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Development of science teaching materials based on concept maps using group investigation model to improve student learning outcomes of public junior High School 3 in Ternate City

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Abstract
This research develops science teaching materials based on concepts by using a group investigation model on human respiratory system material. This study discusses the procedures for conducting research and development following development research according to the Directorate General of Higher Education (2008) by combining the stages of the learning model according to Dick and Carrey (1990). The study was conducted at Public Junior High School 3 in Ternate City in class VIIIb with a total of 20 students. Research samples taken from participants with normal distribution with a significant value> 0.05 were tested with the help of SPSS software. The results showed the development of science teaching materials based on the concept is very well used as a learning medium in science learning with the results of the research percentage of 97% in terms of media and 97.4% in terms of material that has been validated by experts as media experts and material experts. Student learning outcomes data is implemented using the t test with the help of SPSS software. For testing hypotheses, the pre-test and post-test data of the experimental class were analyzed using paired sample t-test (different test of two paired samples). In this study, the difference between the pre-test and post-test of each meeting and the difference between the post-test and post-test of each meeting. Evidenced by student learning outcomes in the post-test without the product with the post-test using the product the significant value is 0.00 <0.05. The importance of differences in learning outcomes are significant. Likewise with student learning outcomes, improving material on the human respiratory system reaches 90.59. Increased student learning outcomes are marked by student learning completeness that reaches 100%. This proves that the development of science teaching materials based on the concept of maps using the group investigation model is very well used as a learning medium so that it can improve student learning outcomes in human respiratory system material Public Junior High School 3 in Ternate City.

Keywords: Science teaching materials based on concept maps, group investigations, learning outcomes

Introduction

Teachers in the current era of technology, information and communication are not just teaching but must be learning managers. This implies, each teacher is expected to be able to create learning conditions that challenge students' creativity and activities, motivate students to use media and learning models to achieve the expected learning goals (Rusman, 2012). Learning objectives will be achieved if the teacher is able to package an interesting learning for students by applying various learning strategies, models or methods, so that it can foster student interest and motivation to improve learning outcomes (Ni Wayan, *et al*., 2014) [14]. To improve the quality of education, the government has launched a curriculum as a reference for learning that applies throughout Indonesia. Natural Sciences is one of the main subjects in the education curriculum in Indonesia, including at the junior high school level.

SMP Negeri 3 is one of the schools in Ternate City, North Maluku Province. The curriculum used in SMP Negeri 3 Ternate City is the 2013 curriculum (K13). In natural science there is material for the respiratory system in humans. The material of the human respiratory system consists of three indicators. The first indicator is the human respiratory organs, the second is the mechanism of human breathing and the third is the abnormality or disease found in the human respiratory system. The purpose of presenting this material is that students know how the relationship between the human respiratory organ with its function, how the human respiratory mechanism and what are the abnormalities or diseases of the human respiratory system, both trigger factors, prevention and even treatment.

Science lessons have a lot of material study, so students find it difficult to master. Besides students, the teacher's difficulty is conveying material or transferring knowledge to students. Starting from outlining the respiratory organs and their functions, distinguishing the mechanism of chest breathing and abdominal breathing, outlining examples of diseases of the human respiratory system, triggering factors, prevention to treatment. How can a teacher explain the material so that it is easily understood by students? Students who cannot master the subject matter, will have an impact on the low learning outcomes. Teachers are expected to be creative in presenting respiratory material to humans so that students more easily understand and master the material. Through the concept map, the relationship between diseases in the human respiratory system with trigger factors, prevention and even treatment will be easier to learn because it is more structured. Likewise the relationship between the human respiratory organ with its function and the relationship between chest breathing and abdominal breathing on the human breathing mechanism will be easily understood.

If referring to the concept map, the teacher can create a teaching program that is more directed and tiered, so that in the implementation of the teaching and learning process can increase students' absorption of the material being taught. Concept maps can train students to conceptualize their knowledge so that it is more structured so that it is easy to understand. This is consistent with what was stated by Kusmiati (2005) [15], that the use of concept maps can increase student learning activities.

Teaching material is one example of learning media. Media is an inseparable part of the learning process for the achievement of educational goals in general and learning objectives in particular. Media in the learning process can be interpreted as graphic, photographic, or electronic tools, to capture, process and rearrange visual information (Arsyad, 2009) [6].

In addition to how to transfer knowledge to students, another difficulty of teachers is that learning is applied in part still prioritizing teacher activity, and this causes low student learning outcomes. Therefore, it needs to be improved by learning innovation by emphasizing the activeness of students in the learning process. If using teaching materials, the teacher is easier to convey the subject matter. During observations at SMP Negeri 3 Kota Ternate, LKPD was one of the students' learning media. There is no science teaching material based on concept maps developed by teachers. For this reason, researchers are interested in developing teaching materials. The teaching material that will be developed is teaching materials based on concept map maps. Concept maps are generally included in each teaching material, but different from the concept map in the teaching material to be studied. In the teaching material to be developed, the concept map will be loaded at the beginning of each material sub-chapter. The material that will be included in teaching materials are the human respiratory system, the human circulatory system, plant structure and photosynthesis. So, at the beginning of the lesson material sub-chapter, a concept map will be loaded so students and teachers can find out the entire material in the teaching material by referring to the concept map that has been printed at the beginning of the subject matter.

The benefits of science teaching materials for teachers include supporting the process or teaching and learning activities. For students the benefits of science teaching materials as a learning resource and can be used anytime and anywhere. Both at school and at home, students can learn by using science teaching materials. In addition, teachers do not have to be active in all learning processes. When using teaching materials, learning no longer refers to the teacher.

In addition to the media, the learning model that teachers use in classrooms also supports teaching and learning activities. Based on observations in SMP Negeri 3 Kota Ternate, the learning outcomes of some students in class VIIIb on science subjects under KKM 75. Many factors that enable student learning outcomes are low, for example students who are unable to master the material, unpleasant classroom atmosphere, learning that only teacher centered. This means that students do not actively participate in class and so on.

The results of interviews with science subjects teachers, the learning model that teachers present in the classroom is a conventional model. This means that students only refer to the teacher. Often the teacher has difficulty managing the class because when the teacher explains, there are some students not paying attention to the teacher's explanation. That is because the teacher lacks in making learning discussion groups. Even though the discussion group is very good for practicing how students learn to be more independent and can also hone students' thinking skills. Like the group investigation learning model. The group investigation model is one of the models in cooperative learning that trains students to develop the ability to think independently and critically as well as train students in solving a problem in a group (Wahyu, *et al*. 2013).

The advantages of the group investigation model can make students active in the class. Active student involvement can be seen from the first stage to the final stage of learning. Starting from the formation of discussion groups to present the results of group discussions in front of the class. Using the group investigation learning model, teachers do not have to be involved as a whole in teaching and learning activities, because during teaching and learning activities students play an active role.

If the presentation of respiratory system material in humans uses a group investigation model, the procedure or implementation in the classroom is the teacher will mention the human respiratory organs then divide students into discussion groups. Each group will look for information about the discussion material, for example in teaching materials. Then the group will discuss, exchange ideas with friends and then summarize and present it in front of the class. In addition to practicing thinking skills, student involvement can be seen from the beginning to the end of learning. Learning is not only centered on the teacher. Students are invited to be active in class. The learning process in the classroom is expected to be successful, of course due to the teacher who must be creative in teaching and learning activities and provide adequate learning experiences to students (Amalia, 2011) [2].

Based on the description above, the writer is interested in conducting research with the title “Development of Science Teaching Materials Based on Concept Maps Using Group Investigation Models to Improve Student Learning Outcomes in SMP Negeri 3 Ternate City”.

Research Methods

This research uses research and development methods ("research and development" (R&D) following the stages of Dick and Carey's research development (7 Stages). This research was conducted in March 2019, located at SMP Negeri 3 Ternate City. The subject of this research was class VIIIb, totaling 20 students.

1. Planning

The researcher made observations at SMP Negeri 3 Kota Ternate, then formulated the problem and objectives after obtaining data from students and teachers through questionnaires and interviews. Then the researchers arranged science teaching materials based on concept maps. Researchers will use the group investigation learning model in teaching and learning activities. The steps of the group investigation learning model are (1) Topic selection; (2) Planning for cooperation; (3) Carry out investigations; (4) Prepare the final report; (5) Presentation of the final result or presentation and (6) Evaluation.

2. Exploration Study

Analysis activities are generally carried out through field

studies and literature studies. The observation method is used to observe students' characters during learning. Observations are carried out using observation sheets containing observation instruments and referring to the observation rubric that has been prepared.

3. Development of Initial Product Forms

The activity in this step is an activity of making product design that will produce the desired initial shape, which means collecting materials needed in the development of science teaching materials based on concept maps. The validity of the practicum guide is processed from an expert evaluation and validation questionnaire consisting of 2 aspects, namely the material and language aspects as well as the physical or presentation aspects. The data obtained were analyzed by comparing the number of answers from respondents with the ideal number multiplied by 100%.

4. Validation

In the validation step, there are two aspects that must be considered, namely:

1) Instructional aspects

Instructional aspects are lessons about suitable material, when incorporated into teaching materials based on concept maps, including:

a) Clarity of competency standards to be achieved
b) Ease of understanding material
c) The accuracy of the order of presentation
d) Accuracy of evaluation and so on

2) Product aspects

The product aspects used in learning activities are concept map based teaching materials, including:

a) Writing
b) Readability
c) c) Systematic material
d) Image display quality
e) Clarity of the form of concept maps

Product validation is done through:

a) Expert Validation

Expert validation is carried out by experts or experts in the product field which are useful for reviewing initial products.

b) Field Test

The field test is a test of the use of the product against class VIIIB in SMP Negeri 3 Kota Ternate. The design of the field test is to master the experiment.

5. Product Revision Based on Validation Results

This stage is the final revision stage for the product produced. The product produced at this stage is a product that is ready to be disseminated. The revision was based on input from the results of the field trial in the previous step.

6. Dissemination

This step is a step to report products that have been produced at scientific meetings and/or scientific journals.

Results and Discussion

The product produced is a product that has been through the revision stage, both in terms of media and material. The purpose of this development is to produce products that can be used as learning media both for students and for teachers.

In this study, 7 major stages were carried out in the development research in accordance with the research stages of the Ditnaga Dikti's R&D research with a combination of the Dick and Carey method (1990). The stages of development carried out are (1) Planning which consists of identifying learning objectives; (2) Exploratory studies consisting of analysis of learning, identification of initial behaviors, and formulation of learning objectives; (3) Development of initial forms of products; (4) Making data collection instruments; (5) Expert Validation and Field Test; (6) Revisions based on validation; (7) Product dissemination.

This development is carried out in accordance with the development procedures outlined in the research methodology that involves validation of teaching material experts and material experts so that it can be continued for testing in small groups and large groups. Before conducting a small group trial, the media and material experts were validated. The assessment of media experts on science maps based on concept maps is 89% very good and the assessment of media experts on science maps based on concept maps is 98.21% very good. The response or assessment of students to the concept of science teaching materials based on concept maps in small groups is 84.75% very good. Even though the teaching materials are already very good, the researchers continue to make revisions so that science-based teaching materials based on concept maps are suitable for use in field tests or large group tests. In the large group test the following results were obtained:

1. Science learning products based on concept maps

After the revision, the results of the media expert assessment of instructional materials was 97% and the expert judgment of the material on teaching materials was 97.4%. While the response or assessment of students to teaching materials is 90% and the response or assessment of teachers to teaching materials is 91%. Based on the above it can be concluded that the concept map-based science teaching materials are included in the criteria very well. The use of teaching materials in the learning process has an important role. The role includes the role for the teacher and for students. For teachers teaching materials for teachers have a role, namely:

a. Save the teacher's time in teaching. The existence of teaching materials, students can be assigned to study in advance the topic or material to be studied, so the teacher does not need to explain in more detail.

b. Change the role of the teacher from a teacher to become a facilitator. The existence of teaching materials in learning activities, the teacher is more facilitating students than the conveyor of subject matter.

c. Improve the learning process to be more effective and interactive. The existence of teaching materials will be more effective learning because teachers have plenty of time to guide their students in understanding a learning topic, and also the methods used are more varied and interactive because teachers do not tend to lecture.

For students teaching materials for students have a role namely:

a. Students can learn without attendance or there must be a teacher
b. Students can study whenever and wherever desired
c. Students can learn at their own pace
d. Students can learn in their own chosen order
e. Helping the potential to become independent students.

Similar to the opinion of Lu'Mu (2011) [11], that teaching material when viewed in terms of its function, namely as a presentation material, reference material, and independent learning materials. Science teaching materials that refer to concept maps will make teaching programs more directed and the delivery of structured material so that students can more easily understand. The existence of concept maps at the beginning of the subject matter in teaching material makes students easy to understand the entire contents of the material because it has been summarized in the form of concept maps. This is in accordance with the understanding of Anisa and Hercules (2016) [3], that concept maps will provoke students' creativity in learning, because students are directed to use their potential in an effort to map subject matter so that students are able to remember the concept of subject matter better and longer.

2. Effectiveness of Products and Learning Models in Improving Learning Outcomes

From the results of the study showed that the product which is the result of development is very good for improving student learning outcomes. There was an increase in learning outcomes in the material of the human respiratory system that occurred at the first meeting that was 79.59 and the second meeting which was 84.3 and the third meeting 90.59. The mastery of student learning on human respiratory system material also increased from the first meeting to the end. At the first meeting the percentage of students who completed was only 64.7% ie 11 out of 20 people. The second meeting increased to 82.35% ie 14 out of 20 people and last increased to 100%. This proves that the use of science teaching materials based on concept maps using the Group Investigation learning model has succeeded in improving student learning outcomes. This is in line with Indrawati, *et al* (2013) [13] which states that the use of concept maps can improve student learning outcomes in science learning cycle I to cycle II with the acquisition of an average score of 54.2 to 65.8 with classical completeness 41.6% to 66.7%.

The material displayed attractively through the concept map on science teaching materials makes it easy for students to understand material about the human respiratory system. Concept maps can display the material of the human respiratory system in a structured way from general to specific. The material presented in the concept map starts from the human respiratory organs then the respiratory mechanism to abnormalities or diseases of the human respiratory system. Human respiratory organs are divided into 5 parts, then the mechanism of human breathing is divided into 2 mechanisms and finally examples of disorders or diseases of the human respiratory system. The presentation of this structured material makes it easier for students to understand the relationship of science concepts ranging from respiratory organs to examples of diseases of the human respiratory system. This opinion is supported by Rohana (2009) which states that the concept map is a tool used to find out what students already know. Learning accompanied by the preparation of concept maps enables students to be actively involved in the thought process of linking relevant concepts they have with new information being learned. Students who understand or understand the subject matter will find it easier to do the assignments given by the teacher and impact student learning outcomes. BouJaoude (2008) [8] explains that concept maps can also change the thinking of their makers into more structured and concept maps are successful tools to help low achievers improve their grades.

In addition to the media in the form of science teaching materials based on concept maps that help teaching and learning in class, learning models are also needed. The use of the lecture method has been widely used by teachers. The lecture method tends to make the teacher the center of learning while the students only pay attention to what students have explained without taking an active part in teaching and learning activities. Right now, it's not the teacher center anymore, but the student center. That is, learning should not be teacher-centered, but student-centered. The teacher is only as a facilitator and students who play an active role in the class. One learning model that is not only teacher-centered is the investigation learning group model. According to Indrawati (2011) [12], the group investigation model can develop skills to play a role in groups that emphasize interpersonal communication skills and scientific inquiry skills. Based on the syntax of the group investigation learning model, the teacher divides students into several learning groups then the teacher divides the material that will be the subject of group discussion. Students are required to be active in group work to find information from a variety of group discussion materials. The teacher as a facilitator helps in the course of the discussion. Then students present the results of the discussion in front of the class, while the other groups pay attention. For this reason, the use of the group investigation learning model is very well applied in the classroom. Students who are active in the class will have a good enthusiasm for learning so that it has an impact on increasing learning outcomes. Based on Primarinda's research, *et al* (2012), the group investigation model is able to train students to have scientific process skills and positively influence learning outcomes in the cognitive, affective and psychomotor domains. This is evidenced by the increase in student learning outcomes in SMP Negeri 3 Kota Ternate in the subjects of the human respiratory system using the group investigation learning model with science teaching materials based on concept maps as learning media. Increased student learning outcomes from the first meeting to the last prove that the use of science teaching materials based on concept maps using the group investigation learning model is very well applied in teaching and learning activities in class. The increase in student learning outcomes is marked by the completeness of student learning that reaches 100% from the first meeting to the last on the material of the human respiratory system in class VIIIb, SMP Negeri 3, Ternate City.

Conclusion

The conclusions from the results of research and development of science teaching materials based on concept maps using the Group Investigation model in SMP Negeri 3 Ternate City are as follows:

1. The development of science teaching materials based on concept maps using the Group Investigation model is very well used as a learning medium after passing through the revision and assessment stages of teaching material experts and material experts.
2. The application of science teaching materials based on concept maps using the Group Investigation model can improve student learning outcomes in human respiratory system material in SMP Negeri 3 Ternate

City.

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