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Developing Guided Discovery Based Biology Teaching Material Supported by Pictorial Analysis

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Abstract

Most of students still consider the subject of classification to be the most difficult subject. 33.989% of the students chose the classification of living things subject as the most difficult subject. This study aims to determine the validity and impact of using learning material based on guided discovery with pictorial analysis on students' learning outcomes on the classification of living things subject. in junior high school. The research method used quasi experimental design with pre-test-post-test non equivalent control group design. Research development was done through 10 stages. This study was conducted at SMPN 1 Jati Kudus. The sample in this study was the students of grade 7th of academic year 2017/2018. Sampling was done by purposive sampling. The research revealed that learning material based on guided discovery with pictorial analysis has validation value with an average of 3.52 with the very valid criteria, but still needed revision on learning material. The learning material that is developed, it has a positive impact on student achievement. There are significant differences between the control class and the experimental class of the t test results obtained by the value of t arithmetic (5.041) > t table (1.988) indicates that there is the impact of using learning material based on guided discovery with pictorial analysis to the students achievement in the classification of living creatures subject. Guided discovery based teaching materials with pictorial analysis make students more active in learning with student activity level in experimental class 80,25% higher than control class that is equal to 70,36%.

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INTRODUCTION

The result of National examination of science in Kudus in academic year of 2015/2016 was 54, 17%. The students still got score less than 55 and the lowest score was 17. In 2016/2017 it decreased of 10%. From the result of the questionnaires that has been distributed to the students of seventh and eighth grade, 33, 989% of students chose the material of classification of living things as the most difficult material.

The material of classification of living things is considered the most difficult material by students because it has extensive material. Not all the objects of classification of living things can be observed in environment and presented directly in the class. So, it needs learning material that can support in the learning activity of classification of living things. Majid (2008) stated by using appropriate learning material, enabling students to learn a basic competence coherently and systematically. Systematical competence causes the knowledge that is got by students can be accumulated and mastered completely and integrated.

In learning activity of classification of living things, students are asked to be able to understand the procedure of classifying, classify, and collect the data for the classification of living things. When the students were asked, most students said that they can not able to describe the characteristic of plants that are often consumed. For example, when they were asked to describe corn plants, they said that they have never seen corn plants so, they could not mention the characteristics. Therefore, it can be used alternative development of learning material by using pictorial analysis. Hoirina (2015) and Safryadi (2016) said that the use of picture media can improve the learning mastery around 79-89%.

To support students' learning activity of classification of living things, a supportive environment is needed. Based on observation, the school environment has not been representative for learning material of classification 5 kingdoms. In school environment only represent of kingdom plantae and some small animals such as insects. Therefore, it can be used learning material that based on guided discovery to support students' activity. Sembiring & Sihombing (2014) stated that guided discovery has positive impact that relates with students' activity. Students become more active and cooperative with their group in finding principles to find out answer to problems. Bamiro (2015) also stated that learning by using guided discovery improves students' achievement around 38, 296%.

In learning activity of guided discovery, teacher guides students in studying by asking about thought of a problem. The thought will help to find out the solution, so students have their own experience to solve a problem in learning material (Hake, 2002). The process of guided discovery, teacher provides illustrative material for students to learn independently. Teacher asks the initial question to enable students to think and conclude according to the science process (Akinbobola & Afolabi, 2010; Braund et al., 2013). With that abilities, students can have experience to find out the relationship and method of solutions, generalize, and summarize the material that being studied. Based on competency's demand, and problems that are experienced by students, it can be taken one of the alternative learning material development of classification is learning material based on guided discovery (penemuan terbimbing) with pictorial analysis. The research development that was conducted has aims to determine the validity of learning material that is developed and found out the influence of the use of learning material based on guided discovery with pictorial analysis on the material of classification of living things with students' learning outcomes.

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METHODS

The research was conducted by using research development (Research and Development). The research was conducted by developing a learning tool based on guided

discovery with pictorial analysis on the classification of living things' material for the seventh grade students. The development process was done through 9 stages that summarized in 3 main stages; identification of problem and potency, material validation, and trial usage. The first stage is identifying the problem and potency. The problem and potency in school were identified through interview with teacher and filling the questionnaire of material difficulties by students that are needed to collect data and design the learning tools. The second stage is the validation of learning material. After designing learning materials the next step is doing validation. Validation of learning material includes on content validation, language and presentation. Validation of learning material was conducted by two science teachers at SMPN 1 Jati and two UNNES' lecturers. After validation, revision was done based on suggestion that was given by validator. The third stage is trial usage. The trial usage was done 2 stages; small scale trail and large scale trail. Small-scale trial was done by using cloze test from 10 students that have been selected by the teacher randomly in class except control class and experiment class. The result of cloze test is used to measure the level of legibility. The revision of learning material is done by the students' opinion about learning materials. After doing small-scale trials, then it was conducted large-scale trial

The large-scale trial was conducted at SMPN 1 Jati Kudus on classification of living things. The population of this research was all of the seventh grade students of SMPN 1 Jati in academic year 2016/2017. The trial was conducted on two classes as a sample of 7E as a control class that consisted of 31 students and 7D as an experimental class that consisted 33 students. The trial usage in the control class used learning material that was provided by the school and used the teaching method which was used by the teacher. The trial usage of experimental class used learning material based on guided discovery with pictorial analysis and the learning activity used guided discovery. The trial design used pre-test post-test control group design. The sampling technique that was used was purposive sampling because the selection of the sample was based on the classroom which was managed by the teacher who was selected by the principle. Before the large-scale trial was done, the researcher did pre-test. Then, the result of pre-test was analyzed by using t-test to know that the students' initial ability between control class and experiment class was same or different. After knowing the result of data analysis of pre-test, then it was conducted the trial usage.

After doing learning activity by using learning materials that was developed in experiment class and the learning method that was usually used by the teacher. The researcher did post-test to test the students' learning outcomes and filling the activeness questionnaire by the students. Then, the result of post-test was analyzed by using t-test to know whether there is significant difference of the learning's result between control class and experiment class after given treatment. The students' activeness data was analyzed by descriptive.

RESULTS AND DISCUSSION

The data is obtained by the data of the development result and the data of the result of the trial. The data of the development result includes in data of validation result of learning material, data of cloze test, and questionnaire of result of legibility of learning material. The test result data includes in the post result data and questionnaire's respond result to the learning material.

The data validation result was obtained from validation that was done by the expert and the science teacher at SMPN 1 Jati. Validation was done on learning material which was developed. To know the result of validation of learning materials can be seen on Table 1.

Table 1. The recapitulation of Validation Learning Material

No	Validation Aspect	Validator 1	Validator 2	Validator 3	Validator 4	Mean
1	Content Aspect	3,67	3,67	3,33	3,50	3,54
2	Language Aspect	3,40	3,40	3,80	3,80	3,60
3	Presentation Aspect	3,67	3,67	3,00	3,00	3,34
Total		3,57	3,57	3,42	3,50	3,52
Category		Very valid	Very valid	Very valid	Very valid	Very valid

Note:
Validator 1 and 2 = Science teacher
Validator 3 and 4 = Lecturer/Expert

The validation results show that the mean is >3,25, it shows that the learning material that was made, it includes in very valid category and can be used for the next trial after doing revision based on validator's suggestion. In the material feasibility aspect, the validation's result of all validators was obtained of 3,54 and it includes in very valid category. Depdiknas (2009) stated that the quality of a learning material is measured by the suitability of the material with basic competence and indicator competence. The achievement of competence can be benchmark in the learning activities so the students will avoid from material that does not support the achievement of competence. If the suitability of the learning material that is used by students with basic competence is low, so the competence that is expected is difficult to reach.

In language aspect is obtained the validation result of 3,60 and it means that the learning material that is developed is very valid. Nevertheless, it is still needed revision related to some words and sentences that use foreign terms that have been not understood yet by the students and there is no explanation about the terms. The revision has been made by adding definition on the words or sentences. In other hand, there are some sentences that are too long so it needs to be more effective. In the presentation aspect, the learning materials based on guided discovery with pictorial analysis has a validation value of 3, 34 that includes on very valid category. Wulanzani et al (2016) said that the development of learning materials that are contextual with picture visualization have validation value around 94, 7%. It is also supported by Safitri et al (2014) stated that learning material by using picture can give positive influence and support learning activity. It also can stimulate students in analyzing, and processing the existing information.

Learning material based on guided discovery with pictorial analysis that is developed has advantages and disadvantages. The advantages of learning material are it can train the students' cognitive abilities to solve problem in learning materials. It also can train the students to be more know the living things around them. By using pictorial analysis, the students can know the living things' description and characteristic in various kingdoms that it is not all the object in classification of living things can be presented and observed contextually. However, the learning material that is used still has disadvantages. It still has lack of picture in providing detailed information.

After being validated, small-scale trial were conducted on learning material with cloze test. The cloze test that was used had two paragraphs which cover two sub-chapters of the characteristic of living things and classification of living things. In the first paragraph consisted of 103 words with 7 sentences, while in the second paragraph consisted of 114 words with 9 sentences. From the cloze test that has been conducted obtained the result. The result of cloze test is from 10 students who followed the test, 8 students get score up to 80. From the result of the test, it can be concluded that the cloze test has 80% of students answered correctly. Based on the criteria of analysis of cloze test, the score that is obtained >60%. It

shows that the reading material is easy to understand and can be used by the readers.

The large-scale trial is used to know the effect of the use of learning materials that is developed to students' learning outcomes. The data of learning result is obtained from the result of post-test of control class and experiment class. Before doing post-test, the questions was analyzed the level of difficulty, differentiation, the validity and reliability of the questions. For the data recapitulation result of the questions can be seen on Table 2.

Table 2. Recapitulation Result of Questions Analysis

No	Test	Category	Item Number
1.	Validity	Valid	1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 13, 15, 16, 17,18,19, 23, 24,25,26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 38, 40, 41, 42, 43, 44, 46, 47, 49, 50
		Invalid	4, 12, 14, 20, 21, 22, 36, 37, 39, 45, 48
2.	Level of Difficulty	Easy	2, 3, 5, 6, 7, 39, 44, 45, 46
		Medium	1, 8, 9, 10, 11, 13, 15, 16, 17, 18, 19, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 34, 35, 38, 40, 41, 42, 47, 49, 50
		Difficult	4, 12, 14, 20, 21, 22, 33, 36, 37, 43, 48
3.	Differentiation	Bad	3, 4, 12, 14, 20, 21, 22, 33, 36, 37, 39, 43, 45, 48.
		Enough	1, 2, 5, 6, 7, 10, 11, 13, 15, 16, 19, 24, 26, 27, 28, 30, 31, 32, 34, 35,38, 40, 41, 42, 44, 45, 46, 49, 50.
		Good	8, 9, 17, 18, 23, 25, 29,
		Excellence	-

From 50 questions, 35 questions were used in the post-test. If the questions that were not valid, it removed and not reused. In the level of difficulty used questions that had easy-medium category. The questions that had bad category of differentiation and had negative value were removed. The reliability test is obtained coefficient value of the reliability questions of 0, 802. From the result, it can be concluded that the test instrument has very high level of reliability and has good quality.

The result of pr-test and post-test were analyzed by normality test and homogeneity test. The result of the normality test can be seen in Table 3.

Table 3. The Result of Normality Test of Pre-Test and Post-Test

No		Class	D_{max}	D_{table} (α=0,05,N=31 and N= 33)	Result
1	*Pre-test*	Control	0,1771	0,2204 (N=33)	Normal
		Experiment	0,1116	0,2132 (N=31)	Normal
2	*Post test*	Control	0,2180	0,2204	Normal
		Experiment	0,0877	0,2132	Normal

The normality test data that was done by using kolmogorov-smirnov test. It was done to know the type of statistics which was used in the research. If the data has normal distribution, it used parametric statistics. In other hand, if the distribution is not normal, it uses non-parametric statistics. Based on the data analysis, the result of pre-test and post-test in control class and experiment class obtains that Dmax< Dtable at significance level α=0,05 and N=31 for control class and N=33 for experiment class that is obtained normal distribution data.

After the normality test was done, the next test is homogeneity test. Data homogeneity test was done by using variance test. The result of homogeneity test can be seen on Table 4.

Table 4. Variance Value of Initial Condition

Hal	Total		dk numerator	dk denominator	S_x^2	S_y^2	F_{count}	F_{table} (α=0,05)
	X (eks)	Y (ctrl)						
Value	2528	1775	30	32	38,998	30,832	1,265	1,82

The data homogeneity test was used to find out the variance of the sample that was observed had the same variance or not. From the calculation of significant level α=0,05 dengan dk numerator 30 dan dk denominator 32 obtained the result of Fcount = 1,265< Ftable =1,82 it can be concluded that both groups have the same variance value (homogeneous) and assumptions homogeneity is fulfilled.

Normality test and homogeneity test were done as requirement for t-test. To prove that two classes have different cognitive learning outcome or not then it is done by using t-test. The t-test was done on the result of pre-test and post-test. The result of pre-test that was got by the students in the t-test to determine whether the students' initial ability are different or same. From t-test on the score of pre-test obtained at significance level showed there is no significant difference in experiment class and control class. So, the students' initial ability between control class and experiment class there is no significant difference and can be categorized as having the same initial ability.

The t-test on the result of the post-test was done to know whether there is a significant difference to the learning outcomes from control class and experimental class. The result of t-test calculation on the post test score can be seen on Table5.

Table 5. The result of t-test on the Post-Test score

Total (∑)		$\sum X_1^2$	$\sum X_2^2$	Mean		Standard deviation		T_{count}	T_{table} (α=0,05, df= 62)
X_1	X_2			X_1	X_2	X_1	X_2		
1775	2528	114217	195674	57,258	76,606	12583,9	2013,88	5,041	1,988

Note: X_1 : Control Class
X_2 : Experimental Class

From the data of t-test calculation on post-test score obtained tcount (5,041) > ttable (1,988) with significance level α=0,05 and df =62, so hi is accepted and ho is rejected. From the result, it can be concluded that there is a significant difference of learning outcomes between control class and experimental class. So, the use of learning material based on guided discovery with pictorial analysis on the classification living things has positive effect on the learning outcome of the 7th grade students of SMPN 1 Jati Kudus.

In the experimental class, learning activity was more focus on the discussion of characteristic analysis of living things that are classified based on differences and the similarities of features. The learning material was developed by using color picture with larger size than the package books that have been provided by the school. While learning activity that was conducted on the control class, the students was given task of discussion that was provided on textbook and LKS, it was done at home individually, in the next meeting the teacher discussed and gave the correct answers. Then, the students matched the result with the teacher's answers. In the learning activity was also conducted group discussion, but it was not until presenting the result. The students only matched their answer with the teacher's answer and then changed the answers according to the answers that were given by the teacher. The pictures on the worksheet (LKS) were also colorless and unclear, so the students still had to ask to the teacher about the living things that was on the picture. Therefore, the students in the

experimental class can be more specific and clear in analyzing the characteristic of living things than the control class.

From the discussion activity that was done by the students, it builds knowledge so that it is got the learning experience and concept that can be remembered in the long term. It appropriates with Jean Piaget's constructivism learning philosophy based on each of us the premise that reflecting on experience. It can build our own understanding about world which we live. Each of us produces a "rule" and a "mental model of its own", that are used to make our experience. So learning is a process of adapting the mental model to accommodate new experience (Bhattacharjee, 2015).

The learning result of experimental class has mean of 76, 6061 higher than control class that has mean of 57, 2581. It shows that the higher result is in the experimental class because the learning activity is more focus on analysis discussion the characteristic of living things that is classified based on the differences and similarities of features. In addition, the learning material that is developed as learning media in the printed form that is called textbook. Learning activity by using written material is faster three or four times more than oral learning (Nasution, 2009:196). Beside of learning materials in printed form, the picture media that is used also has a role in influencing the students' outcomes. Ristiono (2012) stated that picture media can improve the average of students' learning outcomes of 5%, it was from 69% to 74%. Fuadah (2016) also stated that the use of picture media, the students' ability increased of 20, 27%. It was from 48, 38% to 68, 65%. In addition of affecting the students' outcomes in learning aspects of knowledge, the learning material based on guided discovery with pictorial analysis also influences to the students' activeness. The recapitulation of students' activeness can be seen on Table 6.

Table 6. Recapitulation of Students' Activeness

No	Percentage	Criteria	Student Total			
			Experiment Class	%	Control Class	%
1	75,00% - 100,00%	Very high	25	75,76	10	32,26
2	50,00% - 74,99%	High	8	24,24	21	67,74
3	25,00% - 49,99%	Enough	-		-	
4	0,00 % - 24,99%	Low	-		-	
Total			33	100	31	100

From the data analysis has been obtained in the experimental class of the students' activeness has very high criteria than the students' in the control class. Classically, the students of experimental class have the students' activeness of 80, 25% that includes in highest criteria. The control class has percentage of students' activeness of 70, 36% that includes in high criteria. The result of the students' activeness can be seen on figure 1.

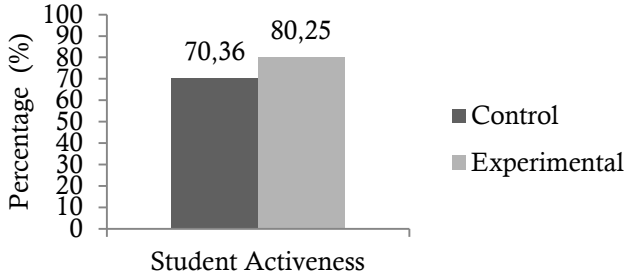

Figure1. Graph of Student Activeness Percentage in Classical

In supporting students' activeness to find a problem, it is used guided discovery as learning material. The guided discovery method that is used in learning material requires students to active in finding a problem to find out solution based on existing theory. The use of guided discovery with pictorial analysis in learning materials that is developed more emphasize on the analysis discussion process of the characteristic of living things on the picture that has been provided in each group and outdoor learning. The process of picture analysis discussion in each group was done to solve problem on the material that is learned, so learning activity becomes more collaborative.

Onwioduokit & Akinbobola (2005); Akinbobola & Afolabi (2009) proved that the use of conceptual picture is one of the most effective in facilitating students' achievement and retention. It also conforms to constructivist view that leads to encouraging students to be active in creating more knowledge. The teacher ensures that the students understand the pre-existing conception through conceptual picture, and guides the activities to solve and build them. The collaboration between teacher and students involves the students' active role to use mental processes so it makes students are not bored and they interested in the learning activity (Almubaid, 2008). It is supported by a research of Kyporus et. Al (2012) stated that the students' active involvement in learning activity can improve the mastery and understanding concept. The discussion process in group makes students more active in expressing their opinion and in the learning activity.

Besides that, the students' activeness and the learning outcomes are also influenced by the students' interaction with their environment. In the control class was not done by outdoor learning activity, but in the experimental class did it to observed the living things especially kingdom plantae that can be found in the school's garden. So, the outdoor learning activity is needed. It makes the students can interact with the environment so the learning activity can be more contextual and it is not only conceptual. The direct observation was done on material object in the school's garden. The students can analyze and find the answer of the similarities and differences of living things that was found. Besides that, the students can interact with the environment and discuss with peers to determine the classification of living things based on the similarities and differences features that was found.

The students' activeness and knowledge learning outcomes are supported by outdoor learning activity and direct observation of material object with the theory of cognitive development Vigotsky. The theory stated that students will be easier to learn concept if they are in the zone closest from them. Problem solving skills can be got by the adult guidance, peers collaboration, or the people who understand well about it. The outdoor class learning is very needed to support learning material based on guided discovery. Germain (2013) stated that the guided discovery to teach and apply the finding concept has improved. It is not only on the student's understanding and performance but also teachers' ability to connect with students and present that their ideas are important and constructive in their own understanding. Same with the statement, Reynold (2016) stated that guided discovery trains the students to learn contextually and provide various structure assessments through collaborative and investigative task. Besides that, it also helps students to do what they learn and builds a new knowledge with analysis and synthesis.

Based on Azizah's research (2016) the use of guided discovery can improve the students' science outcomes of 14,3%. It is supported by Rochim's research (2014) stated that the students' learning outcomes with by using guided discovery increased more than 30%. Udo (2010) in his research compares some learning approach, by using guided discovery had the highest mean gain score was 22, 65 while the other two approaches for each student centered demonstration had mean 17, 83, and expository had mean 16, 35. The use of learning material based on guided discovery makes the learning activity more meaningful. The use of guided

discovery, students can interact with material and explore the investigate questions or through experiment to find more knowledge so, students will tend to remember the concepts of material that they find (Olorode & Jimoh, 2016).

One of the other factors that influence the learning outcomes is the students' enthusiasm the learning material based on guided discovery with pictorial analysis that is developed. The students' enthusiasm can be seen from the result of students' response to the learning material that has been used. The result of students' response questionnaire can be seen on Table 7.

Table 7. Recapitulation of Students Response Result

	Point											
	1	2	3	4	5	6	7	8	9	10	Total	Mean total
Mean	3,69	3,50	3,53	3,59	3,63	3,28	3,66	3,47	3,59	3,50	35,4	3,54
Percentage	92%	88%	88%	90%	91%	82%	91%	87%	90%	88%		89%

Note:
1 : help in understanding material
2 :communicative language and easier to use
3 :clear sentences, simple and short
4 :interesting design, writing, and drawing
5 :the guidance steps are clear and easy to understand
6 :require students to be more active
7: build knowledge little by little
8: make more passionate in learning
9 :material presentation based on students' ability
10:learning materials have used well in learning activity

From the questionnaire analysis is obtained mean 3,54 that includes in valid category so, it can be concluded that the learning material is good and practical to use in learning activity of classification of living things. Besides that, it is around 89% students have enthusiasm to the learning materials that is developed. The students' enthusiasm shows that they interested in learning activity. Students' interest is very influential in learning activity. Yan (2011) said that the students' interest in specific field can improve students' enthusiasm, so it can build a spirit, scientific attitude, and active thinking that can help the students in mastering knowledge and biology technique well. The students' interest was shown when they got learning material, they read it directly. Besides that, the color picture, clarity and sentence that is easy to understand attract the students' interest to read it. So, the learning activity by using guided discovery with pictorial analysis on classification of living things that is developed for junior high school gives a positive effect to the students' learning outcomes.

CONCLUSION

Based on the result, it is concluded that guided discovery with pictorial analysis has validation value of 3,52 in very valid criteria, but it still need revision on the learning material. The learning material that is developed has positive effect to the students' learning outcomes. It proves that there is a significant difference between control class and experimental class that is obtained from the t-test result. Besides that, guided discovery based learning material with pictorial analysis makes the students are more active in learning activity of experimental class with percentage of 80,25% higher than control class that is 70,36%.

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