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Original Research Article

The Influence of *Guided Discovery* and *Group Investigation* Learning Strategies on Science Process Skills and Higher Order Thinking of Senior High School Students

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ABSTRACT

This study was conducted to determine the influence of guided discovery and group investigation learning strategies on science process skills and higher order thinking skills (HOTS) of senior high school students in SMA Negeri 1 Kutacane-Indonesia. This research was quasi experimental with the samples of three classes, determined by purposive sampling. Students in class X IPA Plus were taught by guided discovery and class X IPA 1 were taught by *group investigation* as experimental groups, and class X IPA Inti were taught by conventional learning strategy as control group. The research instruments were the essay tests to collect the data of science process skills and HOTS. Analysis of Covariate (ANCOVA) was used to analyze the data by using SPSS 22.0. The results showed that there was a significant influence of learning strategies on student's science process skill (F = 141.52; P = 0.00). The students' science process skills taught by guided discovery (84.49 ± 5.92) were significantly higher than student's science process skills of group investigation (78.76 ± 5.76) and conventional learning strategy (62.08 ± 4.45). There was also a significant influence of learning strategies on student's HOTS (F = 117.86; P = 0.00). Students' HOTS taught by guided discovery (81.76 ± 4.48) was significantly higher than students' HOTS by group investigation (71.31 ± 5.47) and conventional learning strategy (64.31 ± 4.61). As a follow-up, teachers were suggested to apply guided discovery learning strategy in teaching ecosystem topic as an effort to improve students' science process skills and higher order thinking skills.

Keywords: *Guided Discovery* learning strategy, *Group Investigation*, science process skills, higher order thinking skills

INTRODUCTION

Education is a means in realizing quality human resources; therefore the Indonesia government continues to update the curriculum regularly. Various efforts have been made to improve the quality of national education, among others are through various training and improvement of teacher qualification, curriculum improvement, book procurement, teaching equipment and improvement of other educational facilities and infrastructure and also improvement of school management quality. However, the quality of Indonesia education has not been able to show adequate improvement (Nurhadi, 2004).

Currently the position of the quality of Indonesian students in the international world in terms of literacy ability of science is very low. From the results of the PISA

survey in 2000 to 2015, the performance of Indonesian students is still relatively low. In 2000, Indonesia ranked 38 out of 41 countries with an average score of 393 and ranked 38 out of 40 countries with a score of 395 in 2003. The worse was in 2009 and 2012, Indonesia was only able to reach ranked 62nd and 64th out 65 countries participate, with an average score of 382. While in 2015, Indonesia ranked 66th out of 72 countries participated (OECD, 2016, Manurung *et al*., 2017, Wahidah *et al*., 2017). These data indicated that Indonesian student's science processes skills are still at the beginner level.

There are several factors that caused science process skills and student higher order thinking skills are still low. These factors can be known in terms of teacher quality, learning approach used, student and school conditions. In the classroom learning, the teachers tend to show learning process by *transfer knowledge* or by one-way learning that often resulted passive respond of student in learning. Student activities only write the material and listen to what is delivered by the teacher with the help of *powerpoint* media, that causes students not involved in doing thinking activities. Two-thirds of the allocation of learning time is spent by the teacher to explain the material, and the students are given little chance to express their opinions. According to Ahmadi (2014) such learning leads students to become passive, boring and lack the critical power or high-order thinking ability.

There are a number of solutions that can be done to overcome these problems, such as by using a scientific approach and media in teaching and learning process. According to Rahmayani (2014), biology learning process that utilizes the school environment as an object of learning and taught by using scientific approach as guided discovery method can improve learning outcomes. Furthermore, Rachayuni (2016) added that the implementation of guided discovery learning strategy in learning proses can improve the science process and student achievement in junior high school. Meanwhile, Sudewi *et al.*, (2014) corfirmed that the application of group investigation and problem based learning in learning process can increase student learning outcomes from the lowest aspect to the highest aspect of Bloom's taxonomy.

The purpose of this research is to know the influence of *guided discovery*, *group investigation* and *direct instruction* or conventional strategies on science process skill and higher order thinking skills of the senior high school students in learning biology at ecosystem topic.

RESEARCH METHOD

This study is quasi experiment research with n*on-equivalent pretest-posttest control group design* (Sugiyono, 2013). The population was 185 first grade students in SMA Negeri 1 Kutacane. Meanwhile, the sample consist of three classes that be taken; by *purposive sampling.* Class X IPA-Plus (34 students) taught by *guided discovery*, class X IPA-1 (17 students) taught by *group investigation*, and class X IPA-Inti (37 students) by *direct instruction* or conventional strategies.

Dependent variables of research were science process skills and higher order thinking skills (HOTS) of the students. The indicator for science process skills are the abilitity to observe, classify, measure, communicate, taking conclusion and predict. HOTS indicators consist of skills to analyze, evaluate, and create. The science process skills and higher order thinking skills data of the students were collected by essay test.

Research data was analyzed by using analyses of covariance (Ancova) and followed by post hoc *Scheffe* test. *Kolmogorov-smirnov* and *Levene's* tests have been used as prerequisite tests for normality and homogeneity test. All data were analysed by using SPSS version 22.

RESULTS

Research data is mean of student's science process skills and higher order thingking (HOTS) of the students. Research result showed that both mean of student's science process skills and HOTS in *guided discovery* and *group investigation* classes were higher compared to conventional class. The mean comparison of science process skills in *guided discovery, group investigation* and conventional classes were 84.49; 78.76, and 62.08, respectively. Meanwhile, their HOTS data are 81.76 in *guided discovery,* 71.31in *group investigation* and 64.31in conventional strategies. According to these scores, it could be concluded that the highest score achieved by *guided discovery* strategy. Therefore, using *guided discovery* as strategy in learning proces gave better in student's science process skills and HOTS compared to the other two strategies.

In order to test the hypotheses, normality and homogeneity tests were done as prerequisite test. The result of normality test for science process skills and HOTS are displayed inTable 1and 2. Meanwhile, the result of their homogeneity test are presented in Table 3.

Table 1. Normality test result of student's science process skills

Learning strategy	One-Sample Kolmogorov-Smirnov Test			
	Pretest		Posttest	
	Sig	Note	*Sig*	Note
Guided Discovery	0.07	normal	0.08	normal
Group Investigation	0.20	normal	0.20	normal
Conventional	0.09	normal	0.15	normal

Table 2. Normality test results of student's HOTS

Learning strategy	One-Sample Kolmogorov-Smirnov Test			
	Pretest		Posttest	
	Sig	Note	*Sig*	Note
Guided Discovery	0.20	normal	0.06	normal
Group Investigation	0.18	normal	0.10	normal
Conventional	0.20	normal	0.05	normal

Based on normality test that have been done, data of student's science process skills and HOTS in *guided discovery, group investigation* and conventional classes are normally distributed.

Table 3. Homogeneity test results of student's science process skills and HOTS

Variable	Statistik Levene's			
	Pretest		Posttest	
Science Process Skills	*Sig*	Note	*Sig*	Note
	0.19	Homogen	0.34	Homogeneous
HOTS	0.09	Homogen	0.81	Homogeneous

Homogeneity test result showed that data of student's science process skills and HOTS in *guided discovery, group investgation* and conventional classes are homogeneous.

Furthermore, hypothesis test result of influence of *guided discovery* and *group investigation* learning strategies on student's science process skills and HOTS are displayed in Table 4.

Table 4. Ancova test results of student's science process skills and HOTS

Variable	F	Sig.	Note
Science Process Skills	141.52	.00	H_0 rejected
HOTS	117.86	.00	H_0 rejected

The result of hypothesis testing showed that there is significant effect or influence of *guided discovery, group investigation* and conventional or *direct instruction* strategies on student's science process skills (F= 141.52; P= 0.00) and HOTS (F= 117.86; P= 0.00). In order to find out which strategy is the best for improving the science process skills and higher order thinking skills of the student, *Scheffe* test was caried out. The result of this multiple comparison test for science process skills is presented in Table 5

Table 5. The result of posthoc *Scheffe* test for science process skills of the students

STRATEGY		Scheffe	
		Sig.	Note
GD (84.49)	GI (78.76)	.00	Significantly different
	Conventional (62.08)	.00	
GI (78.76)	GD (84.49)	.00	Significantly different
	Conventional (62.08)	.00	

Based on *Scheffe* test result, student's science process skills in three classes were significantly different. It showed that student's science process skills in *guided discovery* class were best or highest than in *group investigation* and conventional classes.

Furthermore, the rrecapitulation of *Scheffe* test for higher order thinking skills of the

students in three strategies are presented in Table 6.

Table 6. The result of posthoc *Scheffe* test for HOTS

STRATEGY		Scheffe	
		Sig.	Note
GD (81.76)	GI (71.31)	.00	Significantly different
	Conventional (64.31)	.00	
GI (71.31)	GD (81.76)	.00	Significantly different
	Conventional (64.31)	.00	

The result of *Scheffe* test showed that student's HOTS in three classes were significantly different. The student's HOTS whom taught by *guided discovery* strategy is the best compare to those whom taught by *group investigation* and conventional.

In oder to find out the differences on six components of science process skills in three learning strategies, Ancova test was done and it's result is presented in Table 7.

Table 7. The comparison of six aspects of science process skills in three strategies

No	Science process skills aspects	Mean score			Fh	P	Note
		Guided Discovery	Group Investigation	Conv			
1	Observation	88.97	82.35	79.19	5.81	0.00	Significant
2	Measuring	88.97	82.35	49.31	54.76	0.00	Significant
3	Classification	87.50	85.29	61.46	56.53	0.00	Significant
4	Communication	88.24	76.47	73.96	20.21	0.00	Significant
5	Taking conclusion	82.35	76.47	57.64	54.15	0.00	Significant
6	Prediction	81.62	72.79	53.12	70.95	0.00	Significant

The result showed that mean of every aspect of student's science process skills was significantly higher in *guided discovery* class compare to others. The highest aspect among the six aspects of science process skills in *guided discovery* class are observation and measuring.

Furthermore, comparison test results of three aspects of HOTS are presented in Table 8.

Tabel 8.Comparison of HOTS aspects

No	HOTS	Mean score			Fh	P	Note
		Guided Discovery	*Group Investigation*	Conv.			
1	Analysis	81.99	71.69	69.79	36.57	0.00	Significant
2	Evaluation	80.15	72.55	70.37	45.36	0.00	Significant
3	Creation	80.06	72.06	50.93	106.31	0.00	Significant

The result of testing showed that mean of HOTS's every aspect in three classes (*guided discovery*, *group investigation* and conventional) were significantly different. This result confirmed that *guided discovery* is the best strategy than *group investigation* and conventional in empowering the analysis, evaluation, and creation skills or competence of the students. The highest aspect of HOT'S is analysis, whereas its lowest is creation

DISCUSSION

According to research results, science process skills and HOTS of students who were taught by guided discovery strategies were significantly highest than conventional and group investigation. This happens because guided discovery strategy in the learning process has eight aspects in its syntax that can to empower the science process skills and higher order thinking the student, ie observation to find problems, formulate problems, propose hypotheses, plan problem solving (through experiments or other means), conduct experiments, observe and collect data , analyze data and draw conclusions. The syntax is also makes teachers more instrumental in guiding students to investigate, conceptualize, and evaluate (Arends, 2007). The results obtained in this study is in accordance with what was reported by Rachayuni (2016) that learning present by using guided discovery strategy can improve science process skills and learner's learning outcomes. Khasnis & Munjunath (2011) also said that guided discovery learning can hone scientific attitude, science process skills and improve cognitive learning outcomes. The results of this study were confirmed by Haryati et al. (2017) who stated guided discovery

provides a better effect on higher order thinking and student's science process skills.

In guided discovery learning process, furthermore students experience two learning experiences namely mental experience and social experiences. Mental experience is derived from the sense of hearing and sight, information obtained on the basis of what is acquired by the sense of hearing which got from the explanation given by the teacher, while the sense of sight comes from the student's own discovery. The discovery strategy arouses the students, for example the student feels the effort of his investigation, finds success and sometimes failure but the discovery will always be remembered by the students rather than having to hear the explanation from the teacher. This is in line with the opinion of Purwatiningsi (2013), who state that the learning model guided discovery provides better learning outcomes, because learners gain knowledge directly. The knowledge gained directly has settled deep in students mind. Patel (2014) also stated through the guided discovery learning there was the increasing of motivation of learners to achieve. Matthew (2013) and Haryati (2017) wrote that results of learners who are taught by using guided discovery where better and significant than learners who used conventional learning.

As, a strategy which built on constructivism learning theory and active learning, guided discovery strategy can develop student's ability in analyzing, evaluating, and creating, in the learning process can also maximize the student's ability to develop concepts through ideas, experiences and facts. In accordance with the opinion Dimyati & Mudjiono (2009) who stated, the role of teachers is very important in learning activities. The ability of teachers in managing classroom by creating a fun learning atmosphere and motivate students to actively perform learning activities.

CONCLUSION

Based on the results and discussion of this research, it can be concluded that there is a significant influence of guided discovery, group investigation and conventional learning strategies on student's science process skills and higher order thinking skills in ecosystem topics. The science process skills and higher order thinking skills of students taught by guided discovery strategies are significantly higher than the other two strategies (group investigation and conventional or direct instruction). It is recommended so that the teachers use guided discovery strategy to improve the science process skills and higher order thinking skills of the students.

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