MODIFICATION OF SCIENCE-BASED BOI-BOIAN GAME TO STIMULATE SCIENCE PROCESS SKILLS IN EARLY CHILDHOOD

Rizka Maulia, Euis Kurniati
Universitas Pendidikan Indonesia, Bandung, Indonesia
Email: rizkamaulia@upi.edu, euiskurniati@upi.edu

ABSTRACT
This study aims to determine the implementation of science-based Boi-boian game modification in stimulating Science Process Skills (KPS) in early childhood. This learning innovation is expected to restore children’s mental health due to not facilitating play activities. In addition, this modification is also expected to improve lost learning due to lack of stimulation during online learning. The method used in this research is qualitative with the research subject, namely eight children of group B in one of the kindergartens in Parongpong, West Java. Data collection was carried out by audiovisual and observation. Furthermore, the results of the data were analyzed using six steps, including data collection, data organization, reading the entire data, data coding, data interrelation, and interpretation of meaning. The results of the analysis show that modifications to the science-based Boi-boian game can invite children to explore, observe, and solve problems. These activities stimulate the ability to predict, ask questions, observe, classify, differentiate, measure, record, and communication. In practice, learning development can also stimulate the emergence of critical and creative thinking skills in children. The emergence of various KPS, critical and creative thinking is supported by two factors, namely the four principles of learning science in early childhood and classroom management. From this study, it can be concluded that The modification of Boi-boian game based on science can develop various science process skills, critical and creative thinking skills in early childhood

KEYWORDS: The Traditional Boi-boian Game, Science Learning, Science Process Skills, Early Childhood

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INTRODUCTION

The spread of Covid-19 has had a broad impact on the education sector, including in early childhood education. During a pandemic, governments in many countries established policies that required students to do online learning. The implementation of this policy has changed children's daily lives which has an impact on their psychology. Christner et al. (2021) dan (Egan et al. (2021) found that during online learning, children miss playing with their friends and all their routines at school. These feelings made children bored, lonely, sad, and even became tantrums (Milawati et al., 2022; Tabi, 2020). The same thing was also found by Pisano et al. (2020) who examined attitude and psychological problems during the lockdown period of 5989 children aged 4-10 years, that 54% of children became irritable, 43% were lazy, 31% showed excessive anxiety, 21% had tantrums, and 19% had difficulty sleeping.

On the other hand, during online learning, not all family conditions support the creation of an environment that is rich in stimulation. First, the busyness of parents while working from home makes it difficult for them to accompany their children, triggering parents to let their children play gadgets for hours (Ulfasari & Fauziah, 2021; Wardani & Ayriza, 2020). This certainly makes children lazy to do activities, socialize, lack discipline, and unsensitive to their surroundings (Rohayani, 2020). Second, low economic factors make it difficult for parents to facilitate an educative environment so children's development is not optimal. Finally, the low educational factor also causes parents to have difficulty understanding the psychology of children's learning, how to stimulate children according to their development, how to provide appropriate rewards and funism, and how to deal with children's erratic moods. (Ambarita et al., 2021; Wiresiti, 2020). This lack of understanding triggers parents to guide their children under pressure or take over their children's assignments so they can finish quickly (Rohayani, 2020). This mentoring crisis certainly results in a lack of development of important abilities in children, such as independence, problem solving, fine and gross motor skills, communication skills, material exploration, creativity etc. (Egan et al., 2021).

The existence of mental health issues and lost learning that may occur in children during the lockdown period should be of concern to educators to arrange appropriate learning activities during the new normal period. Cahapay (2020) emphasizes that face-to-face learning for early childhood in the new normal period apart from paying attention to health protocols, must also be utility in nature. Utility means that the curriculum must consider the learning content needed now and in the future. It means that the new normal curriculum must facilitate learning activities that can support children recovering from the psychological impact during the pandemic while at the same time preparing children for future challenges. Thus, during the new normal period, teachers are required to accommodate learning activities that is not only appropriate with health protocols (Diana & Rofiki, 2020; Putri & Wulansari, 2021), but also deliver fun activities and stimulates 21st century skills, such as critical thinking, communication, and problem solving (Panda et al., 2021; Rogers, 2022).
Conditions in the field show that not all teachers can accommodate playing activities when face-to-face meetings are implemented. Based on observations in kindergarten in Bandung, the researchers found that instead of the teacher gave children opportunities to play, interact, and explore, they actually used it to pursue reading targets that were left behind during the online learning period. The same thing was also found by Putri & Wulansari (2021) that during the new normal era, teachers often used the storytelling method and gave assignments that were one-way. They reported that limited time, infrastructure, and limited teacher skills made it difficult for teachers to provide proper learning during the new normal period.

Those problems show the need to develop learning methods during the new normal period which is not only provide opportunities for children to play and interact, but also stimulate various important skills. Modification of the science-based Boi-boian game can be one of these alternatives. First, the Boi-boian game can make children keep their distance because it is played outdoors and does not invite children to crowd around for a long time. Second, this game is very fun (Adi et al., 2020) and encourage all children to be active (Rahmawati & Reza, 2014; Rosyidin & Kumaat, 2021). Finally, the elements of science included in these traditional games can stimulate various science process skills (KPS) in children which are closely related to 21st century skills, such as the ability to predict, compare, classify, sort, solve problems, and communicate. It is hoped that these characteristics will not only restore children's mental health, but also improve lost learning that occurs due to lack of stimulation during online learning. In addition, the implication of traditional games as a learning method at schools can also help revive and preserve Indonesia's cultural heritage.

On the other hand, research that focuses on studying the development of science-based Boi-boian traditional games in early childhood is still very limited. In previous research, the modification of The Boi-boian game was aimed at introducing geometric shapes to kindergarten (Rahmawati & Reza, 2014), studying triangular shapes in elementary children (Nurjanah & Nur'aeni, 2020), forming the character of elementary children (Lusi'ani & Khusumadewi, 2008), improves gross motor skills of early childhood (Purwanti, 2020), and develops basic movement skills of elementary children (Ribarto et al., 2006). In addition to different learning objectives, several steps of the Boi-boian game in this study are also different from the five studies above. This is because there is an element of science learning in the Boi-boian game that the researcher has developed. With this innovation study, hopefully it can be a solution to the issues of mental health and lost learning during pandemic.

The need to develop learning methods during the new normal period and the limited relevant research invites the author to conduct research. Thus, this study aims to find out how the implementation of the modification of the Boi-boian game based on science in stimulate science process skills in early childhood.

**RESEARCH METHOD**
This study used a qualitative method with the research subjects being eight children of group B in a kindergarten in Parongpong, West Java. The data were collected by audiovisual and observation. This observation was carried out in two meetings and was aimed at observing children's science process skills.

Furthermore, all research data were analyzed using the procedure described by Croswell (2015, p.236) as follows:
(1) Collection of all data (Audiovisual, observation, and interview)
(2) Preparation of data analysis, namely changing all data into transcripts
(3) Reading the entire data
(4) Coding data into themes and descriptions, namely classifying data into eight categories of science process skills (KPS) and building descriptions for each category
(5) Interrelation of themes and descriptions, namely connecting each KPS category with its description
(6) Interpretation of data, namely combining the results of analysis with relevant theory or research to create a certain meaning

The learning that is applied to stimulate the KPS is the Boi-boian game.

Boi-boian is a traditional game originating from West Java. In general, this game is played by 5 to 10 children who are divided into two groups (groups of players and guards) (Ribarto et al., 2006). Media commonly used in this game, including: tile or wooden blocks and balls (Astuti, 2018). In this study, the modification will be made to the media and steps of the game.

First, the media used is a circle tower (wooden blocks that have a gradation in size, the higher up the smaller the blocks). Likewise for balls, the balls provided have different masses, including paper balls, volleyball balls, rubber balls, and cloth balls. In addition, there are also artificial scales and worksheets to support science learning. The learning media can be seen in Figure 1.

![Figure 1](image)

**Figure 1**

The media: (a) The Tower; (b) The Balls; (c) The Artificial Scales and blocks; (d) The Worksheet

Second, the modification of the science-based Boi-boian game is designed based on the principles of science learning in early childhood, including: being fun (Yoon & Onchwar, 2006), involve exploratory and investigative activities (Kelly & Stead, 2015), more emphasis on process than results (abstract concept) (Harlen & Qualter, 2009), and maximize the use of the five senses (Inan & Inan, 2015; Martin et al., 2005). The stages of the Boi-boian game can be seen in table 1. In
practice, the science-based Boi-boian game activities are carried out in two days because the learning duration for the new normal is shorter than usual. On the first day, the children were given Boi-boian game activities while the activities on the second day were investigation and problem solving related to the first day. As a note, the second day was interrupted by one day from the first day because there was a training program for teachers so schools were closed.

**Table 1**

<table>
<thead>
<tr>
<th>No.</th>
<th>Boi-boian Game Steps (Original)</th>
<th>Boi-boian Game Steps (Modified)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Children are divided into two groups (players and guards)</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>The group of players throws the ball into the pile of tiles</td>
<td>Before throwing the ball, the group of players must choose which ball to use to collapse the circle tower.</td>
</tr>
<tr>
<td>4.</td>
<td>When the tile collapsed, the group of players ran to avoid throwing balls from the guard group. At the same time, the group of players must also work together to rearrange the tiles. On the other hand, the guard group is in charge of guarding the tiles by throwing the ball at the players who are trying to arrange the tiles.</td>
<td>The steps are almost identical to the original version, except that groups of players have to arrange a circular tower from largest to smallest.</td>
</tr>
<tr>
<td>5.</td>
<td>The player hit by the ball is not allowed to continue the game. If all players are hit by the ball, they lose. The group of guards also had their turn to play.</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Investigative activities:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a. The teacher gives a problem, namely which ball has the greatest power to tear down the tower. then, the teacher invites the child to predict the answer.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. The teacher invites children to explore the media. In this case, the teacher arranges three tables for different media, namely: the ball and tower; The artificial scales and blocks; and the worksheet. Children in groups are allowed to play with the media for 5 minutes/table.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>c. The teacher gives the child an opportunity to ask questions, then the teacher explains that to solve the</td>
<td></td>
</tr>
</tbody>
</table>
problem at the start, they have to find out which ball is the heaviest and the lightest.

d. the teacher demonstrates the use of media (scales and worksheet)

e. The teacher gives an opportunity for children to practice how to weigh and record it in the worksheet

f. The teacher directs the children to sort the balls from lightest to heaviest

g. the teacher invites the children to throw the ball into the tower sequentially from the lightest ball to the heaviest.

h. the teacher helps the child conclude that the heavier an object is, the greater the pushing force.

RESULT AND DISCUSSION

Based on the results of observations, the children seemed to really enjoy and have fun playing Boi-boian. They looked happy, running freely, laughing out loud when they managed to avoid throwing the ball, and cheered when they managed to reassemble the circle tower.

Besides being fun, The Boi-boian games are also rich in scientific experiences. This can be seen from the emergence of various KPS. The appearance of the KPS can be seen in the following observation table.

<table>
<thead>
<tr>
<th>Day</th>
<th>KPS</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st day</td>
<td>Observation</td>
<td>Observing the game demonstration and select the balls</td>
</tr>
<tr>
<td></td>
<td>Prediction</td>
<td>Selecting a ball</td>
</tr>
<tr>
<td></td>
<td>Differentiate</td>
<td>selecting a ball</td>
</tr>
<tr>
<td>Day 2</td>
<td>Observation</td>
<td>Observing the media</td>
</tr>
<tr>
<td></td>
<td>Ask</td>
<td>Observing the media</td>
</tr>
<tr>
<td></td>
<td>Experiment</td>
<td>Measuring the weigh of balls and throwing the balls</td>
</tr>
<tr>
<td></td>
<td>Measure</td>
<td>Weighing the balls</td>
</tr>
<tr>
<td></td>
<td>Differentiate</td>
<td>Counting the number of blocks</td>
</tr>
<tr>
<td></td>
<td>Classify</td>
<td>Counting the number of blocks</td>
</tr>
</tbody>
</table>
Table 2 shows that more KPS appeared on the second day than on the first day. On the first day, the KPS that appeared in children include: observing, predicting, and differentiating. On the second day, KPS on the first day reappeared on the second day, except for the prediction skill. On the second day, learning activity developed the ability to observe, ask questions, experiment, measure, differentiate, classify, record, and conclude. In addition, based on the table 2, it can also be seen that one activity can stimulate more than one KPS, such as selecting a ball besides raised the observation skill, it also stimulated the prediction and differentiation skills.

On the other hand, the science activities on the second day also triggered the emergence of critical and creative thinking skills. First, the child showed the critical thinking when she figured out which the ball was heavier. She put forward her idea in a simpler way. She directly comparing the two balls on the scales so that she could see which ball was heavier. Second, children's creativity emerges when they are given the opportunity to play with the media. There were children making various buildings from blocks, weighing objects around them with scales, playing wheels with circle towers, and playing bowling using balls and blocks.

At the beginning of the Core activities, the researcher also used the free play strategy. Free play is a classroom management strategy by giving children the opportunity to play with the media before entering the core activities. This strategy is carried out by three steps, including: arranging tables to store different media; direct children to play at each table alternately and in groups; making an agreement about the play duration for each group. Based on the observations, this strategy succeeded in creating a conducive classroom where there was minimal distraction from children playing media so that they could participate in all activities in an orderly manner. The class condition can be conducive because children's curiosity about media has been channeled at the beginning of activities when they are playing freely.

Based on table 2 it can be concluded that the activities on the second day can stimulate more KPS than the activities on the first day because the core of science activities is on the second day. On the first day, children were invited to do play activities which contain problems. The problem was solved on the second day. In other words, on the second day, children were invited to carry out problem-solving investigations through exploration, experiment, measurement, and proofment. This whole processes triggered the emergence of various scientific process skills. In more detail, the emergence of KPS can be seen in the following discussion.

1. The Observation Skill

On the first day, The observation skill appeared in the game demonstration and ball selection activities. During the demonstration, the researcher asked, “Are all the wooden blocks in the tower the same size? Please hold them! " . Then in the activity of selecting balls, the researcher also directed children to compare the balls first, "Please compare one ball with the others before you choose a
ball!". Based on the observations, such directions encourage children to identify the ball and the tower not only by looking, but also by touching it. It is as described by Martin et al. (2005) that the observation is the ability to use various senses to gain information.

The children's observational abilities reappeared on the second day when they observed the media, such as towers, balls, scales, and worksheet. On the second day, the researchers used the free play strategy so that science activities run conducively. Before entering the main activity (investigation), the researchers gave the children an opportunity to play with the media they would use. In this case, the researchers arranged three tables with each table containing different media, namely ball and circle tower; scales and ballast blocks; and LKA. On this occasion, they are free to explore them (observing, touching, and playing the media within a agreed timeframe). After free play, they also agreed to focus on learning activities. Based on observations supported also by the literature, the strategy of free play provides many benefits. First, the free play strategy is effective in helping children focus on learning because their curiosity about the media has been channeled (Nugraha, 2005). While there are some children who are tempted to play the media again when the researcher gives an explanation, they can easily follow the researcher's directions to return to listening to the explanation. Involving children in making learning agreements makes it easier for them to be disciplined in rules. Second, the free play strategy can develop children's creativity (Andayani, 2021). Some children made buildings from blocks, played bowling with balls, and weighed any objects around the child in their own way. Third, the free play strategy supported by interesting media can encourage children to make observations (Brunton & Thornton, 2014; Campbell et al., 2012; Oliver, 2006). Based on the results of observations, after the exploration activity there was a child who mentioned the materials of the artificial scales. His explanation then invites other friends to identify the materials of the scales and correct their wrong answers. This reconfirms the explanation earlier that the interesting element in learning activities has an important role in forming children's intrinsic motivation so that children can be actively involved in activities (observation) initatively. (Kelly & Stead, 2015; Musfiroh, 2014)

2. The Prediction Skill

Predictive abilities appear when the child selected a ball. Brunton & Thornton, (2014) explained that it is important to stimulate children the prediction skill so children learn to think logically based on the results of their observations. This means it is important to ensure that they guess based on the results of observations, not because they followed their friends' choices. There were three ways to ensure it. They were always directing children to compare one ball with another before choosing a ball; explaining that his friend's guess is not necessarily correct; as well as inviting the children to select a ball first then start the game. However, there were still some children who did not follow the directions so they did not make observations and selected balls quickly. Unlike most of the other children, they seemed to think for a moment after comparing the balls, then made their decision.
Responding to the case above, the researchers tried to ask a teacher to confirm whether they usually do this. There is interesting information that the broken home factor made her withdraw from the environment. It was also found by Sary (2022) that 16 children aged 4-6 years having divorce of their parents caused them to be embarrassed to play with their friends because they was afraid of being made fun of so they withdrew from association. It was also same as the child in the class that she was also reluctant to communicate and did not want to participate in class activities. The researchers then asked about her preferences and it turned out that her hobby is drawing. Knowing this, the researchers tried to offered her paper to draw on. Enthusiastically, she took the paper and other drawing tools. In this regard Campbell et al. (2012) explained that science activities in early childhood do not always have to be done through experiments with certain media, but science activities actually can be carried out in informal learning, such as playing with blocks, cooking, playing on the beach, repairing toys, including drawing activities. Chang (2012) explains that when a child draws, the child must observes the details of the object to be drawn, records his identification in the form of an image, compares the results of the image with the original object, criticizes what parts do not resemble the original object, and allows for problem solving when he finds it difficult to make the image match the object. In addition, various studies also emphasize that it is important for teachers to facilitate learning activities according to the interests and needs of children (Brunton & Thornton, 2014; Oliver, 2006; Santrock, 2010; Wortham, 2006). Therefore, researchers try to provide science activities to the child according to their interests (drawing).

3. The Ask Skill
   The ability to ask appeared after the child made observations of the media. These questions include "What is this ball made of?" and “How do I make these scales?”. This ability is relatively less common in children, although researchers try to stimulate it by asking, "Anything you want to ask?" and “Anything you want to find out after looking at the ball?”. Based on the literature review, there are two possible factors regarding the skill. First, Brunton & Thornton (2014) explained that not all children use words to express their curiosity. Second, Santrock (2010) added that communication skills that are still not well developed can trigger children's difficulties in conveying ideas or curiosity.

4. The Experiment Skill
   The child's experiment ability appeared in the activity of weighing and throwing the ball. When the child weighed the ball, the child was actively involved in trying to balance the two baskets by adding and removing the blocks until the basket of blocks was balanced with the ball basket. In this weighing activity, children's observational abilities were also stimulated again that children were encouraged to observe the yellow line which is an indicator of balance.

5. The Measurement Skill
   In early childhood, measurement activities are carried out using non-standard standards, such as spans, cubits, fathoms, and footsteps (Brunton & Thornton, 2014). In this activity, the non-standard standard used was the number
of blocks. At the time of weighing, one of the children found a creative idea regarding how to find out which ball is heavier and which is lighter. She explained that we can also figure out which ball is heavier by directly comparing two balls on the scale (each basket contains one ball) so you can see the results immediately. Hearing this creative and critical idea, the researcher immediately appreciated it and gave him the opportunity to put his idea into practice. Then the researcher resumed the activity of weighing the ball with a block. This is not because the child's idea was wrong, but because these activities will support the achievement of learning objectives.

6. The Record, Differentiation, and Classification Skills

The results of the scales were recorded in the worksheet. As shown in Figure 1, the worksheet contains children's activities recording the results of weighing in a table, sorting the number of blocks from the smallest to the largest, sorting the balls that have the smallest to the largest number of blocks, and finally determining which the ball has the greatest pushing force, whether the ball with the smallest or largest number of blocks.

Through the worksheet, children will be encouraged to record, identify, differentiate, and classify. These four abilities will appear sequentially. When children classified objects, children would identify similarities and differences then group them based on certain characteristics (Brunton & Thornton, 2014). Furthermore, the results of grouping were recorded in the worksheet (Chang, 2012). In this activity, the ability to classify appeared when the child counted the number of blocks in the weighing basket. The block used has three types of shapes, namely rectangles, squares, and triangles. First, the child differentiated each type of block in the weighing basket, then grouped the blocks according to their shape, then recorded them in the table. In this activity, to make it easy for children, weighing and recording can be done together with teacher then giving children an opportunity to do it independently for the other balls.

In addition to the four abilities above, the worksheet can also stimulate children to think critically. When the researcher demonstrated the use of worksheet and asked "Can we record the results of the rubber ball scales in the first row?". For a moment the children seemed to think and one child then replied "No, since the first row is for cloth balls". Getting this critical answer, the researcher immediately gave a thumbs up and praised him. In this case Harlen & Qualter (2009) and Nurmawanti et al. (2021) explained that science learning can develop children's thinking skills.

The next activity is to interpret the record. Researchers helped children understand that the ball has the most blocks is the heaviest ball and vice versa. After children understood it, they were asked to sort the balls from the lightest to the heaviest one. Finally, children are directed to test their guesses by throwing balls in sequence from the lightest to the heaviest balls.

7. The Communication Skill

The last science process skill is concluding. During the review, the children were able to tell what they had done. However, they found it difficult to explain what they already knew, so the researchers helped arrange the words and stopped several times to give them a chance to complete the sentences.
Vigosky's theory, this role is scaffolding which is temporary support to help children master a task (Santrock, 2010; Wortham, 2006). This support will decrease as the child's skills increase. The concept of scaffolding is important in learning because temporary assistance can help children build their understanding in a systematic and coherent manner (Etnawati, 2022; Hong & Diamond, 2012; Nurtaniaiwati, 2017).

The emergence of various important abilities, not only science process skills but also 21st century abilities (critical and creative thinking) in the learning activity shows that the development of this game can be an alternative learning to overcome problems, such as mental health and lost learning.

**CONCLUSION**

Online learning that has been applied to early childhood for almost two years has had an impact on the emergence of various problems. Various studies have reported that during the lockdown period many young children were affected by mental health and lost learning. These two issues are the main considerations in the development of science-based Boi-boian games. Based on the observations, the active play element attached to the Boi-boian game makes the children happy and happy during the activity. On the other hand, the addition of science learning in Boi-boian games makes this fun game stimulate various important abilities, such as thinking skills and science process skills. The thinking skills are critical and creative thinking while the science process skills include: the skill of observation, prediction, asking questions, experiment, measurement, record, differentiation, classification, and communication. Even so, there are also abilities that are not yet optimal in children, namely the ability to ask questions and conclude. In the implementation process, the emergence of various important abilities is supported by two factors, namely the principles of science learning and classroom management strategies. The modification of the science-based Boi-boian game was designed based on four principles, namely being fun, maximizing the use of the five senses, involving exploration and investigation activities, and emphasizing process more than results. In addition, various strategies are also used to support learning activities. These strategies include taking an emotional approach to children, implementing free play strategies, and accommodating children's interests and needs in learning activities.

**REFERENCES**


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