The Moon Topography Model as an Astronomy Educational Kit for Visual Impaired Student

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Abstract. The visual impaired students need science educational kit at the school to assist their learning process in science. However, there are lack of the educational kit especially on the topic of astronomy. To introduce the structure of the moon, the moon topography model has been made in circular shape only shown the near side of the moon. The moon topography module are easy to be made since it was made based on low cost material. The expertise on astronomy and visual impaired media marked the 76.67 % and 94 % ideal percentage, respectively. The visual impaired students were able to study the moon crater and mare by using the kit and the braille printed learning book. They also showed the improvement in the material understanding skill.

1. Introduction

Teaching natural science subject is tricky. Since the needs for adequate simulation and educational kits are high. This also includes the appropriate image to be used to explain the course material. Astronomy course covers the knowledge of the objects that are far from the earth. Some of the object are difficult to be observed with simple method or optical wavelength. The optical wavelength observation is the main way to observe the phenomenon. Hence, the astronomy is strongly related to the observation using the optical wavelength. However, some of the people have limitation on the visual ability. The students who have the limitation will put less interest to study astronomy.

The visual impaired students is a term for students who are not only unable to see completely but also partially blind. For learning process, the students need to use Braille letter. Even though the learning strategies is similar to the sighted students, the learning strategies need to consider the modification to ensure the messages and contents are well delivered to the students [1]. Optimization of other sense other than visual will be the best way for Astronomy learning. The hearing and touching sense of visual impaired students are employed to study the environment around them. Hence, the research is mainly to build the tactile astronomy educational kit and validate its contents and structures.

The preliminary observation has been done at Madrasah Tsanawiyah Yaketunis (MTs) Yogyakarta. There is lack of educational kit especially for natural science courses. The visual impaired students are able to take benefits by using the educational kit that is supported by braille-written instructions. Their psychomotoric were improved with the help of utilizing the Braille-written ruler, spring and measurement glass [1]. A Touch of the Universe is an

educational kit to introduce the celestial object to the visual impaired students. The simplicity of the kit is able to assist the learning process [2]. The prototype of eclipse models has been built for visual impaired students in the high school level. They were validated to be a good educational kit by the teacher, lecturer and the students [3].

The specific topic in Astronomy need to be considered in such a way that there is improvement on the students interest and curiosity at the end of the learning process. Hence, the topic should be related to the daily observation. They are a moon and number of planets that students familiar with. Even though the visual impaired are unable to observe them.

2. Theory

The educational kits have to cover 6 components. They are learning instructions, students competences, supported information, assignments, worksheets and evaluations. The educational kit is designed to create the learning activities more attractive, to assist the students to be able to study independently and effectively. Hence, the modul is needed to guide the students and teacher for using the educational kit. Based on the objective of the educational kit, it can be divided into two categories. They are core modul and enrichment modul [4]. Astronomy is taught only being a part of the physics and geography courses in the secondary school level. Hence, the astronomy educational kit is created to assist the students who are willing to pursue their knowledge to the advance level in physics and geography courses.

Worksheet was designed to support the learning process using the moon topography educational kit. Worksheet can be utilized to assist the students to apply and integrate the astronomy concepts that they found. Worksheet contains the questions that their answer can be found in the modul. It can be used also to be an experiment guideline for students [1].

To study the astronomical concepts, the students usually use their visual ability to observe the celestial object and investigate the structure of them. The moon and planets in the solar system are interesting objects to be investigated. Since their surface structure and topography are strongly influenced by internal force and external force. The external force will be more dominant if the atmosphere is thinner. From the distance, the surface roughness of moon and planets are difficult to be observed. The moon surface appears to be a flat like surface with a number of dark areas on it. The students need to understand that the actual surface of the moon are full of different structure. There are mountains, highlands, ocean like surfaces and craters [5]. The dark areas correspond to the area that are called as maria. The bright ares correspond to the area that are called as terrae. The sighted students are able to observed the moon surface topography by looking at the picture or watching the documentary movie. They get sense the roughness of the moon surface.

3. Method

This is a Research and Development research. This research was using the experimental method to produce and validate the product. It is not only to produce and develop a product but also to find the solution for practical problem. Procedural method was used in this research to describe the stage to produce the educational kit. The development process was limited to 5 of 7 development step of Borg and Gall. They are research and collecting data, planning, developing the preliminary products, the preliminary products test and the products revision [1]. The products are the moon topography model and worksheet.

4. Result and Analysis

The moon topography has been designed and built. The moon surface of the model is limited to the near side of the moon since it is the surface that are always facing the earth. It contains the structure of maria and terrae. Since the educational kit need to be reproduced easily, the materials were chosen in such away that are easy to find and inexpensive. The material are the

flour, glue and baby oil. They were mixed together and shaped to be like the moon surface. The dark and light areas were painted. The moon topography is in a plate shape since the spherical shape need more delicate process. The diamater of the model is about 20 cm and the thickness is about 1 cm. Besides the moon topography model, the worksheet also has been created. The worksheet is written in Braille. The moon topography is completed with the name of craters, maria and oceanus. Since there is limitation of model area, only the number of structures are put on the model. The complete name of structures are written in the separate sheet that is writter in Braille. They are shown in fig 1. The model was design only for showing the structure of the moon near side surface but not in the scale.

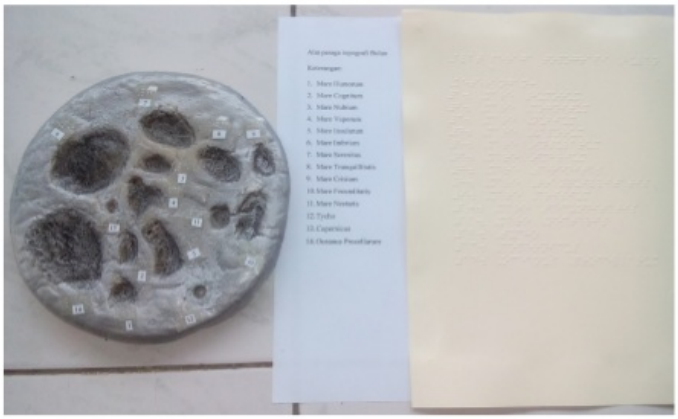

Figure 1. The moon topography model and the Braille written explanation

The validation process was done when the moon topography model was in the preliminary product. This is to ensure that the astronomical contents are correct. Hence, it will avoid any misconseptions on the visual impaired students. There were 3 validators. They were professional astronomers from LAPAN and Bosscha Obervatory and a science communicator. They gave the feedback about the weakness and strength of the model. Besides the content validation, the model was also validated by the teacher to investigate the quality of the product. It is to ensure that the visual impaired students are able to understand the message and have to be safe to be used. Hence, there are number of feedbacks from the content experts and media experts. Most of the feedbacks were followed up to make revision of the preliminary product.

The scoring instrument that were going to be used at the field test have to be validated by the scoring instrument experts. They were 2 lecturers that have background in educational research especially in physics education research. There are 3 aspects need to be validated. They are format, languange and contents. The score are 95%, 97.5% and 100%, respectively. Hence, the average value of the scoring instrument validation is 97%. It means that the scoring instruments is ideal and appropriate to be used.

The revised product need to be evaluated by the content experts, the media experts and the teacher of MTs Yaketunis. There are 3 aspects to be evaluated. The content quality was evaluated by the content experts. The evaluation result by the content experts is shown in table 1. The technical and Braille quality aspects were evaluated by the media experts and the teacher of MTs Yaketunis. The evaluation result by the media experts is shown in table 2. The evaluation results by the teacher of MTs Yaketunis are shown in table 3.

The evaluation results by the content experts show that the products are in a good quality. This is a lower rank than very good quality. Since the moon topography model that was created

Table 1. The evaluation result of the moon topography model and worksheet by the content experts

Aspects	Ideal Percentage %
Content quality of the model	76.67
Content quality of the worksheet	86.67

by the fluor and glue is not perfectly imitate the actual moon topography. The problem rised from the drying process of the fluor-glue mixture. The shringking of the material after dry out alter the topography.

Table 2. The evaluation result of the moon topography model and worksheet by the media experts

Aspects	Ideal Percentage %
Technical aspect of the model	91.67
Braille quality of the model	97.5
Technical aspect of the worksheet	97.5
Braille quality of the worksheet	91.67

Table 3. The evaluation result of the moon topography model and worksheet by the teacher of MTs Yaketunis

Aspects	Ideal Percentage %
Technical aspect of the model	90
Braille quality of the model	100
Technical aspect of the worksheet	95
Braille quality of the worksheet	100

The evaluation results by the media experts and the teacher show that the products are in a very good quality. It implies that the model is an effective model and easiliy to be maintained by students and teachers.

The products try out were given to the 5 visual impaired students of MTs Yaketunis. There were 2 steps for the try out. The first one was the pretest and was followed by hand the worksheet to the students. The second step was the posttest and student quisioners to compile the students responses about the products. The students responses are shown in table 4. The pretest and posttest results are shown in table 5

Table 5 shows the significant improvement occurs on the translation concept. The visual impaired students tend to be careful to try the new experience. However, they are able to translate from the abstract to the simbolic model so that they can understand.

Table 4. The student responses

Aspects	Ideal Percentage %
Content quality of the model	100
Technical aspect of the model	100
Braille quality of the model	100
Content quality of the worksheet	100
Technical aspect of the worksheet	100
Braille quality of the worksheet	100

Table 5. The pretest and posttest of the students

Concepts	Pretest	Posttest
Translation	15	50
Interpretation	20	36.67
Extrapolation	30	40

5. Conclusions

The research and development research on the astronomy educational kit have been done. The products are the moon topography model and the worksheet. The material of the model is inexpensive and easy to find. The evaluation result by the content experts, the media experts, the teacher and the visual impaired students of MTs Yaketunis show that the products are in very good quality and appropriate to be used to support the natural science course especially on the astronomical subjects. The students improvement on the test also show that the products have potential to asisst the students to gain more information and found the concept of astronomy.

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