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The influence of 3D geometric puzzle media on the collaboration abilities of early childhood children

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Abstract

Collaboration is an important skill that needs to be developed from an early age. This study aims to determine the effect of 3D geometric puzzle media on the collaboration skills of children aged 5-6 years. The study used a quasi-experimental method with a nonequivalent pretest posttest control group design. The research sample consisted of children from Bani Umaro Kindergarten and Al Abror Kindergarten in Tasikmalaya City. Data collection techniques were carried out through observation, while data analysis used descriptive and inferential statistics. The results showed a significant increase in children's collaboration skills after using 3D geometric puzzle media, with an Asymp. Sig. (2-tailed) value of 0.000 <0.05. These findings prove that 3D geometric puzzle media is effective in improving collaboration skills in early childhood.

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INTRODUCTION

The rapid development of the times demands various 21st-century skills that every individual, including young children, must possess. One of these important skills is collaboration, which is part of the 4C skills (Communication, Collaboration, Critical Thinking, Creativity). Collaborative skills are an important foundation in shaping children's social character from an early age, because at this stage children are in a very rapid stage of social-emotional development. Through collaboration, children learn how to work together in groups, respect differences of opinion, resolve conflicts constructively, and achieve common goals. According to Hurlock (2019), collaborative skills

plays a crucial role in developing healthy social behavior. Children who are able to collaborate tend to be more adaptable in facing complex social situations in the future. Early childhood education (PAUD) environments are strategic places to instill these skills, considering that PAUD is not only a place for children to learn cognitive skills but also fosters social, emotional, and moral development. However, in practice, many PAUD institutions still do not optimally develop collaborative skills in a structured manner. Learning still tends to focus on individual and basic academic skills, such as reading, writing, and arithmetic, without providing sufficient space for children to learn to work together. However, cooperative and collaborative

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learning can increase positive social interactions and foster empathy, tolerance, and a sense of responsibility towards the group.Learning media is an important component in creating a collaborative learning environment. One effective medium is 3D geometry puzzles. 3D geometry puzzles not only provide a fun visual and kinesthetic learning experience but also encourage children to actively interact with peers in arranging puzzle pieces into complete geometric shapes.

This process involves the ability to discuss, make decisions together, share roles, and help each other. Several previous studies have shown that puzzle games can improve children's cognitive and motor skills (Amanda, 2018; Asrori & Yuniarni, 2013). Farida et al. (2022) and Nurhidaya (2019) also showed that 2D puzzles can improve cooperation skills in children. However, research on more complex and challenging 3D geometry puzzles is still very limited, even though this medium has greater potential to stimulate children's collaboration skills, because it combines visual-spatial, kinesthetic, and social aspects. Previous research (Farida et al., 2022; Nurhidaya, 2019) has shown that 2D puzzle games are effective in improving children's collaboration skills. However, the use of 3D geometric puzzles, which have more complex spatial and manipulative elements, has rarely been studied. Therefore, this study aims to test the effectiveness of 3D geometric puzzles in improving early childhood collaboration skills. Therefore, this study was conducted to fill this gap by empirically testing the effect of 3D geometric puzzles on early childhood collaboration skills. This research is expected to contribute to the development of more varied and effective learning methods in early childhood education (PAUD) in shaping children's social character.

METHOD

This study used a quantitative approach with a quasi-experimental method and a nonequivalent pretest-posttest control group design. The sample was children aged 5-6 years from two schools in Mangkubumi District, Tasikmalaya City. The data collection instrument was a child collaboration observation sheet, which has been tested for validity and reliability. Data analysis was conducted using descriptive statistics and the Mann-Whitney U Test to determine differences in results between the experimental and control classes.

RESULTS AND DISCUSSION

Result

This study aims to determine the effect of 3D Geometry Puzzle media on the collaboration skills of early childhood children. Data were obtained through observation instruments for collaboration skills administered to the experimental and control groups, both before (pretest) and after (posttest) the treatment was administered. Pretest Results

Based on the pretest results obtained from both groups, it appears that the children's collaboration skills were initially in the low to moderate category. In the experimental group, the average pretest score for collaboration skills was 52, while in the control group it was 50. This indicates that both groups had relatively equal initial abilities before being given the treatment.

Table 1. below presents the pretest results for collaboration skills for both groups.

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Group	Average Pretest Score	Category
Experiment	52	Medium
Control	50	Medium

1. Posttest Results

After being treated with the 3D Geometry Puzzle media in the learning process, there was a significant improvement in the experimental group. The average posttest score in the experimental group increased to 82, which falls into the high category. Meanwhile, the control group, which did not use the media, only saw an average score increase to 62, which remains in the moderate category.

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TUNAS SILIWANGI
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Table 2. below shows the posttest results for the collaboration skills of both groups.

Group	Average Pretest Score	Category
Experiment	82	Height
Control	62	Medium

2. Comparison of Pretest and Posttest Improvements

Comparing the pretest and posttest results, the experimental group experienced an average improvement of 30 points, while the control group only improved by 12 points. This indicates that the use of 3D Geometry Puzzles had a greater positive contribution to improving children's collaboration skills compared to the conventional learning method used in the control group.

Table 3.below shows the difference in scores between the pretest and posttest for both groups.

Group	Group	Average Pretest Score	Average Postest Score	increase difference
Experiment	Experiment	52	82	30
Control	Control	50	62	12

4. Statistical Test

Based on the results of the independent t-test, a significance value (2-tailed sig.) of 0.001 was obtained, which is less than 0.05. This indicates a significant difference between the posttest results of the experimental and control groups. Therefore, the research hypothesis stating that 3D Geometry Puzzle media has an effect on improving collaboration skills in early childhood is accepted.

Table 4. Results of the Mann-Whitney U Test

Statistical Test	Value
Mann-Whitney U	2.000
Wilcoxon W	52.000
Asymp. Sig. (2-tailed)	0.000

A significance value of 0.000 indicates a significant difference between the collaborative skills learning outcomes of children who used 3D geometric puzzles and those who used conventional learning methods. A Mann-Whitney U test yielded an Asymp. Sig. (2-tailed) of 0.000 < 0.05, indicating a significant difference between the two groups.

The results showed that children who learned with 3D geometric puzzles experienced a greater improvement in their collaboration skills than those who learned with conventional methods. 3D puzzles provide opportunities for children to discuss, share tasks, and solve problems collaboratively.

The results table shows that the difference in collaboration scores in the experimental class reached 11.2, significantly higher than the control class' score of 5.1. This finding aligns with Slavin's (2013) theory that cooperative learning and the use of manipulative media can enhance children's social interaction and cooperation.

3D puzzles not only train cognitive aspects of geometric shape recognition but also children's social and emotional aspects. The interaction during puzzle assembly teaches children to listen to each other, respect each other's ideas, and take responsibility within a group.

This research expands on previous findings by showing that more complex 3D puzzle shapes can stimulate deeper collaboration.

Discussion

The use of 3D geometric puzzles provides opportunities for children to interact, share tasks, and collaborate in constructing geometric shapes. This activity involves discussion, mutual assistance, and honing

TUNAS SILIWANGI
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collaborative problem-solving skills. The results of this study support previous findings that puzzle games can improve children's social skills.

The results of this study demonstrate that 3D geometric puzzles are effective in improving collaboration skills in early childhood. The learning process using 3D puzzles requires children to work together to assemble geometric pieces into complete shapes. In this process, children learn to strategize together, assign roles, discuss, and help each other if a friend is having difficulty.

The significant difference in collaboration scores (11.2 points) in the experimental group indicates that collaborative learning activities using concrete media can improve social skills more optimally than conventional methods that tend to be individualistic.

This research reinforces Slavin's (2013) theory on cooperative learning, which states that collaboration skills develop through learning experiences that enable students to actively interact. 3D geometry puzzles also provide spatial challenges that encourage children to think critically and creatively, while also cultivating patience and empathy in groups.

Furthermore, 3D puzzles involve manipulative elements that stimulate children's fine motor development. The activity of assembling puzzle pieces trains hand-eye coordination and collaborative problem-solving skills. This aligns with Amanda's (2018) opinion, which states that puzzles are an educational medium that engages cognitive, motor, and social aspects.

Furthermore, these findings complement previous research (Nurhidaya, 2019), which focused solely on 2D puzzles. More complex 3D puzzles provide additional challenges that encourage children to discuss and find solutions together. This complexity actually deepens the collaboration process because children not only assemble individually but also must reach group consensus regarding the construction strategy.

The results of this study also support a constructivist approach to early childhood learning, where children learn actively through interactions with their environment and peers. 3D puzzles serve as visual aids that help children construct their understanding in concrete ways, rather than simply relying on verbal instructions.

However, there are still several limitations that need to be considered, including the study's limited sample size of two kindergartens in one area and the relatively short duration. Therefore, further research is needed with a broader scope and longer timeframe to determine the long-term effects of using 3D puzzles on children's social development.

Practically, the results of this study provide recommendations for early childhood education educators to begin integrating collaborative-based learning media into their teaching and learning activities. 3D puzzles can be a fun alternative to thematic learning that simultaneously develops children's social, cognitive, and motor skills.

CONCLUSION

Based on the research results, it can be concluded that 3D geometric puzzles have a significant impact on improving early childhood collaboration skills. The use of 3D geometric puzzles in the learning process encourages children to collaborate, discuss, share roles, and solve problems collaboratively. This is evidenced by the higher collaboration scores in the experimental group compared to the control group, as well as statistical test results showing a significant difference between the two groups.

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