Exciting Early Childhood Game with Coloring Ball Based on Arduino Uno

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Abstract. In early childhood play is a very fun activity, but if in the game it can contain learning more benefits. There are many games there are tools, one of which Design Build this. Design arduino uno-based coloring ball for the introduction of early childhood numbers is a medium designed in such a way as to play and learn. This research is background because games combined with technology and can be useful as a medium of learning for early childhood is very rare, most in this game will focus on one point, namely the game rather than the learners. This method of research uses research and development methods often called Research and Development (R&D) that can still be implemented in this study such as: [1] potential analysis and problems, [2] product collection, [3] design validation, [5] design revisions, [6] product trials, [7] data analysis and reporting. From this conclusion Design the build coloring ball based on arduino uno to the introduction of early childhood numbers worthy of being declared as a play medium combined with the introduction of numbers.

Keywords: Early Childhood, Coloring ball, Arduino UnoFirst Section

1 Background

Children in the age range 0 – 6 years are said to be early childhood. The development that occurs in this age range is very rapid. Based on research results, at this age human development reaches 40%. Therefore this age range is considered very important. Because it is very important, this age is often termed the golden age. Early childhood is the most appropriate time to stimulate children's development. A proper understanding of the developments that occur in this age range can maximize stimulus for children. Knowledge about early childhood development can be an asset for parents and teachers to prepare various strategic steps. Strategic steps that can be prepared include stimulation, approaches, strategies, methods, plans, media or educational game tools, which are needed to help children develop. All strategic steps prepared can certainly be useful in all aspects of development according to the needs of children at each stage of their age [1], [2].

Based on data from the Central Statistics Agency, the number of young children in Indonesia reached 30.73 million people, or around 11.21% of the total population in Indonesia. This number decreased compared to the previous year, namely 30.84 million people. The high number of young children is a challenge, especially in terms of

education. We already know that education for early childhood does not start from kindergarten, but from when they are in the womb. Education is a human effort to develop and grow one's potential [3]. Educating is a process to encourage children to grow and develop until they become adults [4].

A process of teaching students using educational principles and learning theories is the definition of learning. Educational principles and theories applied in learning activities are one of the main determining factors for educational success [5]. Several stages that must be considered in learning activities include planning, implementation and evaluation. Learning stages that are carried out well and correctly will support student growth and development [6].

It has been explained previously that learning as an early child begins when he is in the womb until he reaches the age of 6 years. This learning process starts from parents, family, home environment, to the wider external environment. The next process is to start introducing children to early childhood schools, in this case play groups and kindergartens. These two types of education are called pre-school education.

Preschool education provides a variety of long-term benefits. The benefits and success of school are obtained through its contribution to cognitive abilities that are not adequately measured by Intelligence (IQ) tests [7]. Pre-school education support for children's cognitive abilities will be able to make children better prepared to face higher levels of education.

Pre-school education, playgroups and kindergartens are the first types of formal institutions for children. Here children are taught to get to know a wider environment than family and the environment around the house. Through learning at preschool, it is hoped that children will be able to learn about discipline and responsibility from an early age. Even though up to now there is still a lot of debate about the benefits of pre-school education, there is a lot of evidence showing that pre-school education can make children more prepared for school [8], [9].

At this time it is very important to support pre-school education, considering that pre-school education is initial education which is beneficial for the continuation of education at a higher level. Various learning models have been implemented in several pre-school education [10]. Starting from conventional-based or technology-assisted. This aims to ensure that learning activities can run more optimally.

Pre-school education teaches many things to its students. Starting from communication, politeness, self-control, solving problems and basic concepts of arithmetic (mathematics). In this paper we will focus on discussing mathematics. Based on the results of observations made at several preschools in Madiun City, mathematics learning activities have gone quite well so far, although teachers still have some difficulties in delivering the material. One of the problems faced is the lack of supportive learning media. Learning media that provides a special attraction for students, thereby fostering their enthusiasm for learning.

The problems in mathematics learning experienced by several preschools have become the concern of several parties. Some of the solutions implemented are that mathematics learning is carried out using tools available in the environment around us. For example, fun cooking activities, from these activities children are taught to weigh, measure or make patterns [11]. Apart from that, mathematics learning is also

provided with the help of Microsoft Powerpoint ISPRING [12]. Through Microsoft Power Point ISPRING media, children are taught to recognize the concept of numbers.

The learning model assisted by Microsoft PowerPoint ispring also indirectly introduces children to technology. As we know, currently technology is used in almost all walks of life. Likewise in the learning process of early childhood. Even though in its use, children have not been directly involved [3].

Based on the background that has been presented, we are trying to provide a solution that we hope will be able to make a contribution to mathematics learning as well as the use of technology in learning. We designed a teaching aid for mathematics learning using Arduino Uno technology. Where children will be directly involved in practicing using these teaching aids.

2   Method

Research methods are used as tools or methods that researchers can use to collect data on the research being conducted [13]. Besides that, research methods are tools or methods used to answer research questions [14]. Based on these two opinions, we chose to use the research and development method or commonly known as RnD. Research and development procedures that used the initial six steps and at the end are data analysis and reporting steps. In research and development also implement some stages that for now are not focused because the next four stages are a step aimed at products that will be made in a large area or in this case mass produced, while the resulting tool of this research will only be tested in a limited area namely for the manufacture of Early Childhood Excitement Games With Arduino Uno Based Coloring Ball. "The following are steps to be used in the "Research and Development" method that are still relavanable and can be implemented in this study such as: (1) potential analysis and problems, (2) data collection, (3) product design, (4) design validation, (5) design revisions, (6) product trials, (7) data analysis and reporting.

The instruments used in this research include validation sheets. This validation sheet is used by a team of experts to provide an assessment regarding the suitability of the media we create. Based on the assessment of the expert team, we can justify whether this media is appropriate and suitable for use in learning activities about mathematics at the early childhood level.

Fig. 1. Step of Research

3   Result and Discussion

The prototype development of this teaching aid used an Arduino Uno type micro-controller. Arduino is an open source electronic device. This device is often used to design and create electronic devices and software that are easy to use [15]. Arduino was chosen as the type of microcontroller used because this type has several advantages. Some of the advantages include ease of use, relatively affordable prices and modules that have been provided so we just need to use them by adjusting them according to our needs.

Learning media is very important to support early childhood learning. Learning media can be used as an intermediary in stimulating all aspects of development in early childhood, including aspects of moral and religious values, physical motoric aspects, language aspects, social emotional aspects, cognitive aspects and artistic aspects [16]. The development of several learning media for early childhood using Arduino has been widely carried out. For example, in educational games for children's memorization and prayer. This media uses Arduino Nano and Reed Switch in its manufacture [17]. With this media, children are greatly helped because it is easier to memorize daily prayers. Furthermore, Arduino combined with RFID is used as a learning medium about marine animal material [18]. The English Fun media which is used as an English language learning medium for early childhood also uses Arduino in its manufacture [19]. There is also media called "Tepikan" which is an educational game media based on Arduino Uno [20]. This shows that Arduino is a microcontroller whose use has been widely developed. This also shows that the use of technology in early childhood schools is not only limited to the use of laptops and the internet, but goes much further

Coloring Ball is a medium to make it easier for teachers to teach students about numbers. This media can be directly used by students under the supervision of supporting teachers. This media has four main components, namely push button, Arduino, LCD and color ball.

Making Coloring Balls begins with tool design and system analysis. The design of the tool must take into account that this media is used by young children, so its use must be made as simple as possible but still not ignoring the purpose of creating this media. The next stage is the Arduino installation process (Figure 2). This process is done by connecting the Arduino to a PC or laptop using a USB cable.

After the Arduino driver is installed properly, as indicated by the appearance of the first IDE window after verification, we can edit the code according to our needs.
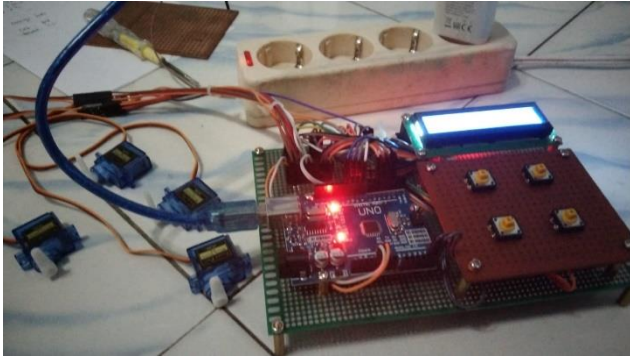
Fig. 2. : Arduino Instalation Process

When we have finished installing and coding according to requirements, the next stage is to assemble the circuit in the casing that has been prepared. The appearance of the Coloring Ball media is shown in Figure 3. The choice of cover design also takes into account the student's focus. Providing minimal images will make students focus more on the media, not on the images in the media. The steps for using media are briefly shown in Table 1.

Fig. 3. : Coloring Ball

Table 1. : Simple step how to use Coloring Ball

Number	Description	Picture
1.	Students enter the ball according to the color on the Coloring Ball	
2.	The teacher gives instructions to remove, for example, 2 red balls, 3 yellow balls, 1 green ball, then students must press the push button according to the color and number mentioned by the teacher. If the student is correct when pressing the button, the balls will come out according to the number mentioned by the teacher, and the LCD layer will also show the same number.	

The Coloring Ball used as a mathematics learning medium has gone through expert testing or validation testing. Assessments from experts are very necessary as input for media evaluation materials, as well as assessing the suitability of this media if implemented in early childhood. The percentage of assessments from experts is shown in Table 2.

Table 2. Result of validation

No	Validator	Aspect				Total
		Komponent	Use	Design	Clear	
1	Validator 1	10	10	10	10	100 %
2	Validator 2	9	8	8	9	85 %
3	Validator 3	9	8	6	9	72 %

Validator 1 as the teacher who taught the number recognition material gave a perfect assessment, namely 100%. According to him, this media is very interesting and useful for learning mathematics. Its use is also very simple for students

Validator 2 gave a lower assessment. According to him, media cover designs tend to be full of images, which will reduce children's focus. For information, the design shown in Figure 3 is the final design after input from the expert team. The second input is the coloring of the push buttons and balls must use colors that are clear and do not cause double perception. The difference in cover design before and after expert team validation is shown in Figure 4.

Fig. 4. Before and after expert team validation

The third input regarding the technique of making tools from Validator 3 is that the display layer selection can be further enlarged. The media must also be equipped with simple instructions for use. This aims to make it easier for users to operate the tool. Based on the three expert teams, the total percentage of media suitability level assessments was 88.33%. Based on the validity criteria table, this value shows that the media is suitable for use but still requires several improvements [13].

The next stage is user testing. This test is intended to find out input from users, in this case students, regarding media. Because the respondents in this test were children, we used an instrument in the form of an observation sheet. We will observe students and ask questions about the media.

Based on observations, the feedback we got from students was that they were very happy because they could learn about technology. They feel happy because there is direct involvement in the use of media, moreover according to them this media is "sophisticated". According to them, they usually only use wooden blocks or drawing paper. If you use a laptop, only the teacher is allowed to use it, while they are only spectators.

Secondly, they said that if the ball were bigger it would have been more fun. According to them, the ball is small, like candy, so they are afraid of swallowing it. Apart from that, it is also better to enlarge the size of the push button so that it is easy for their small hands to press it. Based on the responses from students when they use this media, it appears that they are very enthusiastic. They feel like they are playing with "advanced" technology, and this makes them feel good.

4   Conclusion

Coloring Ball is a learning medium for recognizing simple numbers for young children. This media is declared suitable for use in learning activities. The weakness of Coloring Balls is that the balls used are not big enough so there is a risk of them being swallowed by children. Second, the LCD used can be changed to a larger size, making it easier for children to see the results of their work. Further research can develop Coloring Ball into media that is integrated with both laptops and smartphones, and is equipped with incorrect and correct response sounds to what students have done according to the teacher's instructions.

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