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The Application of Discovery Learning Using Interactive Multimedia to Enhance Students' Metacognition onthe Content Area of Biological Inheritance

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ABSTRACT

The purpose of this research is to describe the students' metacognition characteristics after learning using discovery-based interactive multimedia. The research employed experimental design with a pretest-posttest control group design which comprises one experimental group and one control group. This research involved 54 grade nine students at SMPN 4 Gadingrejo, in Pringsewu regency in the academic year of 2016/2017. The questionnaires used to measure students' metacognition are adapted from the Scraw and Dennison (1994) in the journal entitled "Assessing Metacognitive Awareness with Metacognitive Awareness Inventory *(MAI)."* The instrumental questions comprised knowledge pretest and posttest questions which had been aligned with the phases of discovery learning and metacognition strategy. The result showed that discovery-based interactive multimedia had a significant effect on the students' improved metacognition evidenced by the increase in the learning outcome which is represented by the effect size of 0.74. Therefore, the interactive multimedia as the learning media contributes positively to students' enhanced learning outcome.

Key Words: Discovery learning, interactive multimedia, metacognition,learning outcomes.

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INTRODUCTION

The development of science and technology has ushered in an era in which the information is globalized and multidimensional processes are made easier (Poedjiadi, 2005). The enhanced ability and understanding of human resources in terms of science and technology is the key to the advancement of a nation (Bahriah, 2012). Human resources that develop skills and competence constitute a huge capital in the attainment ofadvancement and development. The improved quality of human resources can be realized through the science education. Science education is instrumental in elevating students' ability to understand science and technology (Poedjiadi, 2005).

Science is knowledge instrumental in the development of scientific understanding whereby students are able to explain, evaluate and construct their scientific knowledge on their own (Duschl, *et al.,* 2007). As a subject, science through the development of thinking skills has an applicative orientation (Kemdikbud, 2013). Science provides high order thinking

exercises for students to solve problems through effective strategy designs that help them develop their ability to better regulate their cognition (Inam, 2009).

The science learning process in Indonesia is deemed to be relatively inadequate. This is exhibited by the analysis conducted on the results of Indonesianstudents' achievement in science in several international studies, such as PISA (Program for International Student Assessment) and TIMMS (Trends in International Mathematics and Science Study). The mapping results of PISA in 2015 show that the Indonesian students' average score in science is still below the international average score, which is below 500 pointthat caused Indonesia to rank at 62nd place out of 70 participating countries. Furthermore,based on the results of analysis conducted by TIMSS in 2015ofthe science achievement,more than 95% of Indonesian students are able to demonstratemiddle level performance that causes Indonesia to rank at 45 out of 48 participating countries (OECD, 2017).

Some factors are said to be attributed to Indonesian students' low achievement in science such as the development of metacognition ability of students which has not been maximized in the learning process. This condition is evidenced by students' lack of skills needed to complete the tasks assigned encompassing understanding the subject matter, setting up problem solving strategy, making and carrying out the decision. Students even hardly cross check their assignment once it is completed. In addition, students do not possess alternative knowledge to ratify the incorrectly made decisions. The students' knowledge of thinking processes is known as a metacognition (Flavell in Cautinho, 2008).

Selecting appropriate learning resources will impact on the success of teaching conducted by teachers. Teachers as educators should be deliberately careful in choosing the teaching materials to be used in the teaching-learning process. When the teaching materials appropriated are interesting to the students, they will get motivated to learn as they are encouraged. Teaching and learning materials largely encompass knowledge, skills and attitudes that students are to learn in order to attain standard of competence determined beforehand.A shift in the mindset through the learning process is of necessityin order to provide education which meets with the needs of the future if any which includes the alteration from a single tool toward multimedia tools (Kemdikbud, 2014). Multimedia learning can also be integrated into the classical teaching process (Crozat, 2004).

Multimedia learning in Indonesia is currently underutilized. The learning process is generally dominated by the use of teaching materials in the form of books and delivered using traditional teaching methods (Fathurrohman, 2012). As conventional learning has not fulfilled the needs of students for better learning Interactive multimedia-based learning is necessarily developed (Vaughan, 2014). Multimedia technology can help facilitate students in obtaining the expected information (Waryanto, 2008). Multimedia learning serves to visualize an appealing and more interactive application that keeps students from being bored that they may be deeply engaged in the learning process (Vaughan, 2014). Furthermore,Stoney and Oliver

(1999) also stated that multimedia products can enhance the high-level thinking ability, problem-solving skills and cognitive capacity in students.

The integration of Multimedia learning into the teaching process can be done using various instructional model options available (Crozat, 2004). The discovery learning process which is integrated with computer-based multimedia learning maysupport students' learning process to construct knowledge (De Jong and Van Jolingen in Dalgarno, 2014). The discovery learning enables students to solve problems by thinking logically and systematically (Kemdikbud, 2015). Discovery-based interactive multimedia program affords students opportunities to solve problems in accordance with the appropriate level of difficulty. Having successfully solved low difficulty problems students can proceed on to higher difficulty problems (Wijaya, 2014).

Some studies conducted on discovery -based multimedia learning include as follows: the research which Dalgarnoet al., (2014) conducted on the impact of students' exploration strategies on discovery learning using computer-based simulations suggested that discovery learning model integrated with software which is employed as a computer-based learning mediacanenable students to reap more potential benefits of learning which have a positive effect on the students' achievement of learning outcomes. Moreover, research conducted by Rieber et.al. (2004) on discovery learning, representation and explanation within a computer-based simulation: finding the right mix revealed that discovery learning using computer-based multimedia in the learning of Newton's Law enables students to gain a better understanding of the scientific principles in terms of the abstract and difficult subject matters. This study is intended to find out the effect of discovery learning using interactive multimedia on the increase of students' metacognition at SMPN 4 Gadingrejo,Pringsewu Regency in Lampung.

MATERIAL AND METHODS

This research conducted at SMPN 4 Gadingrejo, Pringsewu Regency in Lampung employed experimental design with pretest-posttest control group design. The subject comprises 56 grade nine students studying in the year of 2016-2017. Data are collected using questionnaires and test methods. The questionnaire method was administered to measure student'smetacognition ability using MAI (Metacognitive Awareness Inventory) questionnaire developed by Scraw&Dennison which isrendered into Bahasa Indonesia. This study used52 questions based on 5 point Liker scale which are distributed among the respondents to discover theirmetacognition ability.Test method constitutes awayof collecting data by giving students 5 essay questions. The collected data were analyzed by comparing the N-Gain score obtained by both the learners in the control group and the experimental group. Statistical analysis was performed by determining the difference and equality of the means of two groupsusing SPSS version 17.

RESULTS AND DISCUSSION

The result of students' metacognition questionnaire was measured using adapted version of Scraw and Dennison (1994) in the journal entitled"Assessing Metacognitive Awareness using Metacognitive Awareness Inventory" (MAI) which comprises 52 questions to be filled out by students where each indicator represents students' metacognition ability. Questionnaires were administered to all students of both the control group and experimental group. The result thereofwas geared up to obtain students' metacognition data during the implementation of discovery-based interactive multimedia in the experimental group and control group. The questionnaire results for students' metacognition ability can be seen in figure 1.

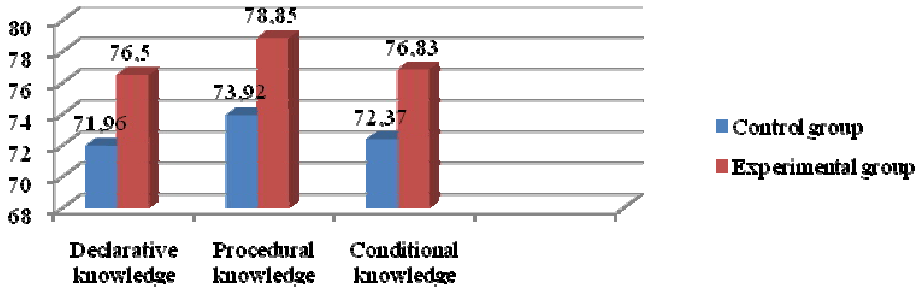

Figure1. Students' Metacognition Knowledge

Figure 1 shows that students' the metacognition ability in both classes mostly deals with the procedural knowledge. The level of procedural knowledge is attributed to several influential factors such as the appealing instructional strategies designed by the teacher that effectively hold the attention of students that they do not get bored in learning. The more students are interested in the learning, the more motivated they are that it brings about enhanced learning outcomes. Furthermore, the result of questionnaire regarding students' metacognition skills can be seen in Figure 2.

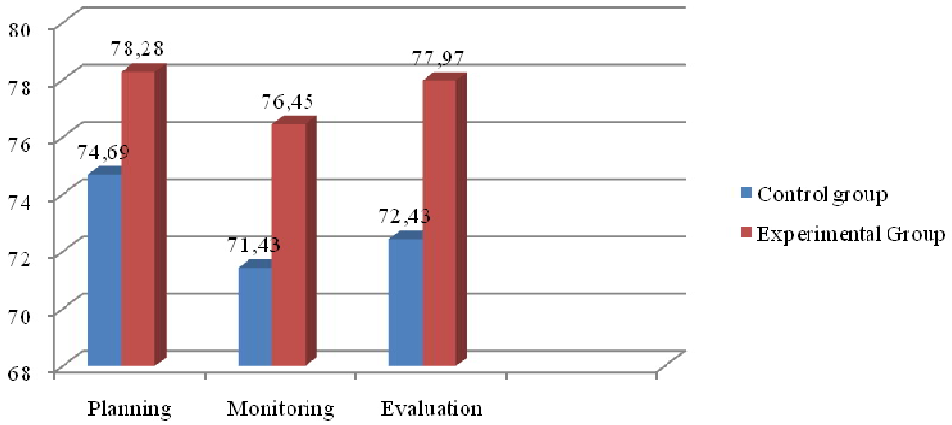

Figure 2: Student'smetacognitionskills

Figure 2 shows that another dominant factor is the skill in planning and determining goals before learning takes place. It is marked by the effort students make to grasp and work on the questions given. As reflected in the answer sheet, students show good planning skills which are evidenced by the initial step they take in doing the problems such as writing the plans for solutions.

Students' increasing metacognition skill is shown by scores they gain in metacognition tests (pretest and posttest). The increased metacognition is shown by the N-gain score which constitutes the difference between the pretest and posttest scores calculated using the Hake equation. The means of students' metacognition test result are exhibited in Figure 3.

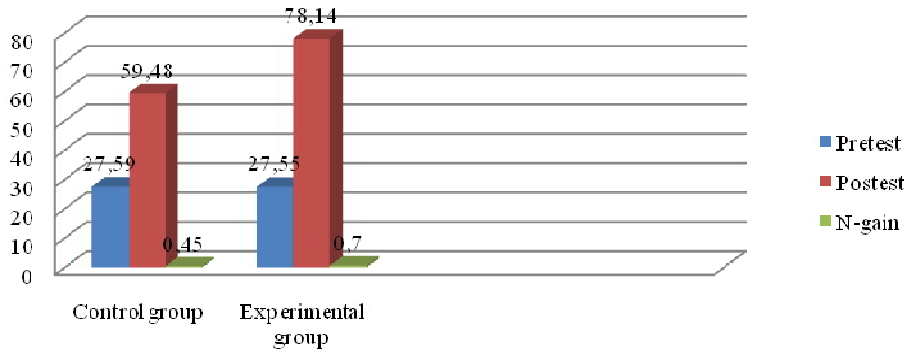

Figure 3: Average of pretest and posttest, and N-gain value of students' metacognition

Based on the research result conducted at the beginning of learning the pretest score obtained of students' metacognition regarding the biological inheritance was basically not satisfactory. After discovery -based interactive multimedia was applied noticeable improvement was indicated by the posttest result of students' metacognition. The result also showed an increase in the N-gain score. The average N-gain for the control class was0.45 which is categorized as moderate while the average N-gain for experimental class was 0.70 which is of high category. It indicates that science learning using discovery-based interactive multimedia can help improve students' conceptual understanding of science. Hence, it potentially helps develops students' metacognition which is line with Dalgarno's research et al. (2014) which states that discovery -based learning model integrated with the use of software employed as a computer-based learning media can provide guidance to students and potential learning benefits that it has a positive effect on the achievement of student learning outcomes.

The differences in thestudents improved ability between the control group and the experiment group using interactive multimedia is proved by using independent sample t-test which can be seen in Figure 4.

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
gab_pre	Equal variances assumed	6,479	,014	-,028	54	,978	-,04087	1,48262	-3,01334	2,93161
	Equal variances not assumed			-,027	39,987	,979	-,04087	1,51146	-3,09567	3,01393
gab_pos	Equal variances assumed	23,884	,000	8,279	54	,000	18,65645	2,25348	14,13850	23,17440
	Equal variances not assumed			8,065	33,782	,000	18,65645	2,31325	13,95423	23,35867
gab_Ngain	Equal variances assumed	16,692	,000	10,292	54	,000	,25190	,02448	,20283	,30097
	Equal variances not assumed			10,033	34,378	,000	,25190	,02511	,20090	,30291

Figure 4. The result ofindependent sample t-test

The test result on the gain value for the control group and the experiment group shows the sig value 0.000 less than α 5%. The test result shows that there is a difference in the students' improved learning outcomes between the control group and the experiment group.

The interview resultswith 6 students withdiverse levels of metacognition also reveal characteristics of students' metacognition. Students with good metacognition demonstrate strategies in solving the problems given through their explanation. They are conscious of their own ability and have a good impression after being engaged in the learning process. However, students with lower metacognition are lacking in strategies in carrying out theirassignments as revealed through their explanation. Students do not seem to understand the questions given and do not have a good impression with the learning process done. Students with such level of metacognition can be categorized as tacit learners who are unaware of their metacognitive (Swartz and Perkins, 1992).

CONCLUSION

Based on the data analysis it can be concluded that afterlearning using discovery based interactive multimedia students demonstrated improved characteristics of metacognition from moderate to good level. The students' improvement in metacognition ability regarding the biological inheritancelargely deals with the procedural knowledge and planning skills. The discovery-based interactive multimedia has a significant effect on the metacognition in terms of the biological inheritance which is evidenced by the effect size of 0.74 categorized as "high"

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