Validation of audio-based solar system visual aid for special school students

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Abstract. Making and testing of miniature solar systems intended for students has been carried out and specifically for special school students. The purpose of making this tool is to help the learning process in students with special needs for science materials, especially in the solar system. The solar system visual aid consists of sun with its planets, including from Mercury to Neptune. Planets were designed to move automatically. In addition, this visual aid was also made audio containing explanations for each planet and also the sun. Validation of tools is carried out by material and media experts. The results of the material validation are good. While the media validation is sufficient and received well. This audio-based solar system visual aid is good enough to be used by special school students.

1. Introduction

Education is the right of all Indonesian citizens protected by the 1945 Constitution of the State of the Republic of Indonesia article 31 section 1 and 2. Thus, education should touch all walks of life, both from the lower economic society to the upper economic society, the people living in big cities up to people living in rural areas maybe even in remote areas, ranging in age from children to old age. With education, self potential can be explored and developed maximally, not only for normal society, but also for children with special needs [1].

In special education, children with visual impairments are more familiarly called blind children. Understanding blind people are not only those who are blind, but also include those who are able to see, but are very limited and less can be used for the benefit of everyday life, especially in learning. So children with vision conditions that include half sight, low vision, or myopic are part of a group of blind children [2]. Based on the level of the disorder, blind people are divided into two: totally blind and those who still have low vision. In the field of special education, children with visual impairments are more familiarly called blind children [3].

Based on the observations of researcher who have been conducted at Special School throughout East Jakarta, it showed that the Special School does not generally have teaching materials that support the learning process of blind children, for example in Learning Natural Science. From the results of interview with blind student, the researcher obtained information that the interest of blind students in natural science was very large. However, the availability of learning resources is very...
minimal. For this reason, it is necessary to make a material or tool that can assist them in the process of learning and understanding about natural science. Because of this, the researcher took the initiative to make a simple teaching visual aid for science subjects.

Lessons about the solar system in Special Schools are found in 6th grade science subjects. The solar system itself can be interpreted as a collection of celestial bodies, which consist of the sun and several other objects that are bound because of the gravitational force, see [4] [5]. These objects are planets that circle the sun, asteroids, meteors, and comets. The planets surrounding the sun include Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune. There have been many studies on making of learning media for science subjects in solar system material, both from elementary, middle and high school levels. Among other things carried out by Melinda [6] which resulted in a research in the form of multimedia products for interactive learning as an effective and interesting source for the material of VI grade elementary school solar systems. Pakpahan [7] has conducted research on the application of demonstration methods by using audio visual media for solar system material. In addition, similar studies have also been conducted, namely the development of teaching visual aid of the solar system by Putri[8]. The tool was made for students with visual impairments in class IX at the YAAT Special School-A in Klaten.

The visual aid that will be made are teaching visual aid with audio-based solar system material. Audio-based means, there are sound recordings that explain the sun and eight planets circling the sun. This teaching visual aid is intended to help the learning process of students in Special schools. With these visual aid, it is expected that students in Special schools can easily understand the solar system.

2. Methodology

This study was conducted from September, 2018 to April, 2019. The method used in this study was research and development (R & D), with a 4 D development model, namely define, design, develop, and disseminate. In this study, it arrived at the development stage, because the purpose of this study was only to make visual aid and to test their usefulness. Some tools and materials used in making simple visual aid included large plastic balls, small plastic balls, black wire straws, pipe, watercolor, acrylic, batteries, small dynamos, electric cables, wooden boards, MMC, Speaker boxes, stops contact, and glue.

The making of miniature solar system visual aid is carried out at Universitas Indraprasta PGRI, Jakarta. The construction began with drawing designs, collecting tools and materials, assembling tools, making audio which was an explanation of each planet and the sun, and validating tools from experts. The design of the visual aid of the solar system that will be made as shown in figure 1.

![Design of a simple solar system visual aid. (a) is a design tool to be made with information 1) Sun, 2) arrangement of planets, 3) pipe, 4) box. (b) the arrangement of the solar system.](image-url)
In figure 1 above, the pipe is not only intended to support the sun, but also to save the electrical cables. While the box at the bottom is used as a base so that the tool can stand upright, it is also used to save speaker and dynamo.

Validation for the solar system visual aid that has been made is conducted materially and theoretically. The validator is an expert in a field, namely teaching staff at Universitas Indraprasta PGRI. This validation is needed to find out how much audio teaching materials assisted by solar system visual aid for the blind before being tested at school.

Validation of material and media was done by filling in the questionnaire that has been made. The questionnaire consisted of 9 statements that contained aspects of the suitability and accuracy of the material, as well as aspects of material fitness. Some statements for material validation, including 1) Tools in accordance with the material, 2) As a support teacher in science learning media, 3) In accordance with the facts, 4) Can explain the abstract material, 5) Completeness of the components of the tool in accordance with the material, 6) Tools can attract and motivate students, 7) Suitability of tools and materials with the current development, 8) Support the industrial revolution 4.0, 9) Material renewal.

While some statements for media validation, among others 1) Attractive design, 2) Location of appropriate components, 3) Colors in accordance with the situation, 4) Appropriate size, 5) Can describe real shapes, 6) Easy to use, 7) Comfortable to use, 8) easy for students to understand, 9) practically everywhere. Each of the statements above, both from the material and the media, is given evaluators 1 - 4 for each statement. The assessment has a qualitative meaning as in table 1 below:

| Value | Criteria          |
|-------|------------------|
| 1     | Very Poor        |
| 2     | Less Good        |
| 3     | Fair             |
| 4     | Good/appropriate/clear |

If a is the value of each statement item and b is the total value of each statement item, then the assessment for the validation sheet can be calculated by:

\[ N = \frac{\sum a}{\sum b} \]  \hspace{1cm} (1)

For average values, if T is the validator of each field, it can be calculated by:

\[ R = \frac{\sum N}{\sum T} \]  \hspace{1cm} (2)

3. Results and Discussion

3.1. Visual aid to the solar system

The visual aid for solar system displays that have been made are shown in figure 2. The central part of the solar system with this visual aid is the Sun, which is a staring our solar system. Next to the side are the planets Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune. The arrangement is shown in figure 3.
As a buffer for the sun in this miniature visual aid is a pipe which is punched in the top (under the sun) to insert a wire. Wire is used as a buffer for each planet. The wire is then covered with a black straw to make it look better. The planets are made of balls of various sizes, depending on the size of the planet. Big balls for large planets, and small balls for small planets. Although not in actual comparison. Planets are sorted according to the order of planets to the sun, the distance between each planet is not determined by comparison between the actual distance of the planet. The planets of the balls are then given color.

The planets in the figure 3 above can rotate by pressing the switch button in the wooden box (bottom), this is because a dynamo is given which can make the planets spin. In addition, in the wooden box, there is also a speaker that when the on button is turned on, it will display sound / audio which contains an explanation of the sun and the planets. This is as shown in figure 4.
Figure 4. Wooden box with contents inside. (a) the appearance appears from the front. (b) the display appears from the side when the lid is opened 1) dynamo, 2) speaker, 3) battery, 4) switch.

3.2 Tool Validation
An evaluation or validation of a simple solar system based audio for special school students has been carried out. Validation is done both material and media. Each validation consists of two validators with expertise in their fields.

3.2.1 material validation
The results of material validation as shown in figure 5. Evaluation of material validation from validator 1 and validator 2 are 3.78 and 3.89. The two values are then added up and divided into two, so that the final value of material validation is 3.83. This value, if adjusted to table 1, can be interpreted qualitatively that the tool is good, appropriate, and clear.

In the comment sheet, there is input from the validator which provides explanation that it is better if the distance between the planets is adjusted to the scale. This input is of course aimed at making the tool even better. In this visual aid, indeed the distance between the planets has not been adjusted to the scale. This is due to difficulties in adjusting the actual scale, if the visual aid are still made in small and compact size.

Figure 5. Graph of material validation values
3.2.2 tool validation

While the results of media validation obtained values as shown in figure 6. Toward the visual aid made, the values obtained by validator 1 and validator 2 are 3.67 and 3.44. These two values are then summed and divided into two, so that the average value for media validation is 3.56 with a maximum value of 4.00. A value of 3.56, if adjusted for Table 1, then means that this tool is more than adequate or close to being used as a visual aid for solar cell material based audio for special school students.

![Validation of Media](image)

**Figure 6.** Graph of media validation values

In the comments column for media validation, the validator that contains the input is given so that the tool becomes even better. It states that it is better if audio is given for each planet and sun in the visual aid. This was intended to make the delivery of material for each planet clearer. The initial plan of making this tool was audio for the sun and each planet that circled it, but due to several considerations it was made in one audio. So that it does not rule out the possibility of developing this visual aid media with some audio.

According to Barab et al on this research about virtual solar system project. Focusing primarily on the dynamics of the earth–moon–sun system, we illustrate the modeling process and how learning evolved in this context [9]. This project is one of media learning for students with disabilities. For students with disabilities, using module learning to help study in the class. The universal elearner is an online integrated learning module, under development, that incorporates accessible technology dan universal design for learning [10]. This can use learning students in anywhere and anytime.

Media or teaching materials will help students in quality question to make interactive learning process because the learning experience becomes more meaningful and satisfying [11][12]. Better education media used to assist teaching has constantly been sought by researchers in the educational technology domain[13]. the use of multimedia for students can help students increase learning motivation and student interest in the material, with aids for the blind they are helped in understanding abstract material that becomes real [14]. The technological media have affordances which change the learning experience. Thus, it is important to study the effects of integrating technology in educational settings, and how such technologies can be maximized to improve learning [15][16].

4. Conclusion

Based on the result of the validation by the material and media experts for the research that has been done, namely making simple audio-based visual aid for special school students, the material validation obtained is 3.83 or good. While the result of media validation obtained is 3.56 or more than adequate
and almost good. Therefore, it can be concluded that this tool is good enough to be used as audio-based visual aid for special school students.

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