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DEVELOPING LEARNING SCIENCE TEACHING MATERIALS BASED ON SCIENTIFIC TO IMPROVE STUDENTS LEARNING OUTCOMES IN ELEMENTARY SCHOOL

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Abstract:
This research aims to develop learning science teaching materials based on scientific. The methods of this study are a research and development (R & D) by Borg and Gall. The instruments that used to collect data were observation sheets, interview guidelines, scoring questionnaires, and test (pre-test and post-test); To verify the effectiveness of the application of teaching materials using t-test. The results of this study can be concluded: 1) The results of the validation of learning experts obtained the value of 4.76 and a result of expert validation material obtained value 4.39. 2) For the effectiveness of teaching materials obtained an average score pre-test and post-test is obtained t_{obs} = 7.9360> t_{table} = 2.024, it can be concluded that the test H_0 is rejected. It means that the teaching materials developed can improve student learning outcomes.

Keywords: development, instructional materials, science, scientific, elementary school

Introduction

Education is a conscious and deliberate effort to create an atmosphere of learning and learning process so that students are able to actively develop the their potential to have the spiritual power of religion, self-control, personality, intelligence, character, and skills which can be useful for themselves, society, nation, and state (UU No 20: 2003). The improvement of education quality is one of the national development programs which is largely determined by the increasing of learning process. The improvement of education quality is the key to success in improving the quality of education. While

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qualified teachers and educators are the main key to improve the quality of learning. Therefore, the education should be encouraged to be able to create a meaningful, fun, creative, dynamic, dialogical and innovative educational atmosphere in the learning process. The purpose of education includes an overview of the values of good, noble, worthy, true, and beautiful for life. The purpose of education has the dual functions of providing directions to all the educational activities contained in an order which is called the curriculum.

Learning science in elementary school (SD) is one of the lessons that can be designed as interactive and student-centered, because Science is closely associated with natural events in the environment of students. The problems that arise in everyday life can be brought into the classroom to be practiced or demonstrated in the learning process, so that students are more actively contributed to the learning process. According Abruscato & DeRosa (2010) that science is studied as a group through a systematic process to collect information on neighbor universe. Science is also the knowledge gathered through the process. Finally, science is characterized by the values and attitudes processed by people who use the scientific process to gather knowledge. In addition, Asy'ari (2006) stated that learning science requires the direct interaction with students with the object or nature. Students can observe and understand the object of science when teachers as facilitators create conditions and provide the mediums so that students will be able to find a concept and build the cognitive structure. In addition, Aktamis and Ergin (2008) that the purpose of science education is to enable peseta students to use the skills of the scientific process, in other words, to be able to define the issues around student activities to observe, analyze, hypothesize experiment, deduce, generalize, and apply information owned with the necessary skills.

Natural science as a discipline and its application in society makes science education becomes important. The cognitive structure of students cannot be compared to the structure of cognitive scientists. Students need to be trained and given the opportunity to acquire skills and be able to think and act scientifically. According to Samatowa (2006) found that elementary school students aged 7 years to 11 or 12 years included in the concrete operational phase, where at this stage students develop logical thinking, but still very tied to the facts of perceptual, it means students are able to think logically but still limited to concrete objects and are able to make observations.

Learning science is defined as learning that educates students to develop scientific thinking skills or known as the scientific learning and actively participate in the learning process, thus it makes patterns within the students to develop the ability to think, learn, a caring attitude towards the surrounding natural environment. According to Fauziah (2013), scientific approach invites students to draw the conclusion over the

problems that exist in the form of formulation of the problem and hypothesis, a sense of environmental awareness, curiosity and love to read. In doing so, students will have the opportunity to conduct an investigation and inquiry as well as develop and present work. Thus, a more scientific approach emphasizes inductive reasoning that educates students to be active in discovery through a process that later resulted in the conclusion. Scientific approach is a learning approach which encourages students to participate in finding knowledge process related to the subject materials through the various activities of the science process as was done by the scientist (scientist) in conducting scientific investigations. That is, students are directed to the various facts, concepts, and necessary new values for their life by themselves.

Based on the observations and interviews that were hold on March 17, 2016 with the fifth grade elementary school teacher Mangkubumen Kulon No. 83 Surakarta, the learning process in the classroom was going pretty well. In each lesson, the teacher always tried to interact with the students, by asking questions, answering questions of students, and motivate students. Yet, during the learning process, teacher often used the lecture and question &answer methods, because they were considered as effective and efficient methods. To support the learning process, teacher used teaching materials like text books or books from outside publishers companion which was not necessarily in accordance with the state of the school and students' worksheet (LKS) developed by publishers who had a cooperative relationship with the school. LKS used by the teacher was selected based on the suitability of the material on the syllabus. Based on the results of the pre-test that was hold on August 6, 2016, they indicated that there was 90% of students who received grades below KKM that is 75, there was 18 out of 20 who had not completed yet. The teacher found that LKS used by the teacher was less supportive in the learning process, because the material in LKS was less completed. According to the teachers, good teaching materials science for elementary school children are instructional materials that use colorful pictures which are interesting to read by the student, containing completed material, using language that is easily understood by the students, and there are guidelines for conducting simple lab science.
From the observations and interviews that had been conducted, it can be the concluded that the main problem is the lack of teaching materials of science learning in the learning process. Therefore, several solutions are needed to overcome these problems, based on a needs analysis it is stated that the teacher needs to make an interesting learning teaching materials and relevant, which can foster students' interest in reading and studying these materials. Teaching materials are aimed to improve the process of learning science in the classroom so they are packaged in the form of scientifically based

teaching materials as materials for the process of learning science and preparation in facing the curriculum 2013.

The crucial role in teaching materials is constrained due to the existing teaching materials which also have deficiencies, so it makes the teaching materials are less useful in learning. Here, the teachers play crucial role in developing teaching materials, in line with Government Regulation No. 19 of 2005 section 20 that teachers are expected to develop their own learning materials to support learning. However, due to limitations of the teacher, most of them cannot implement the development of their own materials. Learning materials are teaching materials arranged in a complete and systematic learning based on the principles used by teachers and students in the learning process. Learning materials is systematical; it means they are arranged in sequence so they make students easier to learn. In addition, teaching materials are also unique and specific because they are used for a specific goal and in particular learning process, while the specific means the contents of teaching materials are designed to achieve a certain competence (Sungkono, 2009). Teaching materials can be defined as all kinds of materials used by teachers to implement teaching and learning activities. Reinforced, Opera and Oguzor (2011) adds that the teaching materials are a source of learning visual or audiovisual form that can be used as an alternate channel of communication in the learning process.

Instructional materials have important role for teachers and students in the learning process. Belawati (2013) argues that the role of teaching materials for teachers, among others: 1) save teachers' time in teaching; 2) change the role of the teacher of a teacher becomes a facilitator; and 3) enhance the learning process to be effective and interactive. While the role of teaching materials for students as follows: 1) students are able to study without a teacher or another students' friend; 2) students are able to learn anywhere and anytime desired; 3) students learn at the speed of learning; 4) students learn based on their desired arrangements; and 5) helping potential students to become independent learners.

According to Suparman (2012)the advantages of teaching materials, as follows: 1) the cost of learning is efficient, because it can be followed by a large number of students; 2) students can go forward with the speed of their own; 3) teaching materials can be reviewed and revised at any time and gradually, piece by piece to improve its effectiveness; and 4) the students receive feedback in manageable units in the learning process, because the feedback process that can be integrated into teaching materials.

Besides the advantages expressed by Suparman (2012), there also disadvantages about teaching materials, including: 1) high development costs; 2) the long development time; 3) it requires a team of highly skilled designers and able to work

intensively during its development; 4) students are required to have a high learning discipline; and 5) the facilitator are demanded to be diligent and patient in learning, motivate and serve individual student consultation whenever they need.

Scientific method was first introduced through the science of American education in the 19th century, as the emphasis on formalistic laboratory methods that lead to scientific facts. Scientific approach according to Hussain (2011) that the involvement of students in learning demonstrated the skills and attitudes that allow finding answers to questions and problems when learners construct new knowledge that has. The scientific approach in the learning process becomes a crucial component. Added by the latter Irwandi (2012) that scientific approach is a core part of contextual based learning activities. Where the acquired knowledge and skills of the students are not expected from the result of a set of facts instead of from the result of finding facts by themselves.

The learning process is called to be scientific if it meets the values, principles and scientific criteria. Kemendikbud (2013) says that the learning process is called scientific if it meets the criteria such as the following: 1) the substance or learning materials based on facts or phenomena that can be explained by logic or certain reasoning not only limited to, approximately, fantasy, legends, and fairy tales alone; 2) explanation of the teacher, student responses, and teacher-student educational interaction free of prejudice necessarily, subjective thinking or reasoning that deviates from the groove to think logically; 3) encourage and inspire students to think critically, analytically and precisely identify, understand, solve problems, and apply the substance or instructional materials; 4) encourage and inspire students to think hypothetically in seeing the differences, similarities, and link to one another on the substance or instructional materials; 5) encourage and inspire students are able to Understand, implement, and develop ways of thinking rationally and objectively in response to the substance or instructional materials; 6) based on concepts, theories and empirical facts that can be justified; and 7) the learning objectives formulated in a simple and clear, yet attractive presentation system. The measures used in the scientific development of teaching materials in this study include: 1) observe; 2) ask; 3) gather information; 4) reasoning; and 5) communicate.

This study aims to determine; 1) the results of science-based development in teaching materials at fifth grade of Elementary School Mangkubumen Kulon No. 83 Surakarta, and 2) the effectiveness of science-scientific based teaching materials to improve students learning outcomes in the material of the respiratory organs and circulatory organ at the fifth grade of SDN Mangkubumen Kulon No. 83 Surakarta.

2. Research Methodology

The model of this research is the research and development of Borg and Gall (2003) which include: 1) research and information collecting; 2) planning; 3) develop preliminary form a product; 4) preliminary field testing; 5) main product revision; 6) main field testing; 7) operational product revision; 8) operational field testing; and 9) final product revision. This research was carried out to the fifth grade of SDN Mangkubumen No. 83 Surakarta. The implementation of this research began from March to December 2016. The tryout subjects of this research were the fifth grade students of SDN Mangkubumen Kulon No. 83 Surakarta in academic year 2016/2017 are 20 students. The data obtained from this research was in forms of qualitative and quantitative data. The qualitative data obtained from observations in the classroom during the tryout, while the quantitative data obtained from a questionnaire given to subject matter experts, learning experts, and students. The instruments used to collect the data were: observation sheets, interview guidelines, scoring questionnaires, and test (pre-test and post-test) to determine the effectiveness of teaching materials by using t-test.

3. Result and Discussion

a. The Procedure of Science Learning Scientific Based Material Development

Initially, the preliminary research includes observation, interview, and literature review. Through the previous study, it is obtained the following condition: the schools still employs SBC (School-based Curriculum), teacher delivers the material through lecturing and question answer; learning science still memories, the teaching material is limited to LKS; and the LKS used is less interesting for students.

Secondly, the design of product development is broadly-based scientific teaching. The result of material development scientific-based of respiratory organs and human circulatory systems include the initial, core and concluding. In the initial or preliminary consists of teaching material identity including francis, acknowledgement, table of content, standard competence, and basic competence, instruction for book usage, the description of teaching material for teacher and students, objective, capacity precondition. The core condition consist of the students' activities in accordance with scientific teaching steps to find out knowledge or information and respiratory organs and human circulatory systems which sustain the teaching process, besides the scientific activities and material in the core of teaching material, it also includes summary and questions to know whether students understand the knowledge and

information has been found. The concluding part includes the summary of overall teaching material, post-test question, and references that contain reference used to construct teaching material.

b. The Result of Teaching Experts' Validation

The data analysis by learning experts is to determine the feasibility of teaching materials that will be applied in the learning process. The result of expert' judgment on the aspects validated by teaching expert is presentation technique, completeness presentation, coherence and flow of thought, and scientific step. The result of teaching expert validation from 21 indicators obtain 100 from overall scores with 4.76 mean scores, so that the teaching material is very good and appropriate in teaching and learning process with revision in accordance with teaching expert' suggestions. Here is an expert assessment of learning on a scale of 1-5 on the frequency distribution based on the assessment by teaching experts who can be seen in Table 1 below.

Table 1: Frequency Distribution Expert Assessment of Teaching

No	Criteria	Frequency	Percentage (%)
1	Strongly disagree	0	0%
2	Disagree	0	0%
3	Less agree	1	4,8%
4	Agree	3	14,3%
5	Strongly agree	17	80,9%
Total		21	100%

The frequency of distribute Table 1 above it can be seen that of the 21 indicators assessed by subject matter experts gained an average of 4.76. Values obtained from the teaching expert exist that shows the criteria very less and less. For criteria, reasonably indicate 4.8%, while for the good criterion of 14.3%. And for a very good criterion of 80.9%. So that the teaching material appropriate in teaching and learning process.

c. The Result of Material Experts' Validation

Evaluation of material experts as a benchmark to improve teaching materials from a material aspect. This validation is done before the test of competence, thereby minimizing errors when applied to the learning process. The material expert validation includes suitability of material descriptions with SC and BC, material accuracy, latest material, encourage the curiosity, and scientific step. The result of material expert validation with 18 indicators obtain 79 scores with 4.39 mean score, so that this teaching material is very good and appropriate to be applied in teaching and learning process.

Here is an material expert assessment in the 1-5 scale frequency distribution data based on an assessment by subject matter experts who can be seen in Table 2 below.

Table 2: Frequency Distribution Expert Assessment of Material

No	Criteria	Frequency	Percentage (%)
1	Strongly disagree	0	0%
2	Disagree	0	0%
3	Less agree	0	0%
4	Agree	11	61,11%
5	Strongly agree	7	38,89%
Total		18	100%

Frequency distribution of Table 2 above can be seen that of the 183 indicators assessed by subject matter experts gained an average of 4.39. Values obtained from the expert material exists that shows the criteria very less is less and pretty. As for the good criterion of 61.11% and for very good criteria by 38.89%. So that the teaching material appropriate in teaching and learning process.

d. The Result of Limited Field Trial

The limited field trial was carried out to six students the fifth grade of SDN Mangkubumen Kulon No. 83 Surakarta, two students with high competence criteria, two students with moderate competence and 2 students with low competence. Based on the result of limited field trial, form 20 assessments indicators obtained the 557 scores with 4.64 mean score. In Table 3 below are shown the frequency distribution data based on an assessment of limited field trial that has been tested to 6 students.

Table 3: Frequency Distribution Limited Field Trial

No	Criteria	Frequency	Percentage (%)
1	Strongly disagree	0	0%
2	Disagree	0	0%
3	Less agree	3	2,5%
4	Agree	37	30,83%
5	Strongly agree	80	66,67%
Total		120	100%

Frequency distribution of Table 3 above it can be seen that of the 20 indicators assessed by the students gained an average of 4.64. Values obtained from learners nothing indicates the criteria very less and less. For criteria, reasonably indicate 2.5%, while for the good criterion of 30.83%. And for very good criteria 66.67%.

By 4.64 mean score, it is concluded that science scientific based teaching material developed by researcher has 'very good' category, so that science teaching material developed has very good appropriateness and is able to be applied in learning process. In addition, through the result of interview with students shows that the teaching material developed is good and the material presented is interesting. The students are able to understand material given and the pictures are also understandable.

e. The Result of Operational Field Trial

The operational field trial was conducted to the 12 fifth grade students of SDN Mangkubumen Kulon No. 83 Surakarta. Based on the result of operational field trial, from 20 indicators with 1052 total scores it is obtained 4.38. In Table 4 below will show the frequency distribution data based on the assessment of operational trials has been tested to 12 students.

Table 4: Frequency Distribution Operational Field Trial

No	Criteria	Frequency	Percentage (%)
1	Strongly disagree	0	0%
2	Disagree	4	1,67%
3	Less agree	32	13,33%
4	Agree	68	28,33%
5	Strongly agree	136	56,67%
Total		240	100%

Frequency distribution of Table 4 above can be seen that of the 20 indicators assessed by the students gained an average of 4.38. Values obtained from learners nothing indicates the criteria very less. Criteria less of 1.67%, for sufficient criteria, showed 13.33%, while for the good criterion of 28.33%. And for very good criteria by 56.67%. From 4.38 mean score, it is concluded that the teaching material of science scientific based which is developed by researcher has 'very good' category so that science teaching material developed has very good appropriateness and is able to be applied in teaching process in the classroom.

f. The Effectiveness of Science Scientific Based Teaching Material

To examine the effectiveness of science scientific based teaching material developed is through competence test. In this research, to examine the effectiveness of teaching material, the researcher uses the students' pre-test and post test scores. To examine the effectiveness of the use of science scientific based teaching material which is developed to improve students' achievement, so it needs to use t test. From t test, it is obtained t_{obs}

= 7,9360 > t_{table} = 2,024, it is concluded that Ho is rejected, it means the teaching material can improve students' achievements.

It is proven by the result of mean score after using teaching material = 76.75 > the mean score before using the teaching material = 56, thus it is concluded that the teaching material developed is effective to improve students' achievements. Comparison of the average value of the pre-test and post-test were obtained by students in class V can be seen in Figure 1 below.

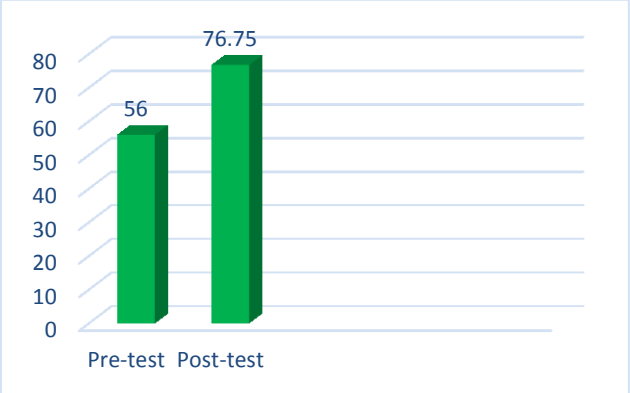

Figure 1: Comparison of Average Value Pre-test and Post-test

4. Conclusion

Based on the result of analysis and discussion, it is concluded that the teaching material developed fulfills valid, effective and practice criteria and can improve student's achievement on science subjects. The result of validation from teaching and material experts show that the teaching material developed is very good and appropriate in teaching and learning process. The result of mean score from teaching expert validation is 4.76 and the mean score of material expert validation is 4.39. The result of limited field trial is obtained the mean score 4.64, while the result of operational field trial is obtained mean score 4.38. To examine the effectiveness of the use of teaching material is employed t test. The result of t test shows t_{obs} = 7,9360 > t_{tabel} = 2,024, thus it is concluded that Ho testing is rejected, it means the teaching material can improve students' achievements.

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