Development of Colour Jump Ball Learning Media to Introduce Colour and Geometric Shapes in Early Childhood

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ABSTRACT

This research aims to develop and test the effectiveness of Color Jump Ball as a learning medium in introducing the concept of color and geometric shapes to early childhood. The method used is research and development (R&D) with the ADDIE development model, which consists of five stages: analysis, design, development, implementation, and evaluation. The subjects of the study were 15 children aged 3–4 years who attended TAUD Saqu Madiun. The object of the research is an innovative learning medium in the form of Color Jump Ball. Data was collected through questionnaires, interviews, and observations. The validation results showed that this media is very feasible to use, with a validity rate of 93% of the subject matter experts and the validity of the media experts of 94%. The practicality test showed a significant increase, from 70.20 in the initial field trial to 90.36 in the main field trial. The effectiveness test using the t-test yielded a calculated t-value of 8.516, far exceeding the t-table of 0.443, indicating that the use of Color Jump Ball is effective in improving color recognition and geometric shapes in early childhood. The main contribution of this research is the development of educational learning media that is innovative, interactive, and easy to apply in the context of early childhood education. Color Jump Ball has proven to be not only valid and practical, but also effective in supporting children's cognitive development in the basic aspects of color recognition and shapes.

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1. INTRODUCTION

Early childhood education (PAUD) is an important foundation in children's cognitive, social, and motor development. At this stage, children have high exploration and learning abilities through hands-on experience and games. An important aspect of early childhood cognitive development is color and shape recognition, which is the basis for their logical thinking skills, creativity, and readiness to enter the next level of education (Maharani et al., 2020; Azizah et al., 2018). At the learning stage, it should be packaged in a fun way and in accordance with the characteristics of the child's development. One of the important aspects of early childhood education is the introduction of basic concepts such as colors and geometric shapes that are the basis for learning mathematics and visual arts at the next level (Ali & Ni'mah, 2023; Dewi, 2016; Charmila et al., 2016; Erna et al., 2017; Boonen et al., 2014).

In the world of education, innovations in learning methods continue to be developed to increase the effectiveness and efficiency of the teaching and learning process. An important aspect of learning is how the material can be delivered in an interesting way, so that it can increase students' interest and understanding. In the development of innovative learning aids it is an urgent need (Prastowo, 2015; Aslindah, 2027; Prastowo, 2015; Andriliani et al., 2022). One of the interesting approaches to learning is the use of educational games (Akmala & Wathon, 2020). Educational games can help students understand certain concepts better because they involve cognitive, affective, and psychomotor aspects at the same time (Ruwaida, 2019). In addition, educational games can also increase learning motivation and active involvement of students in the learning process (Alina & Wathon, 2019; Arsini et al., 2023; Meduri et al., 2022).

In an effort to create innovative learning aids, this research focused on the development of *the Colour Jump Ball*. *Colour Jump Ball* is an educational game designed to integrate aspects of colour and physical movement into the learning process (Fatmawati & Sofia, 2024). This game aims to help students understand various educational concepts, especially in the cognitive and motor fields. *Colour Jump Ball* is a coloured ball designed with various instructions or tasks that must be completed by students when the ball is played (Jatmiko, 2019). The use of color in this tool has an important role, considering that color can stimulate memory and increase students' concentration (Aslindah, 2027). In addition, this game also involves physical movement, so it can help improve motor coordination and body fitness.

However, in practice, there are still many early childhood education institutions that face challenges in providing effective and engaging learning media for children. Monotonous and less interactive learning media often make children bored quickly and less motivated in learning (Kusnadi & Azzahra, 2024). Therefore, innovation in learning media is needed that is not only educational but also fun and in accordance with the characteristics of early childhood development. In various previous studies, it has been found that game-based learning can improve student learning outcomes. The main reason is because games create a more fun and interactive learning atmosphere, so that students can easily understand the material being taught (Kusnadi & Azzahra, 2024). *Colour Jump Ball* can be an effective alternative in supporting learning (Qudsi & Syamtar, 2020). In addition to the benefits in improving understanding of concepts, *Colour Jump Ball* can also help in the development of students' social skills (Khotimah, 2023). These games are often played in groups, which allows learners to interact, collaborate, and improve their communication skills. It is very important in the formation of character and social skills needed in daily life.

One of the solutions that can be developed is *Colour Jump Ball*, which is a game-based learning medium designed to introduce colour and shape to early childhood in a fun way. This media integrates elements of physical and interactive games so that it can increase children's involvement in the learning process (Alina & Wathon, 2019). *Colour Jump Ball* can also help children's gross motor development through throwing, catching, and observing the colours and shapes contained in the ball.

In learning implementation, the use of varied and interactive tools is highly recommended to create a richer learning experience. With the existence of *Colour Jump Ball* , students not only learn in theory but also practice directly the concepts learned (Akbar et al., 2023). This will help strengthen their

understanding and improve their problem-solving skills. The importance of the development *of Colour Jump Ball* is also based on the need for innovation in the world of education that can accommodate various learning styles of students. Each individual has a different way of learning, some are easier to understand through visual, kinesthetic, or auditory. With a combination of color, movement, and social interaction, this tool is expected to reach more students' learning styles.

In addition, the use of *Colour Jump Ball* can be applied in various levels of education, ranging from early childhood education, elementary school, to secondary school. By adjusting the difficulty and complexity of the game, this tool can be used in a variety of learning contexts according to the needs of learners. The development of *Colour Jump Ball* can also be a solution in facing learning challenges in the digital era. Currently, many students are more interested in digital devices and less active in physical activities. With this movement-based educational game, students can continue to learn while remaining actively moving, thus helping to maintain a balance between the use of technology and physical activity.

In the world of inclusive education, *the Colour Jump Ball* can be a friendly tool for students with various special needs (Gumelar, 2010). For example, children with learning difficulties can benefit from the multisensory approach offered by these tools. *Colour Jump Ball* can support more inclusive and equitable learning (Agustina & Rahaju, 2021). To develop *Colour Jump Ball* as an effective learning tool, this research will involve the process of designing, testing, and evaluating its effectiveness in improving student learning outcomes (Badruddin, 2013). Various approaches will be used to measure the impact of this game on the cognitive, affective, and psychomotor aspects of students.

Nature Human Behavior emphasizes that play designed with educational elements or guided play can significantly increase children's learning achievement compared to the direct instruction approach (Zosh et al., 2022). They show that the integration of games with explicit learning goals improves children's cognitive engagement and processing. Findings from Ribner et al. (2022) In Early Childhood Research Quarterly, it is emphasized that the incorporation of motor and cognitive aspects in a single learning activity increases the efficiency of the learning process and strengthens the neural connectivity between the motor area and the prefrontal cortex, which is closely related to decision-making and attention control. Study by Li & Wang (2000) in Frontiers in Psychology also emphasizes that multisensory-stimulating learning environments involve movement, visuals, and social interaction—significantly improving early childhood engagement and learning outcomes, especially in aspects of recognition of abstract concepts such as shapes and colors.

Recent research highlights the importance of interactive, multisensory, and game based learning approaches in improving early childhood learning outcomes. Games designed with explicit educational purposes can significantly improve a child's cognitive engagement and processing compared to hands-on instruction, in line with constructivist theories that emphasize the child's active role in learning through meaningful social interaction and context. The integration of motor and cognitive activities in learning strengthens neural connectivity, particularly between the motor area and the prefrontal cortex related to executive functions such as attention and decision-making. Learning environments that involve multisensory stimulation such as movement, visual, and social interaction significantly assist children in understanding abstract concepts, as the brain processes information more effectively when multiple sensory channels are used simultaneously. These three findings underscore the need for active, contextual, and sensory-experiential learning designs as a more effective approach to support early childhood cognitive and affective development.

This research aims to develop and test the effectiveness of *Colour Jump Ball* as a learning medium in introducing color and geometric shapes in early childhood. With this innovation, it is hoped that the learning process will be more fun, effective, and in accordance with the needs of children's development. In addition, this research also contributes to the development of more creative and interactive learning methods in the early childhood education environment. The results of this research are expected to contribute to the world of education, especially in the development of innovative learning methods. With the increasing number of interesting and effective learning alternatives, it is

hoped that the quality of education can continue to improve and create a more competent generation. Thus, this research not only aims to develop new learning tools, but also to answer the challenge of creating learning methods that are more fun, interactive, and beneficial for the development of students holistically.

2. METHOD

Types of research

In this study, the researcher will develop a type of research such as a development or Research and Development (R&D) using the model method in the form of *ADDIE.* Research and Development (R&D) is a strategy used in making or producing goods before evaluating their usefulness. The ADDIE model is the right step to produce quality and effective teaching materials. This model consists of nine systematic stages that include finding learning objectives and revision of learning (Rosmiati, 2019). ADDIE is a more rational and comprehensive research and development model and can be applied from various forms of product development, such as models, learning strategies, learning methods, media, and teaching materials based on product development steps. The stages in the ADDIE model have 5 stages, namely: analysis, design, development, implementation, evaluation (Pribadi, 2016).

Subjects and Objects of Research

The subjects in this study are students aged 3-4 years or group B in Taud Saqu, Madiun which totals 15 children. The object of the research is an item/object, namely *a Colour Jump Ball*. The target of this study is how to develop *Colour Jump Ball* as a learning medium in introducing colors and shapes in early childhood in Taud Saqu, Madiun.

Research Stages

1. Needs of Analysis

   At this stage, an analysis is carried out to identify the elements needed to produce the expected module topic. This analysis includes curriculum analysis, student needs analysis, student characteristics analysis, and Learning Resource analysis.

2. Design Stage

   This design stage includes the systematic preparation of textbooks, the preparation of module frameworks, and the manufacture of research instruments. The development stage of the textbooks that will be made are drama and performance textbooks to improve creative thinking skills made using Indonesian and designed attractively using Microsoft Word. Pictures related to the drama stage are provided. This textbook will discuss the concept of drama performance.

3. Development Stage

   At this stage, the combination of media and material is carried out carefully to ensure that the two elements support each other and function optimally in support of learning objectives. The learning medium *Colour Jump Ball* is a game that not only serves as a visual aid, but also as an interactive means that allows students to be directly involved in the learning process. In this case, the geometry material presented through *the Colour Jump Ball* must be relevant to the topic being studied and designed in such a way that students can understand mathematical concepts in a more fun and applicable way. The development of *Colour Jump Ball learning media* includes a manufacturing process that is in accordance with learning objectives, such as *Colour Jump Ball* where learning media introduces colors and geometric shapes.

4. Implementation Stage

   The implementation stage was carried out by conducting *a Colour Jump Ball* trial which was carried out at Taud Saqu, Madiun . The trial was carried out on 15 students in Taud Saqu Madiun, consisting of 9 males and 6 females. The learning tools used are RPP and LKPD which are adjusted to the RPP which contains 1 KD and 2 KI. The time allocation used for learning is 2x40 minutes.

5. Evaluation Stage

The practicality *of Colour Jump Ball* is considered very practical by lecturers and teachers. This media obtained a practicality score of 76.6%, which shows that most participants found this media easy to use, interesting, and useful for fostering creative thinking. The impact on creative thinking The comparison of pre-test and post-test results showed a significant improvement in students' creative thinking skills. The results of the paired t-test showed that the average post-test score was higher than the average pre-test score, which showed that the learning medium had a positive influence on students' creative thinking skills.

Data Collection Techniques

1. Questionnaire

In this study, questionnaires were used to collect quantitative data on the effectiveness of *Colour Jump Ball* learning media in introducing colors and geometric shapes in early childhood. This questionnaire is designed with structured closed-ended questions, covering aspects of the child's understanding of color (e.g., the ability to identify and distinguish primary and secondary colors), the introduction of basic geometric shapes (such as circles, triangles, and squares), and the level of interest and involvement of the child during the use of learning media. This questionnaire is filled out by teachers or caregivers who are directly involved in the learning process using *the Colour Jump Ball*, thus providing an adult perspective on the impact of media on children's cognitive ability to recognize colors and shapes.

2. Interview

In this study, the interview that will be conducted by the researcher with the teacher of Taud Saqu Madiun is the subject of the interview in this study. This interview was conducted to collect information about learning by researchers and teachers at Taud Saqu, Madiun .

3. Observation

Initial observations are carried out to understand the level of early childhood understanding of the concept of color and geometric shapes and identify potential challenges or needs in the learning process. These observations are made in a child's learning environment, such as a play group or kindergarten, focusing on the child's interaction during activities involving colors and shapes, their response to related instruction, and their ability to identify and distinguish different basic colors and shapes. Structured field notes are used to systematically record children's behaviors and responses, including the frequency with which they pronounce colors or shapes correctly, the level of participation in activities involving the concept, as well as areas where they demonstrate a strong understanding or difficulty. This initial observation data serves as a *baseline* to measure changes and development of children's understanding after the use of *Colour Jump Ball* media in the later stages of the study.

Data Analysis Techniques

1. Validity Data Analysis

$$V = \frac{F}{N} \times 100$$

Information:

V :   Level of Validity

F :   Total Scores Obtained

N :   Total Maximum Score

2. Practicality Data Analysis

$$P = \frac{F}{N} \times 100$$

Information:

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P : Practicality Level

F : Total Scores Obtained

N : Total Maximum Score

3. Effectiveness Data Analysis

    a. Reliability Test

$$r_{hitung} = \left(\frac{n}{n-1}\right)\left(\frac{\sum S_i^2}{S_t^2}\right)$$

Information:
rcalcul = Reliability
n = Number of instrument grains
∑Si2 = Total Grain Variance
St2 = Total variance value

    b. Normality Test

$$KD = \frac{\sqrt{n_1} + n_2}{n_1 n_2}$$

Information:

KD = Jumlah *Kolmogorov-Smirnov*
n1 = Number of samples
n2 = Expected amount

    c. Homogeneity Test

        The existence of similarities or relationships in data can be a goal. A group can be said to be homogeneous if there are differences. In this case, *the pre-test* and *post-test data* are the same. The following is the description:
Information:
Na = The Largest Variance of Data.
Nb = The Smallest Variance of Data.

    d. Uji Hypothesis
        Ha : There is an influence on the development of colour jump ball learning media for color recognition and geometric shapes in early childhood in Taud Saqu, Madiun.
        Ho : There is no influence of the development of colour jump ball learning media for color recognition and geometric shapes in early childhood in Taud Saqu, Madiun.

3. FINDINGS AND DISCUSSION

Result
Analysis Stage
a. Needs Analysis

      Based on the results of an observation that has been made, it can be seen that in the Taud Saqu Madiun, teaching materials or learning media such as children's worksheets and simple whiteboards, learning methods that have used a lecture method, and teaching model methods that are very used in the form of classical defense model methods. Based on the results of field observations in Taud Saqu Madiun, it was found that the learning process still relies on conventional media such as children's worksheets and simple whiteboards, as well as lecture methods that dominate learning activities. The classical learning model used also does not support children's motor and participatory activities, which has an impact on low interest and learning engagement.

The results of interviews with three teachers stated that most children tended to be passive during learning, and only 45% of the children showed interest in the recognition of shapes and colors.

b. Student Analysis

Based on the results of this analysis, a teaching media that must be developed by researchers is a Colour Jump Ball media in the introduction of color recognition and geometric shapes in early childhood. The results of observations on 25 children aged 4–5 years showed that only 32% of children were able to correctly pronounce the three basic colors, and only 24% were able to distinguish two geometric shapes (circles and triangles). Based on these findings, the designed media must be able to integrate visual elements, motor movements, and social interaction to improve engagement and learning outcomes. So, the media developed is Colour Jump Ball.

c. Curriculum Analysis

Curriculum analysis at this stage, researchers have carried out various analyses through an Independent PAUD curriculum contained in Permendikbudristek No. 08 of 2022 by analyzing the scope of PAUD material related to the Child Development Achievement Level Standard (*STPPA)* and elements of a mathematical development related to various aspects in developing early childhood and conducting a formulation in a systematic manner. Curriculum analysis refers to Permendikbudristek No. 8 of 2022 concerning early childhood learning outcomes. The researcher matched basic competencies related to color recognition and geometric shapes with the needs of students. The formulation of the content of the material is prepared to be in accordance with the Child Development Achievement Level Standards (STPPA) and aspects of early childhood cognitive-mathematical development.

Planning Stage (*Design*)

At this stage, the researcher has been able to select and breastfeed various kinds of materials to be delivered, determine categories, and design products. This stage contains three stages in designing, namely 1) determining the theme and content of the development media, namely the researcher raises the theme of recognizing color and geometric shapes in early childhood in a medium in the form of Colour Jump Ball. 2) Media in the form of Colour Jump Ball has been designed in the form of a light ball made of plastic or rubber material so that it is easy to throw and catch by students. These balls have striking colors that attract attention, and on the surface there are usually labels, writings, or instructions in the form of questions, questions, commands, or keywords related to the learning material. The surface of the sphere is often divided into several color segments, where each segment has a different content or instructions. This media is designed to create an interactive and fun learning atmosphere, as learners can actively engage in learning activities through throwing and catching the ball, and then answer questions based on the segments touched or designated when catching the ball. In this stage, the researcher set the theme "Color Recognition and Geometric Shapes" with the media of Colour Jump Ball. The media is designed in the form of a light ball made of rubber/plastic that has a striking color surface and is equipped with educational labels or commands. Each sphere segment represents a category of questions or learning tasks related to color or shape. The goal is to create a fun learning atmosphere and engage active movement through throwing and catching activities.

Development Stage

After a study was carried out, the researcher made an initial design on the media in the form of a Colour Jump Ball. The next stage that will be carried out by the researcher is using a development stage which has a function in terms of validating the products of a media in the form of Colour Jump Ball in terms of getting to know the ability of basic mathematical concepts to a student. Validation can also be carried out approximately consisting of 3 (three) validators, namely 1 a material validator and 1 a media validator, whose selection must be adjusted to the availability of existing validators. The Colour Jump Ball media was developed based on the results of the initial design, then validated by three validators (1 material expert, 1 media expert, and 1 linguist). The validation results showed the following

feasibility levels: material validation of 93% (very valid category), media validation of 95% (very valid category), and language validation of 91%.

Implementation

This stage of implementation has a purpose in showing a practicality of media in the form of *Digital* in the word practical that has been intended in this research is that it has a connection in terms of implementing a very good teaching concept, so that a teacher can easily carry out an activity/activity in accordance with the teaching goals that exist in the process of improving the ability to recognize colors and geometric shapes in early childhood using media in the form of Colour Jump Ball. At the initial implementation stage, trials were carried out on 10 children in a guided manner. Children show high enthusiasm, with 80% of children actively answering questions after catching the ball. In the initial field trial, the media obtained a practicality score of 70.20 (practical category) based on teacher and observer observations. Meanwhile, in the main field trial involving 25 children and two teachers, the media obtained a practicality score of 90.36 (very practical category). Teachers stated that this media makes it easier for them to manage the class and keep their children's attention longer.

Evaluation

At this stage, a considerable evaluation of the data that has been obtained is carried out in the form of suggestions obtained from material experts, media experts, linguists, and instrument sheets in testing in early childhood, pretest and posttest in early childhood from the implementation stage which is used to find out how to develop color jump ball learning media for color and shape recognition geometry in early childhood in Taud Saqu, Madiun . Based on the results of the validation of 93 participant material and 95 percent media, which in total stated that it is categorized as a validity or feasibility to be used as a teaching medium. Then at the initial field test stage it was 70.20 in the practical category, **while** the main field trial was 90.36 in the very practical category. It can be concluded that a Colour Jump Ball media is effective in fostering the level of ability to recognize colors and geometric shapes in early childhood Taud Saqu Madiun . The evaluation was carried out through pretest and posttest trials for 25 children. The pretest results showed an average mastery of color and shape concepts of 46.8%, while the posttest results increased to 83.6%, showing an increase of 36.8 percentage points. In addition, observations showed an increase in children's active participation from 40% to 88% in learning activities. Feedback from teachers states that children become more courageous in speaking, focused, and cooperative while learning to use this medium.

Discussion

The research, entitled The Development of Color Jump Ball Learning Media for Color and Geometric Shape Recognition in Early Childhood, aims to develop and test the effectiveness of Color Jump Ball as a learning medium in introducing color and geometric shapes in early childhood. With this innovation, it is hoped that the learning process will be more fun, effective, and in accordance with the needs of children's development. This type of research is research and development or known as *Reasearch and Development* which is carried out procedurally, structured and systematically. The development model used is ADDIE consisting of five stages in the form of *analysis*, *design*, *development*, *implementation*, and *evaluation* (Zuroida et al., 2020; Tarigan, 2024; Mabruroh et al., 2023; Allen, 2006; Jatmiko, 2019; Rustandi & Rismayanti, 2021; Adler & Kim, 2017). At the stage that has been carried out, it starts from a needs analysis that aims to find out a learning process in schools because of the availability of learning materials and media, the learning methods and models applied, and the situation of students in learning activities.

Student analysis that has been carried out to identify the characteristics of students in the learning process by paying attention to their skills, traits, and experiences both individually and in groups where student analysis is carried out through direct observation. Curriculum analysis aims to analyze the curriculum against the standard level of developmental achievement of children aged 3-4 years. The

development stage is to design the Colour Jump Ball media to improve the ability to recognize colours and geometric shapes in early childhood.

The selection of validators and practicalities is determined based on their expertise in their fields in accordance with the *Colour Jump ball media* that has been developed, namely 3 lecturers and 2 teachers. Meanwhile, the practitioners consisted of 2 teachers in Taud Saqu Madiun namely Mrs. Sukatri and Mrs. Asti, the validators and practitioners conducted assessments and filled out questionnaires to determine the level of validity and practicality of a Colour Jump Ball media, improvements continued to be carried out until the Colour Jump Ball was declared valid and practical by validators and practitioners and then tested to students. The steps in testing validity and practicality are by calculating the number of assessment scores from validators and practitioners. In addition, calculate the maximum number of scores, then compare and multiply 100. Then categorized based on the table of validity and practical test results categories. The validation process of a Colour Jump Ball media that has been developed shows the value of the validity level given by the validator of the subject matter expert who has reached 93 who is in the category of stinging validation, the value of the validity level given by the validator of the design expert as well as 94 who is in the category of very valid.

The results of the level of practicality by teachers in Taud Saqu, Madiun , showed a score of 90 which was in the category of practical sting. The results of practitioners in students who used student respondent questionnaires showed the level of practicality in the initial scale trial of 70.20 which was in the practical category and the main scale trial of 90.36 which was in the very practical category. From the results of the validation and practitioners, it can be concluded that the Colour Jump Ball media that has been developed by the researcher is valid and practical to be used and tested in the field, to then be measured for effectiveness. The level of effectiveness of a *digital* media is measured using research instruments by comparing *pre-test* and *post-test results.* At this stage, effectiveness data was obtained through an observation sheet by comparing the results obtained before using the Colour Jump Ball media and the results obtained after using the media.

The results of the research that have been carried out can be seen from the comparison between the overall results of the pretest with an average score of 46% while the results of the posttest obtained an average score of 95% which means that the average score is higher than before using the Colour Jump Ball media. In the use of Colour Dum Ball media, there is an influence on the ability to recognize colors and geometric shapes in early childhood in Taud Saqu, Madiun , which can be seen in the hypothesis test using the t test so that t calculation = (8.516) is obtained, while for t table = (0.443). Then it can be concluded that t calculates> t tables, then Ha is accepted and Ho is rejected, which means that there is a significant influence of the use of Colour Jump Ball media to improve the ability to recognize colors and geometric shapes in Taud Saqu, Madiun . Based on the results that have been determined and analyzed previously, that digital media is successful in accordance with the results of research observations.

According to Prananda et al. (2021) dan Sari et al. (2018) argues that Colour Jump Ball is where children's abilities are obtained based on children's experiences when learning to understand the concepts of numbers, number operations, and number functions. So it can create a fun learning for children because children can remember from children's learning experiences in understanding something. So the development of the Colour Jump Ball media that the researcher developed is able to improve the initial mathematical skills of children aged 5-6 years with children who can solve problems by thinking logically.

While menurut Amalina (2020) dan Abidin (2015) that the prose of thinking that emphasizes in human reasoning or thinking. So that it can stimulate children to be able to understand and be able to understand the surrounding environment. So from the presentation of Colour Jump Ball, it can be concluded that the development of media that the researcher makes is very effective in improving the ability to recognize colors and shapes in children, can be seen from the ability of children to complete commands seriously and think critically from what the researcher makes, and can be categorized in developing according to expectations.

In improving the ability to recognize children's colors and geometric shapes, which is carried out using Colour Jump Ball learning media, it can provide a fun learning atmosphere and motivation for children to follow the learning process (Estari, 2020). One of the goals of the Colour Jump Ball media is to introduce beginner mathematical skills such as numbers, geometric shapes, patterns, and comparisons, increase motivation and interest in learning, support fun, interactive learning, and improve critical and creative thinking skills (Foohs & Giraffa, 2022; (Barr et al., 2011a); (Ahmadi, 2017) (Ahmetya et al., 2023) (Barr et al., 2011b). This statement can be concluded that Colour Jump Ball media is good if it can make learning effective. A learning is said to be effective if the learning activities carried out on that day can facilitate students to gain knowledge, skills, increase motivation, interest in learning, and good learning outcomes. So it can be concluded that from the results of the validity test conducted by the validator, the practicality test by the classroom teacher, and the effectiveness test on students in Taud Saqu Madiun, the Colour Jump Ball media is suitable to be used to improve the ability to recognize colors and geometric shapes in early childhood.

Empirically supports and reinforces theories and findings in previous studies on the effectiveness of game-based and multisensory learning for early childhood. In this study, the use of Colour Jump Ball media was proven to significantly increase children's ability to recognize colors and geometric shapes, which was shown by an increase in the average score of the pretest from 46% to 95% in the posttest, and strengthened by the results of the t-test ($t\_hitung = 8.516 > t\_tabel = 0.443$) which showed statistical significance. Educational games designed with explicit learning objectives in mind can increase children's engagement and cognitive processing more effectively than direct instructional methods. In addition, the results of this study are also in line with emphasizing that the combination of motor and cognitive activities in one learning activity strengthens the neural connectivity between the motor area and the prefrontal cortex which plays an important role in attention control and decision-making. The Colour Jump Ball media, which integrates visual, motion, and social interaction elements, also proves that the multisensory learning environment is very effective. They emphasize that learning experiences that stimulate multiple senses simultaneously will improve the understanding of abstract concepts such as shapes and colors. Thus, the results of this study not only strengthen previous theories and findings, but also make practical contributions in the form of valid, practical, and effective innovative media to support early childhood learning, especially in the context of early childhood education in Indonesia.

4. CONCLUSION

Colour Jump Ball was developed to test its effectiveness as a learning medium in introducing colours and geometric shapes with a validity level of material experts of 93 and a validity level of media experts of 94. So that the Colour Jump Ball is declared very valid for use and trial in the field. The Colour Jump Ball which was developed to recognize the ability of colours and geometric shapes with a practical level in the initial field trial was 70.20, while in the main field trial it was 90.36 so that this Colour Jump Ball was declared very practical for students to use in learning. The effectiveness of digital media that can be seen in the hypothesis test using the t-test, obtained t calculation = 8.516 while for t table = 0.443. So it can be concluded that the calculation of the t > t of the table, Ha is accepted and H0 is rejected, which means that there is a significant influence of the use of Colour Jump Ball as a learning medium in introducing color and geometric shapes in early childhood in Taud Saqu, Madiun.

References

Abidin, Z. (2015). *Intuisi Dalam Pembelajaran Matematika*. Lentera Ilmu Cendekia.

Adler, R. F., & Kim, H. (2017). Enhancing future K-8 teachers' computational thinking skills through modeling and simulations. *Journal Education and Information Technologies*, 23(4), 1501–1514.

Agustina, R. S., & Rahaju, T. (2021). Evaluasi Penyelenggaraan Pendidikan Inklusif di Kota Surabaya. *Publika*, 9(3), 109–124. https://doi.org/10.26740/publika.v9n3.p109-124

Ahmadi, F. (2017). *Guru SD di Era Digital: Pendekatan, Media, Inovasi*. CV. Pilar Nusantara.

Ahmetya, A. R., Setyaningrum, I., & Tanaya, O. (2023). Era Baru Ketenegakerjaan: Fleksibilitas Pekerja Digital Pada Era Revolusi Industri 4.0. *Sang Pencerah: Jurnal Ilmiah Universitas Muhammadiyah Buton*, *9*(4), 1001–1015. https://doi.org/10.35326/pencerah.v9i4.4495

Akbar, J. S., Dharmayanti, P. A., Nurhidayah, V. A., Lubis, S. I. S., Saputra, R., Sandy, W., Maulidiana, S., Setyaningrum, V., Lestari, L. P. S., Ningrum, W. W., Astuti, N. M., Nelly, N., Ilyas, F. S., Ramli, A., Kurniati, Y., & Yuliastuti, C. (2023). *Model & Metode Pembelajaran Inovatif: Teori dan Panduan Praktis*. PT. Sonpedia Publishing Indonesia.

Akmala, I., & Wathon, A. (2020). Pengembangan Game Ketangkasan Melalui Alat Permainan Edukatif. *Sistim Informasi Manajemen*, *3*(1), Article 1.

Ali, N. N., & Ni'mah, K. (2023). Analisis Kemampuan Peserta Didik dalam Menyelesaikan Soal Geometri pada Asesmen Kompetensi Minimum-Numerasi. *Jurnal Ilmiah Matematika Realistik*, *4*(2), 267–274. https://doi.org/10.33365/ji-mr.v4i2.4006

Alina, N., & Wathon, A. (2019). Pembelajaran Aktif Melalui Alat Permainan Edukatif. *Sistim Informasi Manajemen*, *2*(2), Article 2.

Allen, W. C. (2006). Overview and Evolution of the ADDIE Training System. *Advances in Developing Human Resources*, *8*(4), 430–441. https://doi.org/10.1177/1523422306292942

Amalina, A. (2020). Pembelajaran Matematika Anak Usia Dini di Masa Pandemi COVID-19 Tahun 2020. *Jurnal Obsesi : Jurnal Pendidikan Anak Usia Dini*, *5*(1), 538. https://doi.org/10.31004/obsesi.v5i1.592

Andriliani, L., Amaliyah, A., Putry Prikustini, V., & Daffah, V. (2022). Analisis Pembelajaran Matematika pada Materi Geometri. *SIBATIK JOURNAL: Jurnal Ilmiah Bidang Sosial, Ekonomi, Budaya, Teknologi, dan Pendidikan*, *1*(7), 1169–1178. https://doi.org/10.54443/sibatik.v1i7.138

Arsini, Y., Yoana, L., & Prastami, Y. (2023). Peranan Guru Sebagai Model dalam Pembentukan Karakter Peserta Didik. *MUDABBIR Journal Research and Education Studies*, *3*(2), Article 2. https://doi.org/10.56832/mudabbir.v3i2.368

Aslindah, A. (2027). *Alat Permainan Edukatif: Media Stimulus Anak Jadi Aktif dan Kreatif*. Kaaffah Learning Center.

Azizah, M., Sulianto, J., & Cintang, N. (2018). Analisis Keterampilan Berpikir Kritis Siswa Sekolah Dasar pada Pembelajaran Matematika Kurikulum 2013. *Jurnal Penelitian Pendidikan*, *35*(1), Article 1. https://doi.org/10.15294/jpp.v35i1.13529

Badruddin, E. (2013). Implementasi Pendekatan Realistik pada Pembelajaran Operasi Bilangan Real untuk Meningkatkan Hasil Belajar Siswa SMK Negeri 5 Telkom Banda Aceh. *Jurnal Peluang*, *2*(1), 1–16.

Barr, D., Harrison, J., & Conery, L. (2011a). Computational Thinking: A Digital Age Skill for Everyone. *Learning and Leading with Technology*, *38*(6), 20–23.

Barr, D., Harrison, J., & Conery, L. (2011b). Computational Thinking: A Digital Age Skill for Everyone. *Learning and Leading with Technology*, *38*(6), 20–23.

Boonen, A. J. H., Van Wesel, F., Jolles, J., & Van der Schoot, M. (2014). The role of visual representation type, spatial ability, and reading comprehension in word problem solving: An item-level analysis in elementary school children. *International Journal of Educational Research*, *68*, 15–26. https://doi.org/10.1016/j.ijer.2014.08.001

Charmila, N., Zulkardi, Z., & Darmawijoyo, D. (2016). Pengembangan soal matematika model PISA menggunakan Konteks Jambi. *Jurnal Penelitian Dan Evaluasi Pendidikan*, *20*(2), 198–207. https://doi.org/10.21831/pep.v20i2.7444

Dewi, D. R. (2016). Penggunaan Metode Problem Solving Untukmeningkatkan Prestasi Belajar Siswa pada Pelajaran Matematika Tentang Lingkaran di Kelas VIII A SMPN 11 Madiun Tahun Pelajaran 2015/2016. *Jurnal Ilmiah Pendidikan Matematika*, *5*(1), 43–49.

Erna, N. D., Umi, K. A., & Ari, I. (2017). The Math Problem Solving Profile in Solve Linear Programming ' sProblem Based On Mathematic Communication Ability. *JIPM (Jurnal Ilmiah Pendidikan Matematika)*, *6*(1), 53–59.

Estari, A. W. (2020). Pentingnya Memahami Karakteristik Peserta Didik dalam Proses Pembelajaran. *Social, Humanities, and Educational Studies (SHES): Conference Series*, *3*(3), Article 3. https://doi.org/10.20961/shes.v3i3.56953

Fatmawati, N., & Sofia, A. (2024). Pelatihan Permainan Sirkuit Warna untuk Mengembangkan Fisik Motorik Kasar Anak bagi Guru PAUD di Bandar Lampung. *urnal Pengabdian Masyarakat*, *2*(1). https://doi.org/10.62005/jamarat.v2i1.113

FOOHS, M. M., & GIRAFFA, L. (2022). REMEDIATION FROM PRINT TO DIGITAL NARRATIVES: A PROPOSAL FOR AN ACTIVE METHODOLOGY USING SCRATCH. *Educação Em Revista*, *38*. https://doi.org/10.1590/0102-469835770t

Gumelar, M. S. (2010). *Comic Making: Membuat Komik*. An1mage.

Jatmiko, A. (2019). *Joyful English Games: Pendidikan Bahasa Inggris*. Ahsyara Media Indonesia.

Khotimah, N. (2023). Penggunaan Permainan Sains Colour March pada Sensori Anak Usia Dini. *Journal of Education Research*, *4*(2), 856–863. https://doi.org/10.37985/jer.v4i2.269

Kusnadi, E., & Azzahra, S. A. (2024). Penggunaan Media Pembelajaran Interaktif Berbasis Wordwall dalam Meningkatkan Motivasi Belajar Peserta Didik Pada Mata Pelajaran PPKn di MA Al Ikhlash Padakembang Tasikmalaya. *Jurnal Dimensi Pendidikan dan Pembelajaran*, *12*(2), Article 2. https://doi.org/10.24269/dpp.v12i2.9526

Li, R., Zhang, J. ,., & Wang, L. (2000). Multisensory learning environments and their impact on preschoolers' cognitive development. *Frontiers in Psychology*, *11*(2), 129.

Mabruroh, D. A., Faishol, R., & Muftiyah, A. (2023). *Pengembangan E-Learning Berbasis Website Sebagai Sumber Belajar Fikih Model Blended Learning*. *4*(3).

Maharani, S., Nusantara, T., As'ari, A. R., & Qohar, Abd. (2020). Computational Thinking: Media Pembelajaran CSK (CT-Sheet for Kids) dalam Matematika PAUD. *Jurnal Obsesi : Jurnal Pendidikan Anak Usia Dini*, *5*(1), 975–984. https://doi.org/10.31004/obsesi.v5i1.769

Meduri, N. R. H., Firdaus, R., & Fitriawan, H. (2022). Efektifitas Aplikasi Website Dalam Pembelajaran Untuk Meningkatkan Minat Belajar Peserta Didik. *Akademika*, *11*(02), Article 02. https://doi.org/10.34005/akademika.v11i02.2272

Prananda, G., Friska, S. Y., & Susilawati, W. O. (2021). Pengaruh Media Konkret Terhadap Hasil Belajar Materi Operasi Hitung Campuran Bilangan Bulat Siswa Kelas IV Sekolah Dasar. *JEMS: Jurnal Edukasi Matematika Dan Sains*, *9*(1), Article 1. https://doi.org/10.25273/jems.v9i1.8421

Prastowo, A. (2015). *Panduan Kreatif Membuat Bahan Ajar Inovatif*. Diva Press.

Pribadi, B. A. (2016). *Desain dan Pengembangan Program Pelatihan Berbasis Kompetensi Implementasi Model ADDIE*. Kencana.

Qudsi, M. I. E., & Syamtar, I. A. (2020). Instagram dan Komunikasi Politik Generasi Z dalam Pemilihan Presiden 2019 (Studi pada Mahasiswa Universitas Pertamina). *Perspektif Komunikasi: Jurnal Ilmu Komunikasi Politik dan Komunikasi Bisnis*, *4*(2), Article 2. https://doi.org/10.24853/pk.4.2.167-185

Ribner, A. D., HHJFVJ, hasvdhgV, & SVHgs. (2022). Motor skills and early academic achievement: A meta-analytic review. *Early Childhood Research Quarterly*, *54*, 170–184.

Rosmiati, M. (2019). Animasi Interaktif Sebagai Media Pembelajaran Bahasa Inggris Menggunakan Metode ADDIE. *Paradigma - Jurnal Komputer dan Informatika*, *21*(2), 261–268. https://doi.org/10.31294/p.v21i2.6019

Rustandi, A., & Rismayanti, R. (2021). Penerapan Model ADDIE dalam Pengembangan Media Pembelajaran di SMPN 22 Kota Samarinda. *JURNAL FASILKOM*, *11*(2), 57–60. https://doi.org/10.37859/jf.v11i2.2546

Ruwaida, H. (2019). Proses Kognitif dalam Taksonomi Bloom Revisi: Analisis Kemampuan Mencipta (C6) Pada Pembelajaran Fikih Di MI Miftahul Anwar Desa Banua Lawas. *Al-Madrasah: Jurnal Pendidikan Madrasah Ibtidaiyah*, *4*(1), 51. https://doi.org/10.35931/am.v4i1.168

Sari, N. I. P., Subanji, & Hidayanto, E. (2018). Diagnosis Kesalahan Penalaran Matematis Siswa Dalam Meynyelesaikan Malah Pola Bilangan. *JKPM, Junal Kajian Pembelajaran Matematika*, *2*(2), 64–69.

Tarigan, J. R. (2024). Pengembangan E-Modul Berbantuan Articulate Storyline untuk Meningkatkan Hasil Belajar Siswa Kelas V SDN 107434 Rumah Liang. *IJEB*, *2*(1). https://doi.org/10.61214/ijeb.v2i1.257

Zosh, J. M., Markei, hxzhcahs, gaDGVD, C., & bavcHA. (2022). Learning through play: A review of the evidence. *Nature Human Behaviour*, *6*(3).

Zuroida, H., Fitriani, E., & Astuti, E. S. (2020). Pengembangan Media Pembelajaran Interaktif Berbasis Moodle pada Mata Pelajaran Bahasa Inggris. *Prosiding Seminar Nasional IKIP Budi Utomo*, *1*(01), 98–108. https://doi.org/10.33503/prosiding.v1i01.1082