning. Preliminary observations showed that the children were passive during activities, rarely asked questions, and were not careful when observing objects or events around them. In practice, classroom activities did not yet give children room to wonder about what they saw or to look at it closely. This situation was the starting point of the present study, which was carried out in the 2025–2026 academic year with seven Group B children as the subjects.

To change this situation, educational play tools (APE) based on simple science were introduced, and the children used them directly. The first tool, "Pohon Warna" (Color Tree), used water mixed with food coloring,

Children received containers of the basic colors red, yellow, and blue and mixed them to make new colors. While doing so, they watched the colors change and began to ask questions such as why colors can change and how a new color is formed. The second tool, "Magnet Ajaib" (Magic Magnet), gave children a magnet and various objects, including metal ones. They tried attaching the magnet to each object, saw which objects were attracted and which were not, and grouped the objects by their properties. The third tool, "Mengapung atau Tenggelam" (Float or Sink), used a basin of water and objects of different sizes and weights. Children first predicted whether each object would float or sink, then checked their prediction by placing the object in the water.

The results were clear. The average curiosity score rose from 57.6 to 83.0, and the average observation score rose from 55.2 to 88.5. The Wilcoxon Signed Rank Test showed that both differences were significant at the 0.05 level, so the null hypothesis was rejected and the alternative hypothesis was accepted. The change was also visible in the classroom. Children who had been passive and inattentive began to ask questions, sort objects by what they noticed, and test their own predictions on real objects. In this setting, simple science-based APE worked remarkably well and produced large gains in both curiosity and observation.

From the perspective of established theory and research, however, gains this large would not normally be expected. Curiosity is understood as arising when a child perceives a gap in what he or she knows, and it is tied to how much uncertainty the environment offers (Loewenstein, 1994; Jirout & Klahr, 2012). Whether it grows or is suppressed depends heavily on everyday classroom practice (Evans et al., 2023). Early science experience is generally framed as an investment whose benefits accumulate over time and prepare children for later learning (Eshach & Fried, 2005; Saçkes et al., 2011). Research on guided play adds that outcomes depend on the quality of adult guidance. Unassisted discovery does not reliably help learners, whereas scaffolded, guided approaches do (Alfieri et al., 2011; Weisberg et al., 2013; Zosh et al., 2018), and overly directive instruction can even narrow children's own exploration (Bonawitz et al., 2011). Methodological standards point in the same direction. Results from a single group measured before and after an intervention can be inflated by maturation, repeated testing, and regression to the mean (Marsden & Torgerson, 2012), and very small samples tend to exaggerate effects (Button et al., 2013). Taken together, these views suggest that a limited set of three simple activities, given to seven children without a comparison group, should ideally produce gradual and moderate gains, not changes as large as those observed at TK Bumi Bahari.

The empirical picture and the ideal picture do not match. In the field, a small group of children showed large and statistically significant gains in both curiosity and observation after a series of simple APE activities. In theory and in research standards, however, curiosity and observation are expected to grow gradually, to depend on the quality of guidance, and to be hard to demonstrate convincingly with a small single-group design. This mismatch creates a real problem. It is not yet clear whether the gains at TK Bumi Bahari reflect something particular about how these APE work, or whether they also reflect features of the design and the setting. The size of the improvement is documented, but the explanation for why simple science-based APE could produce it, and how far the result can be trusted, remains open.

The gap becomes sharper when we look at the activities themselves. Each APE asked children to do something concrete (mix colors, test a magnet, predict and check floating or sinking), and each gave them a reason to ask a question and look closely at the result. Whether these features are enough to lift curiosity and observation together, and whether the improvement stays significant under a non-parametric test suited to a small group, remains insufficiently tested. The research problem is therefore the distance between the strong improvement seen in practice and the more cautious improvement suggested by theory. This leads to the central question of this study: how effective is the use of simple science-based APE in improving early childhood curiosity and observation at TK Bumi Bahari?

Previous studies that intersect with this topic fall into two streams. The first is conceptual and classroom-based research on curiosity and early science. It has defined children's curiosity as a response to uncertainty and proposed ways to measure and promote it (Jirout, 2020; Jirout & Klahr, 2012; Loewenstein, 1994). It has shown that teachers'

everyday practices can encourage or discourage curiosity in preschool math and science lessons (Evans et al., 2023), and a classroom framework with a coding protocol has been developed to observe such practices (Jirout et al., 2022). Cognitive research has shown that young children test ideas and draw inferences from evidence in ways that resemble scientific inquiry (Gopnik, 2012). Other work has argued for teaching science early, described a vision for preschool science education, and examined how preschool teachers view science and scientific curiosity (Eshach & Fried, 2005; Larimore, 2020; Spektor-Levy et al., 2013). The guided-play literature has examined how the degree of adult guidance changes what children learn (Alfieri et al., 2011; Bonawitz et al., 2011; Weisberg et al., 2013). These studies provide strong foundations, but most of them concern mechanisms, definitions, teacher practices, or general pedagogy. To the best of our knowledge, few test a specific set of low-cost play tools as the intervention or measure curiosity and observation together.

The second stream consists of empirical studies in Indonesian kindergartens that use simple experiments. A classroom action research study found that simple experiments improved children's science process skills, including observing (Wahid & Suyanto, 2015). Science experiments such as colored soap bubbles and sounding bottles were reported to leave the experimental class ahead of the control class in cognitive development (Hasibuan & Suryana, 2022). An experiment-based inquiry method improved children's science ability when observation data were analyzed with the Wilcoxon Signed Rank Test (Yulinda et al., 2026). Simple experiments were also applied to improve curiosity in a Group A class where low curiosity and teacher-centered learning had been observed (Widiastuti et al., 2025). These studies show that simple experiments are promising, but the present study differs from them in three ways. Most measure broader outcomes such as science process skills, cognitive development, or science ability, or look at curiosity alone. They treat experiments as a teaching method rather than as a defined set of educational play tools. And interpreting gains from small or single-group designs calls for particular care (Button et al., 2013; Marsden & Torgerson, 2012). This study fills that space by testing three specific APE (Color Tree, Magic Magnet, and Float or Sink) on curiosity and observation at the same time, using the Wilcoxon Signed Rank Test, and by reading the result against theoretical expectations. It therefore extends earlier work rather than repeating it.

The novelty of this study lies in three points. First, the intervention is a defined set of educational play tools built on simple science. Each one links a hands-on action to a question to ask and something to observe, which goes beyond a general "experiment method." Second, it measures two closely linked aspects, curiosity and observation, in the same group and with the same tools, so their change can be read side by side. Third, it does not only report that scores went up. It reads a large gain from a small group against what theory and methodological standards would predict, and it uses a non-parametric test suited to few participants to judge whether the change is significant. In this way the study offers a context-specific and transparently reasoned account of what simple science-based APE can achieve in an early childhood setting, which justifies its place beside earlier work.

This study is urgent for both practical and global reasons. Practically, many early childhood classes still rely on conventional lessons, as seen at TK Bumi Bahari, and teachers need tools that are inexpensive, easy to run, and clearly linked to the abilities they want children to develop. Simple science-based APE built from water, food coloring, magnets, and everyday objects meet this need. Teachers can only rely on them, however, if the evidence for their effect is examined carefully rather than taken at face value. Globally, early childhood development has been described as the foundation of sustainable development and as essential to realising the Sustainable Development Goals (Richter et al., 2017). This study speaks most directly to Sustainable Development Goal 4 (Quality Education), which calls for quality early childhood development and pre-primary education. It shows how curiosity and observation, the abilities on which later science learning builds (Eshach & Fried, 2005; Saçkes et al., 2011), can be strengthened through affordable and locally feasible play tools. Careful evidence of this kind helps schools invest in what works and supports better early learning for all children.

This study is organized around two central questions. The first asks whether the use of simple science-based APE significantly improves the curiosity of Group B children at TK Bumi Bahari, judged by the difference between their scores before and after the intervention. The second asks whether the same APE significantly improves their observation ability over the same period. Together, the two questions cover both outcome variables and both measurement points without overlapping.

RESEARCH MOTHOD

This study used a quantitative approach with a Pre-Experimental Design, specifically a One-Group Pretest-Posttest Design. One group of children was measured before and after the intervention, and the difference between the two measurements was taken as the effect of the treatment. The study was conducted at TK Bumi Bahari in the 2025–2026 academic year. The population was all Group B children, and the subjects were seven of them. The independent variable was educational play tools (APE) based on simple science, delivered through three activities: Color Tree, Magic Magnet, and Float or Sink. The dependent variables were curiosity and observation ability.

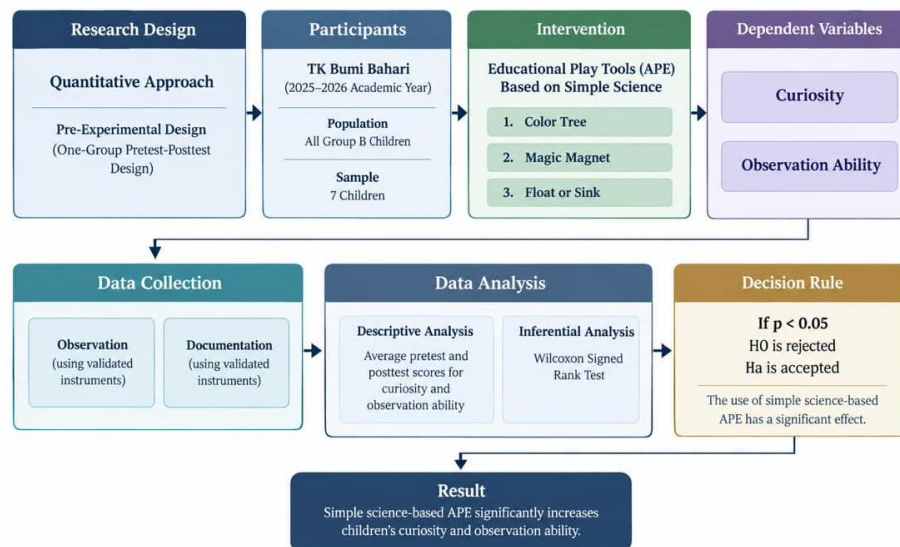


Figure 1. *Research Methodology Framework*

Data were collected through observation and documentation, using instruments that had been validated. The analysis had two parts. Descriptive analysis summarized the average pretest and posttest scores for curiosity and observation ability. Inferential analysis used the Wilcoxon Signed Rank Test to determine whether the difference between pretest and posttest scores was significant. The decision rule was that if the significance value was below 0.05, the null hypothesis (H0) was rejected and the alternative hypothesis (Ha) was accepted, meaning that the use of simple science-based APE had a significant effect.

RESULT AND DISCUSSION

The effectiveness of simple science-based APE in significantly improving the curiosity of Group B children at TK Bumi Bahari

The answer is yes. The average curiosity score rose from 57.6 in the pretest to 83.0 in the posttest, an increase of 25.4 points. The Wilcoxon Signed Rank Test gave a significance value of 0.000, which is below 0.05. The null hypothesis was therefore rejected and the alternative hypothesis accepted, meaning that the use of simple science-based APE had a significant effect on children's curiosity.

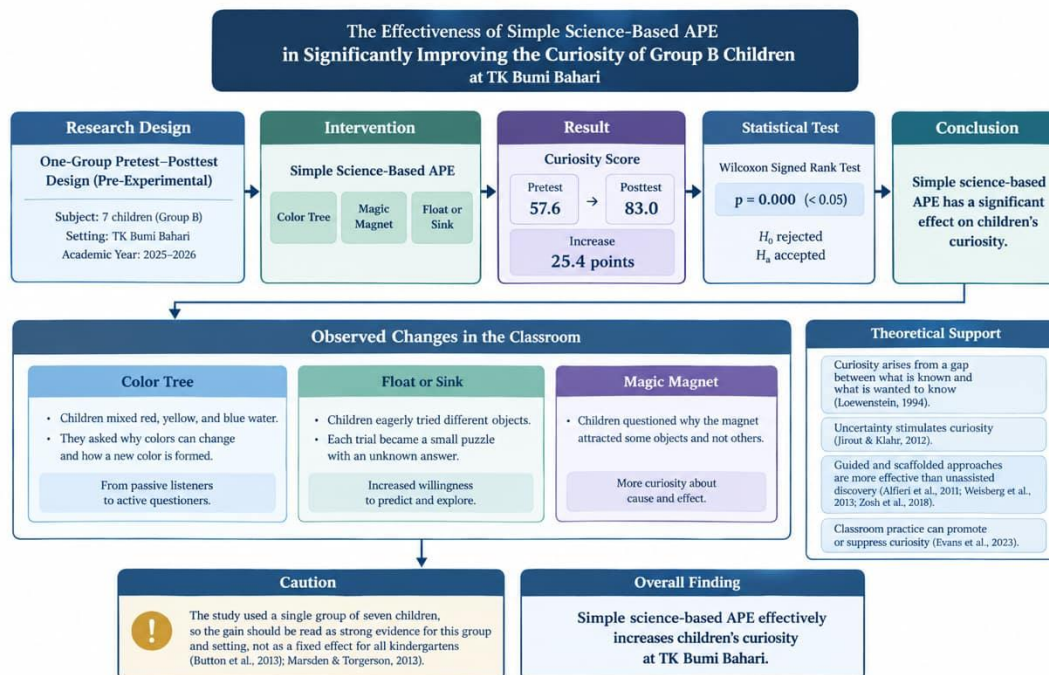


Figure 2. *The effectiveness of simple science-based APE in significantly improving the curiosity*

The numbers match what happened in the classroom. Before the intervention, children rarely asked questions. During the activities, their questions appeared naturally. With the Color Tree, children who mixed red, yellow, and blue water asked why colors can change and how a new color is formed. With Float or Sink, they became eager to see the outcome of every trial, because each object was a small puzzle whose answer they did not yet know. With Magic Magnet, they raised questions about what they saw when the magnet attracted some objects and ignored others. Children moved from being passive listeners to being active askers, and this is the change that the higher curiosity score captures.

This pattern fits the view that curiosity arises when a child notices a gap between what he or she knows and what he or she wants to know (Loewenstein, 1994). It also fits the idea that curiosity is tied to how much uncertainty the environment offers (Jirout & Klahr, 2012). Each APE created a small, safe gap. A new color appeared unexpectedly, a prediction had to be checked, and a magnet behaved differently on different objects. Children then asked questions to close that gap. The activities were also planned and guided, not left entirely to chance, which is consistent with research showing that guided and scaffolded approaches work better than unassisted discovery (Alfieri

et al., 2011; Weisberg et al., 2013; Zosh et al., 2018). Classroom practice is also known to promote or suppress curiosity (Evans et al., 2023), so replacing conventional lessons with hands-on play may itself have removed a barrier. A similar direction was reported in a Group A class where simple experiments were applied to improve curiosity (Widiastuti et al., 2025). One caution applies, however. Because the design used a single group of seven children, the size of the gain should be read as strong evidence for this group in this setting and not as a fixed effect for all kindergartens (Button et al., 2013; Marsden & Torgerson, 2012).

The effectiveness of simple science-based APE in significantly improving the observation ability of Group B children at TK Bumi Bahari

The answer is also yes. The average observation score rose from 55.2 to 88.5, an increase of 33.3 points, which is the larger of the two gains. The Wilcoxon Signed Rank Test again gave a significance value of 0.000, below 0.05, so the null hypothesis was rejected and the alternative hypothesis accepted. The use of simple science-based APE therefore had a significant effect on children's observation ability.

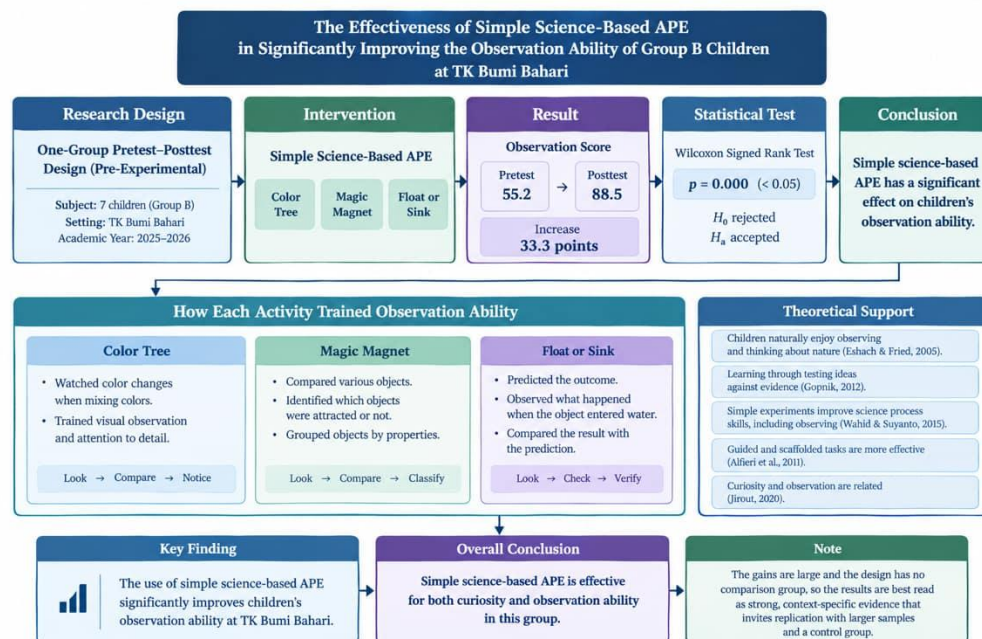


Figure 3. *The effectiveness of simple science-based APE in significantly improving the observation ability*

Each APE gave children something specific to look at and a reason to look carefully. In the Color Tree, children watched the colors change as they mixed them, which trained visual observation. In Magic Magnet, they compared many objects, saw which ones the magnet attracted and which it did not, and grouped the objects by their properties. In Float or Sink, they predicted the outcome, watched what happened when the object entered the water, and compared the result with their prediction. Before the intervention, children were less careful in observing. Afterwards, they were asked to look, compare, and check, so attention to detail became part of the activity itself.

This result agrees with the view that young children naturally enjoy observing and thinking about nature (Eshach & Fried, 2005) and that they learn by testing ideas against evidence in ways similar to scientific inquiry (Gopnik, 2012). It is also in line with earlier Indonesian findings that simple experiments improved children's science process skills, including observing (Wahid & Suyanto, 2015), and with a study that found improved science ability

using the same Wilcoxon test on observation data (Yulinda et al., 2026). The structure of the tasks probably helped as well. Because each activity had a clear thing to look at and a prediction to check, it worked as a form of scaffolding (Alfieri et al., 2011). The two gains also appear to move together. Curiosity is described as motivating information-seeking, and children who wonder about something tend to look at it more closely (Jirout, 2020). This study did not test that relationship directly, so it remains a plausible interpretation and not a finding.

Taken together, the two answers show that simple science-based APE were effective for both curiosity and observation ability in this group. The activities were concrete and hands-on, and they let children explore, experiment, and verify simple ideas by themselves. This is in line with the constructivist idea that children build their own knowledge through direct experience. Because the gains were large and the design had no comparison group, they are best read as strong, context-specific evidence that invites replication with larger samples and a control group.

CONCLUSION

This study concludes that simple science-based educational play tools (APE) were effective in improving the curiosity and observation ability of Group B children at TK Bumi Bahari. Average curiosity scores rose from 57.6 to 83.0, and average observation scores rose from 55.2 to 88.5. The Wilcoxon Signed Rank Test showed that both improvements were significant at the 0.05 level. Through the Color Tree, Magic Magnet, and Float or Sink activities, children moved from being passive and inattentive to asking questions, comparing objects, and testing their own predictions.

These findings show that low-cost, hands-on play tools can turn conventional lessons into active learning and strengthen the abilities on which later science learning builds. This directly supports Sustainable Development Goal 4 (Quality Education), which calls for quality early childhood development and pre-primary education. The gains were large and came from seven children in a single group without a comparison group, so they are strong evidence for this setting and not a fixed effect for all kindergartens. Replication with larger samples and a control group is needed before wider adoption.

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