ICHSS THE 5th INTERNATIONAL CONFERENCE OF HUMANITIES AND SOCIAL SCIENCE

# EARLY CHILDHOOD COGNITIVE STIMULATION THROUGH SIMPLE SCIENCE GAMES

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**Abstract.** This qualitative study aims to explore how simple science game activities can function as a stimulus for the cognitive development of early childhood at Pertiwi 1 Dukuhwaluh Kindergarten (Kembaran District, Banyumas Regency). Using a case study approach, data were collected through semi-structured interviews with teachers and children, participant observation in game activities, and video and photo documentation of activities during six weeks of intervention. The results of the thematic analysis show three main categories, namely: (1) active exploration and curiosity as triggers for cognitive stimulation, (2) teacher-child and peer interactions as mediators of simple scientific learning, and (3) local context and simple materials as reinforcement of the relevance of activities. This study recommends that simple science games are worthy of being integrated into the PAUD curriculum as part of a play-based and exploration-based cognitive stimulation strategy.

**Keywords:** cognitive stimulation, simple science games, early childhood, case studies, PAUD.

## INTRODUCTION

Early childhood is a crucial phase in children's cognitive development: according to classical cognitive development theory (Jean Piaget), preschool-aged children are in the preoperational stage, where they begin to construct understanding through symbolic activity and active play. Cognitive development encompasses abilities such as memory, attention, pattern understanding, classification, early problem-solving, and logical-sequential thinking. Appropriate stimulation at this age has been widely studied as a crucial factor; for example, Indonesian literature shows that educational stimulation has an effect on early childhood cognitive development.

In the context of science learning in early childhood education, simple science exploration activities can provide a "question-experiment-communicate" environment that aligns with scientific learning patterns (observing, asking, trying, reasoning, and communicating). For example, research in Indonesia shows that developing scientific literacy through educational play tools increases children's capacity to understand scientific concepts and processes.

However, while many quantitative studies measure improvements in scores or percentages, few have explored in depth how children and teachers experience and interpret science play activities as cognitive stimulation in the context of Indonesian early childhood education (PAUD). Therefore, this study takes a qualitative approach to uncover the processes and meanings of experiences at Pertiwi 1 Kindergarten in Dukuhwaluh, focusing on simple science games as a medium for cognitive stimulation.

Problem Formulation

1. How do young children experience and express cognitive stimulation through simple science games at Pertiwi 1 Dukuhwaluh Kindergarten?

2. How do teachers view the role of simple science games in facilitating cognitive stimulation in young children?

3. What contextual factors support or hinder the implementation of simple science games as cognitive stimulation in the kindergarten?

Research Objectives

1. To explore young children's experiences participating in simple science games as a form of cognitive stimulation.

2. To describe teachers' perceptions regarding the role, benefits, and challenges of simple science game activities.

3. To identify contextual factors (locale, materials, classroom environment, parent/teacher support) that influence successful implementation.

Research Benefits

1. For Early Childhood Education (PAUD) practice: To provide insights for teachers and administrators in designing cognitively meaningful simple science game activities.

2. For research: To enrich the qualitative literature on cognitive stimulation in PAUD within the Indonesian context.

3. For policy: provide recommendations for PAUD institutions in Banyumas Regency or similar areas in integrating science learning into the play curriculum.

Literature Review

1. The Concept of Early Childhood Cognitive Stimulation

Cognitive stimulation is defined as structured stimulation provided to children to optimally develop their thinking, attention, memory, problem-solving, and information-processing abilities. According to Damayanti & Latifah (2023) in their book "Stimulation for the Development of Six Basic Literacies for Early Childhood," stimulation is not limited to reading and writing but also encompasses scientific, digital, financial, and cultural literacy.

In the context of early childhood education (PAUD), play-based cognitive stimulation strategies are seen as an effective approach because they align with the characteristics of early childhood, who are active, curious, and learn through experience. For example, Sari, Auliya & Wahyuni (2025) state that play strategies designed for children aged 0-8 years can encourage thinking skills, pattern recognition, simple problem solving, and understanding cause-and-effect relationships. In a theoretical review, the constructivist learning style (children actively construct their own knowledge) is the basis that cognitive stimulation must be in the form of activities that enable children to observe, experiment, conclude and communicate, not just passively receive information.

2. Simple Science Games for Early Childhood

Simple science games are defined as exploratory activities that utilize basic science concepts (e.g., magnetism, color, floatation, simple forces/gravity) packaged in a playful format that is engaging for young children. Research in Indonesia, such as that of Widayati, Safrina, & Supriyati (2020), used a qualitative content analysis approach to examine the development of scientific literacy through educational play tools, and found that young children were able to understand scientific concepts and processes after being involved.

Other research shows that a comprehensive game-based learning model that incorporates aspects of color, shape, letters, sequence, and classification can provide cognitive stimulation for young children. (Obsession) Within the framework of science learning in early childhood education, important elements include: opportunities to ask questions, hands-on experiments, observation of results, and sharing of findings—all of which collectively foster children's scientific thinking and basic cognitive skills.

3. Integration of Simple Science Games as Cognitive Stimulation

Studies demonstrating that science games can function as cognitive stimulation in early childhood education (PAUD) are found in research by Woga & Juita (2023), who found that the use of concrete media in PAUD increases children's observation, estimation, and knowledge construction activities.

Furthermore, educational game strategies have also been explored in terms of media development and cognitive stimulation strategies, such as Nurmiyanti et al. (2023), who describe educational game strategies for cognitive stimulation in early childhood bibliographically.

The conceptual framework used in this study is as follows:

• Input: Simple science games (teacher staff, simple local materials, small groups of children)

• Process: Exploration, discussion, reflection, communication between children and teachers

• Output: Enhanced cognitive experiences (questioning, inferring, classifying, and problem-solving skills)

• Context: Local PAUD Pertiwi 1 Dukuhwaluh Kindergarten (Environment, teachers, parents, facilities)

## RESEARCH METHOD

### 1.1 Approach and Design

This research used a qualitative approach with a single-case study design at Pertiwi 1 Kindergarten, Dukuhwaluh. The case study approach allows researchers to deeply explore the processes, experiences, and meanings of participants in a real-life context.

### 1.2 Research Subjects and Context

The research subjects consisted of:

• Two classroom teachers (Group B, ages 4–5) who facilitated the science play activities.

• Twelve children, ages 4–5, who voluntarily participated in the activities (purposively selected based on regular attendance and the conditions of participating in the experiment).

• Observations were also conducted of the children's interactions with the teachers and the play materials.

The research context was Group B of Pertiwi 1 Kindergarten, Dukuhwaluh, Banyumas Regency, during a six-week intervention (two sessions per week).

### 1.3 Data Collection Techniques

Data were collected through:

• Participatory observation during simple science play sessions—the researcher was present as an observer and teacher companion.

• Semi-structured interviews with teachers (after the session) about their perceptions of the process and outcomes of the activity.

• Informal interviews with children (small groups, 2–3 children per session) to gain firsthand insight into their experiences.

• Photo/video documentation of the activity and field notes.

### 1.4 Data Analysis

Data analysis used thematic analysis techniques with the following steps: data familiarization (reading transcripts, watching videos), initial coding (open coding), theme discovery (axial coding), theme review, theme definition and naming, and final narrative development. Data validity was ensured through data triangulation (observation, interviews, documentation), member checking (teacher verification of preliminary conclusions), and audit trail (researcher recording the entire analysis process).

### 1.5 Research Ethics

Written consent was obtained from parents/guardians and school officials. Child participants were given a simple explanation, and the activities were presented as ordinary play. Confidentiality was maintained using pseudonymous codes (e.g., Child A, Child B), and data was stored securely.

## RESULT AND ANALYSIS

This qualitative research explores the process and experiences of children participating in simple science games at Pertiwi 1 Kindergarten, Dukuhwaluh. Based on participant observation, interviews with teachers and children, and documentation analysis, three main themes were identified that illustrate changes in children's cognitive understanding before and after participating in simple science games.

### 1.1 Children's Understanding Before Simple Science Game Activities

Before the intervention, children displayed a tendency toward imitative and reactive learning. They waited for teacher instructions and rarely asked spontaneous questions.

During regular learning activities (e.g., drawing or singing), observations showed that children tended to repeat what their peers did without asking for the reasons behind a phenomenon.

Teacher 1 explained:

"Before science activities begin, many children simply imitate. If I ask, 'Why are leaves green?', most of them answer, 'Because they're painted,' or remain silent."

Children are also not yet accustomed to connecting cause and effect. For example, when shown two objects (wood and stone) in water, some children simply say, "The stone is heavy," without attempting to predict or observe the objects' behavior. This indicates that their early cognitive understanding remains at the concrete-perceptual level, not yet progressing to the reflective stage.

This initial analysis aligns with Piaget's concept of the preoperational stage, where children begin to use symbols but still struggle with logical-causal relationships (Piaget in Damayanti & Latifah, 2023).

### 1.2 Children's Understanding After Participating in Simple Science Games

After six weeks of simple science exploration activities (mixing colors, experiments with floating objects, magnets, and sequential patterns), a shift in children's thinking patterns was evident, from passive to active-reflective.

This change was recorded through the following observations and interviews:

Child B: "Mom, if you mix red and blue, it makes purple. If you add yellow, it makes brown, right?"

Teacher 2: "Yes, you tried it earlier and saw the results, so you know why."

During the floating objects session, children began making predictions:

Child D: "Rocks sink because they're heavy, but light ping-pong balls float."

The teacher reported that after several sessions, the children were asking more questions and trying to discover their own patterns. The teacher stated:

"Now the children are more likely to connect the results of experiments with everyday experiences. For example, when playing at home, they say that spoons sink, but plastic doesn't."

Qualitatively, it can be concluded that the children have demonstrated an understanding of simple cause-and-effect relationships, the ability to classify objects based on their properties, and initiative for independent exploration.

This change is not only an increase in factual knowledge, but also a change in the way of thinking and interpreting phenomena, which is the essence of cognitive stimulation (Sari et al., 2025).

### 1.3 Thematic Analysis of Research Results

Theme 1: Active Exploration and Curiosity as Triggers for Understanding

The most obvious change occurred in the active exploration dimension. Children became curious subjects and dared to take the initiative to experiment. This exploration process gave rise to early scientific awareness — children understood that a phenomenon could be observed and explained, not simply accepted.

This finding aligns with the findings of Widayati et al. (2020) that science-based educational games can foster basic observation and reasoning skills.

Theme 2: Teacher-Child Interaction as a Mediating Process for Understanding

The teacher acted as a facilitator, stimulating children through open-ended questions and encouraging them to reason. For example, the teacher might ask, "Why does water change color?" or "Why does a magnet attract certain objects?"

Questions like these challenge children to think logically and connect empirical experiences with simple concepts. This interaction demonstrates a scaffolding mechanism, where teacher guidance gradually shapes children's understanding until they are able to draw their own conclusions. (Vygotsky in Woga & Juita, 2023)

Theme 3: Local Context and Simple Materials as Reinforcers of Understanding Transfer

Children understand science concepts more easily when the materials used are sourced from their surroundings: water, rocks, spoons, food coloring, or toy magnets. The local context provides meaning and continuity—children bring their learning home, even replicating small experiments in the kitchen. This demonstrates the transfer of learning: children transfer cognitive concepts from play activities at school to everyday life (Nurmiyanti et al., 2023).

### 1.4 Before–After Understanding Synthesis

**Table 1.** Before-After Science Games Understanding

| Aspect | Before Science Games | After Science Games |
|---|---|---|
| How to Learn | Passive, imitating friends, waiting for teacher's direction | Active, ask questions, take the initiative to try |
| Concept Understanding | Perceptual (based solely on sight) | Conceptual (connecting cause and effect) |
| Social Interaction | Minimal collaboration, individual | Collaborative and reflective, discuss with teachers/friends |
| Language & Communication | Simple descriptive (“red water”) | Simple analysis (“the water turns red because it is mixed with dye”) |
| Knowledge Transfer | Limited to the classroom context | Extending to experiences at home and in the surrounding environment |

The table above is not a quantitative analysis, but rather a summary of changes in children's conceptual understanding patterns based on observation and interview data. Thus, the qualitative approach maintains a focus on the process, narrative, and meaning of change, rather than on numerical measurements.

### 1.5 Integrative Discussion

The changes in early childhood understanding in this study reinforce the view that simple science games are a platform for cognitive construction where children learn through hands-on experience.

The results show that cognitive stimulation through science games not only improves logical thinking skills but also builds early metacognition—children begin to realize that they are learning “why things happen.”

These findings reinforce a local study by Kurniawati & Mulyati (2021), which emphasized that hands-on, experiment-based experiences are an effective means of deepening early childhood conceptual understanding. Furthermore, this study also confirms the scientific learning model for

early childhood education (observing–asking–trying–reasoning–communicating) recommended in the Early Childhood Education Independent Curriculum.

## CONCLUSION

Based on the results of qualitative research conducted at Pertiwi 1 Kindergarten in Dukuhwaluh, it can be concluded that simple science games play a significant role in stimulating early childhood cognitive development through exploration, social interaction, and contextual learning.

Science games serve not only as recreational activities but also as a vehicle for knowledge construction, enabling children to actively build an understanding of the phenomena around them.

Before participating in simple science games, children exhibited a learning pattern that tended to be passive and imitative. They waited for instructions from the teacher and showed little curiosity or initiative in reasoning about cause-and-effect relationships. Children's understanding of scientific phenomena remained at the perceptual stage, where information was accepted at face value without reflection or testing of ideas.

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