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The Development of Discovery Learning Model to Reduce Science Misconceptions in Elementary School Students

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Abstract

This research was motivated by learning science at SD Negeri 118382 Torgamba where the teacher still used the lecture learning method, passive students and low learning completeness.This study aims to develop discovery learning models to reduce the misconceptions of science in elementary school students. This research was an R&D (Research and Development). The data collection techniques used were interviews, observation, questionnaires, and checklists. Data analysis techniques used qualitative and quantitative with the pretest-posttest group design. The model design is validated by experts and practitioners with the Delphi technique. The effectiveness of the learning model was tested using the t test. The results of the study after two trials showed that the discovery learning model have been valid, practical, and effective. The discovery learning model is stated to be valid because the assessment of all learning components conducted by validator meets the elements of validity. It is stated to be practical because the discovery learning component is fully implemented, and the ability of teachers to manage learning is at the high category. It is stated to be effective because the misconceptions of Science student are in the medium category. The activities of students in learning are fulfilled the ideal time achievement, and the results of the students' questionnaire give the positive respond to discovery inquiry learning. It is concluded that the discovery learning model to reduce the misconception of Science students meets the criteria of valid, practical, and effective.

Keywords: *Development, Discovery Learning, Science Misconceptions*

I. Introduction

The 21st century is marked by the rapid development of science and technology in the field of life in society, especially information and communication technology. According to Morocco, et al (2008) there must be four competencies that students in the 21st century have. The four competencies are: conceptual understanding, critical thinking, creative thinking, and collaboration and communication. In line with this statement, the learning challenges in the 21st century focus on the process of constructing knowledge. Knowledge is not only transformed but also interpreted to produce new knowledge and students are trained to be able to think critically, think creatively, collaboratively and be able to communicate a knowledge as well. P. C. Ifegho (2012: 76) that is: Teacher of science education in the 21st century should accept the contemporary view of NOS to ensure successful inculcation of the 21st century learning skills to the primary science learner and to enable them face the scientific and technological challenges for sustainable development.

Conceptual understanding or understanding the concept of science is one of the important indicators for achieving success in learning science. There is a relationship between understanding concepts with misconceptions, understanding concepts in science learning in the form of mastery of concepts that are in accordance with the agreement of scientists, do not deviate and do not lead to other hypotheses that can lead to cognitive conflict. Meanwhile, misconceptions are errors or incompatibilities of concepts with scientific understanding accepted by experts. The form of misconception can be in the form of initial misconceptions, errors in connecting various concepts, and wrong ideas. The existence of misconceptions must be a concern for teachers, this is because misconceptions can have an impact on the success of students in learning science.

Simarmata (2008), the concept of error in the field of Science has occurred everywhere and occurs at low levels of education to higher education. In this case, based on a preliminary survey conducted by researchers to students at SD Negeri 118382 Torgamba, has identified the misconceptions of Science to the students, which have an impact on the low mastery of concepts owned by the students. In terms of learning tools that are used in schools, the researchers observed that science teaching still teaching Science based on the textbook, with emphasis on lecture and occasionally asked questions and Students Work Sheet still general and not specifically designed in order to reduce the occurrence of Science misconceptions. Students have to follow the way of learning that is selected by the teacher and obediently studying the sequence that assigned by teachers. Students are less to get the opportunity to be actively involved. The learning is generally exam-oriented so, the result of learning occur just a transfer of information from the teacher to the student. Learning its only memorize the concepts, theories or formulas, so it does not provide a deep understanding of the concepts being studied. It is relevant with Taufik (2012: 43) who said that the conventional learning is strongly suspected as a barrier to achieve the remediation of misconceptions and adequate understanding of the concept. The finding of such issues is supported by Ilahi (2012) said that Science learning is not providing opportunities for students to find and implement their own ideas. It is feared that if this continues over time without any attempt to solve it, then students who have misconceptions especially those still sitting in elementary schools, will find it difficult and failed in mastering the advanced science concepts.

The researchers found that one of the low ability of students in the field of science is due to the occurrence of errors or misconceptions concept of science among students. The problem of Science misconceptions has become a common problem and happens to students at all levels of

schooling. The results showed that most students did not develop in terms of understanding scientific concepts and processes in an integrated and flexible manner. For example, they are can memorize various concepts and facts, but cannot use them to explain phenomena in life related to these concepts (Santa, 1991) Science is only understood as a way to gain knowledge (cognitive) has not yet reached the formation of thought patterns let alone character, so that in learning IPA still has errors.

If this misconception is continued, of course, it will be dangerous because it will have an impact on the acceptance of the next concept. Misconceptions experienced by each student have different causes. Therefore, it is very important for teachers to recognize misconceptions and their causes that occur in each student. Some of the factors causing misunderstanding in science learning in elementary schools include the problem that children who are still at the concrete operational stage have to learn abstract concepts, teachers have not been optimal in managing learning, especially in increasing concept mastery. According to Sumaji (2003), one of the error factors in science learning is the occurrence of misconceptions in science learning originating from the students themselves (initial conception before lessons, experience, abilities, and interests), from teachers who also have misunderstandings and misleading teaching, as well as from used book.

This misconception problem is difficult to solve because the students' thinking framework is strong enough hard to change. If not resolved immediately, the students' misconceptions will continue until at the next level of education it may even remain until the student is an adult. Teachers should have the ability to remediate misconceptions that occur. This misconception remediation process can be done by recognizing and exploring students' initial knowledge, especially wrong initial knowledge so that there is no prolonged misconception. In addition, teachers should have the ability to overcome misconceptions that occur in students by applying learning that is more challenging for students to construct their knowledge directly and independently.

To overcome the misconceptions experienced by the students, the teachersmust choose a learning model that canemphasize the process of critical andanalytical thinking to help them see and find their own answers to a problem(Irwandani & Rofiah, 2015; Khomaria &Nasrudin, 2016). The teacher can choose the relevant learning model, the point is that the model chosen is a model that is varied so that students are not bored and motivated in learning, besides that the model selected can also encourage students to develop way of thinking logically by constructing his own knowledge. Thus science learning will become a meaningful learning, because students undergo a process of changing conceptions.

The learning model that suitable to enable students and is expected to reduce the misconceptions of Science is discovery learning model. By discovery learning model, the students are actively involved in acquiring the concepts and principles and the teachers encourage the students to gain experience by doing activities that enable them to find the concepts and principles for themselves (Slavin, 1994). When the students find a concept that contradicts with the initial concept, there will be a cognitive conflict on children's cognitive structure. The stimulation of cognitive conflict in Science learning will greatly assist in the process of assimilation to become more effective and meaningful. The use of inquiry-discovery learning model is not only relevant with the steps of the scientific method but also relevant to the learning theories such as Piaget's theory of cognitive, conditioning, and constructive. The knowledge gained by learning the invention (discovery) allows the knowledge that last a long time or is more easily remembered. Some studies show that discovery learning model is very

superior and effective to be used in learning, especially for Science learning.

Based on the facts above, it is necessary to look at the profileelementary students' misconceptions. Because knowing misconceptions means avoiding learning problems that occur in the event of misconceptions so that learning objectives are more easily achieved.

II. Literature Review

Discovery Learning was introduced by Jerome Bruner, and is a method of Inquiry-Based Instruction. This popular theory encourages learners to build on past experiences and knowledge, use their intuition, imagination and creativity, and search for new information to discover facts, correlations and new truths. Learning does not equal absorbing what was said or read, but actively seeking for answers and solutions. The Discovery Learning Model integrates the following principles: 1) problem solving, 2) learner management, 3) integrating and connecting, 4) information analysis and interpretation and 5) failure and feedback (Brunr, 1961).

The discovery learning educational sessions should be well-designed, highly experiential and interactive. Instructors should use stories, games, visual aids and other attention-grabbing techniques that will build curiosity and interest, and lead learners in new ways of thinking, acting and reflecting. The techniques utilized in Discovery Learning can vary, but the goal is always the same, and that is the learners to reach the end result on their own. By exploring and manipulating situations, struggling with questions and controversies, or by performing experiments, learners are more likely to remember concepts and newly acquired knowledge.

The Discovery Learning approach gives your learners the opportunity to absorb and retain information more effectively. This is primarily due to the fact that they are interacting with it on a more personal level and are able to move at their own pace. Use this article as a guide to integrate Discovery Learning into your next eLearning course and offer your learners the chance to fully engage in the learning process.

There is some evidence that suggests that when students learn a new material, many of them already have some kind of understanding of the problem. They also may have pre-conceptions or naïve theories in theimind about the new or experienced concept. These pre-conceptions are also called alternative conceptions or misconceptions. Misconceptions also can be identified as students‟ prior knowledge, which are embedded in a system of logic and justification, albeit it may be incompatible with accepted scientific understanding (Tomita, 2008, p.10). Usually misconceptions are robust, very resistant to change, and deeply rooted in everyday experience. Often new information, presented by instructor, comes to conflict with already existing student‟s mental models. Therefore, to overcome existing misconceptions, some kind of conceptual change has to occur in the student‟s mind (Michael, 2014).

Students hold a wide variety of misconceptions about the process of science that range from the nature of scientific knowledge to what scientists themselves are actually like. In addition, there are many aspects of the process of science that they know nothing about they are missing conceptions about things like the role of the scientific community. The overarching misconception that students hold is that science isn't a process at all - it's just a bunch of facts. But misconceptions fall into several categories, and this is by no means an exhaustive list

III. Research Method

This research was an R&D (Research and Development). The stages of the development learning model referred to the development model stages proposed by S.Thiagarajan, Semmel

and Semmel (Four-D models). The stages of the development discovery learning model to reduce the misconceptions of Science students were as follows:

Pic. 1. 4D Stage

The research was conducted at fifth grade student of SD Negeri 118382 Torgamba. While the other variables to consider or be involved in the development of discovery learning model is (1) the misconceptions of Science students, (2) the effectiveness of normative models, namely compatibility between learning model theoretically with the implementation in the classroom, and (3) the effectiveness of correlative model that can be observed from the students' activity in the learning process.

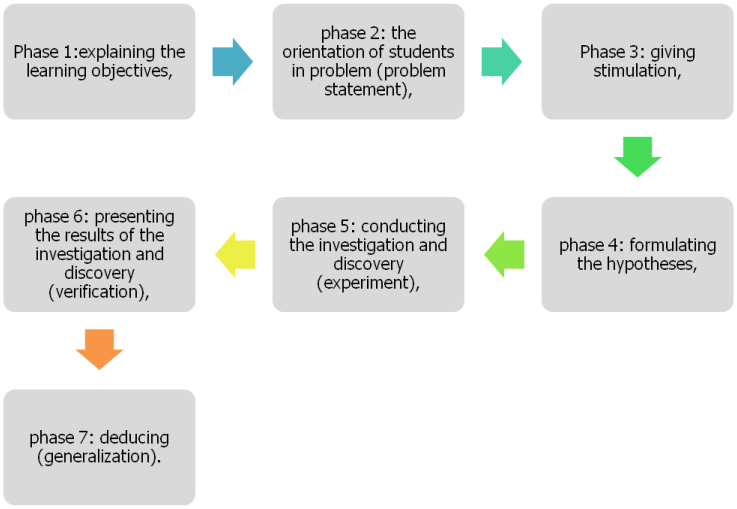
The data analysis was conducted by referring the research problems. Based on the research problem, the data analysis was done in two ways, quantitative and qualitative. To answer the test results of Science misconceptions, it used descriptive statistical analysis by N-gain normalization test. In addition, to clarify the interpretation of the results of the analysis, the data acquisition was also described in the form of diagrams.

IV. Discussion

The results obtained at each phase of development regard to the development process of discovery learning model can be described as follow:

- Defining
  Before carrying out the research, the researchers identified a model of learning and Science misconception by providing observation sheet to the Science teachers at. Based on the results of the initial study that had been done, it was revealed that students in the school generally had Science misconceptions on some specific Science concepts and it needed a specific Science learning model to reduce the Science misconception. The model was expected to have valid, practical and effective criteria.
- Designing
  The results design of discovery learning model was to establish the format of the book models, namely (1) Rational, (2) Support Theories, (3) Discovery learning model, and (4) The Direction of Model Implementation. The rational development of discovery learning model included the things which become the primary consideration or the important basic of discovery model to reduce the Science misconceptions. It also included the results of the research that support the development. In the section about the supporting theories, it stated some related theories, namely (1) the philosophical basis of discovery model, (2) the psychological basis of discovery model, and (3) the learning theory basis. In the section of discovery learning model, it discussed about the basic concept of discovery learning model,

the characteristics of discovery learning model, the components of discovery learning model, and the evaluation applied in learning.
In the section of the direction of model implementation, it discussed two main parts, namely the planning and the implementation of learning. In the planning section, it discussed about the things that need to be prepared so, the discovery learning model can be occurred in a practical and effective, namely (1) Lesson Plan, (2) Students Text Book, (3) Student Worksheet, (4) Task Sheet, (5) Learning Media, and (6) Science Misconception Test. In the section of implementation learning, it discussed the syntax implementation of discovery learning model which consisted of seven phases, namely:



Pic. 2. the discovery learning model

In this phase, the Lesson Plans that were successfully designed based on syntax discovery learning model by taking the consideration related with other components such as reaction principle, social systems, and the impact of instructional and accompanist impact. In the initial design, the Science misconception test had successfully designed 30 test items of true false type (T-F). This instrument was a test item of Science misconception which designed to measure the success of its reduced Science misconception. The design of the test was based on the study and the results of the preliminary observations about the Science material that prone to have misconceptions in SD Neger 118382 Torgamba.
The validity instruments that produced in the design phase was to define the aspects of assessment and indicators in every aspect related to (1) the validation analysis requirement sheet of the development model (2) the validation sheet of discovery learning model, (3) the validation sheet of the implementation of learning model, (4) the validation sheet of the capability of managing model (5) the validation sheet of students' activity (6) the validation sheet of students responses questionnaire sheet, and (7) the validation format of learning device (Lesson Plan, Student Text Book, and the sheet of Science misconception test. The practicality instruments that successfully designed covered the observation sheets, namely: (1) The observation sheet of the implementation of learning model and (2) The observation sheet of the teachers' ability to manage the learning. While the effectiveness instruments which designed include: (1) The evaluation sheet of Science misconception test, (2) Students' activity observation sheet, and (3) Students responses questionnaire sheet.

- Development

- Validity
  The validation result of discovery learning model showed that the average value was Y = 3.25. in terms of all aspects of the discovery learning model, it had met the criteria of validity. So, in terms of all aspects of learning tools such as lesson plans, student worksheet, student text book and Science misconception test then it stated that it had met the validity criteria.
- Practically
  The analysis result of teachers' ability to manage the discovery learning in trial I was the average value of the teacher's ability to manage learning in introductory activities had a value of 3.42 (high), the core activity was 3.46 (high), the closing activity was 3.39 (high), the ability to manage was 3.45 (high), the aspects of classroom atmosphere was 3.52 (very high). While in trial II, the average value of a teacher's ability to manage learning in introductory activities had a value of 3.51 (very high), the core activity was 3.48 (high), the closing activity was 3.39 (high), the ability to manage the time was 3.44 (very high), the aspects of classroom atmosphere were 3.69 (very high). So, in terms of all aspects of learning management, then discovery learning model in trial I and II stated had met the criteria of practicality.
- Effectiveness
  The results of the effectiveness discovery learning model on each trial were analyzed by observing the activity of students, students' questionnaire responses and the result test of Science misconception. At the trial I and II, the observation result of students showed that 9 out of 10 categories of students' activity met the PWI Tolerance Interval (%) which is determined. activity met the PWI Tolerance Interval (%) which is determined. This showed that in terms of the aspects of the students' activity, the discovery learning model trials I and II had met the criteria of effectiveness.
- Dissemination
  Dissemination was the socialization of the result of the development research of discovery learning model that had been done on a limited basis at the meeting of science teachers at SD N 118382 Torgamba. The dissemination was the exposure result of the development research held at the teacher forum in SD 116251 Torgamba.

V. Conclusions

Based on the research results, the researchers present some conclusions thats : 1) science learning at elementary school level, especially in SD N 118382 Torgamba has not been fully focused on scientific learning approach centered on the student and the students still have Science misconceptions on the concept of vibration and optics. 2) the discovery learning model meets the criteria of validity based on the results of the validation of experts and practitioners against the components of the model and the developed learning tools. 3) the discovery learning model meets the criteria of practicality because the implementation of discovery learning has been accomplished entirely and the ability of teachers to manage discovery learning is at the high category. 4) the discovery learning model to reduce the misconception of Science students meets the criteria of effectiveness because the activity of students has been achieved based on the criteria of achieving the ideal time.

Based on the results and discussion, it can be concluded that there was a moderate reduction in students' misconceptions on science after the discovery learning model had been applied. The reduction of misconceptions occurred because the discovery learning model facilitated the

students to be accustomed to freely exploring their own learning resources to find the correct concepts of science. Based on the results of this study, an effective learning model was obtained to reduce misconceptions and it is hoped that the discovery learning model can be applied to other materials

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