

## CRITICAL THINKING SKILLS IN INTEGRATED SCIENCE LEARNING VIEWED FROM LEARNING MOTIVATION

### KEMAMPUAN BERPIKIR KRITIS PADA PEMBELAJARAN IPA TERPADU DITINJAU DARI MOTIVASI BELAJAR

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#### ABSTRAK

Penelitian ini bertujuan untuk mengetahui pengaruh strategi Predict Discuss Explain Observe Discuss Explain dan Small Group Discussion terhadap kemampuan berpikir kritis, dan pengaruh motivasi belajar terhadap kemampuan berpikir kritis. Penelitian ini merupakan penelitian quasi experiment menggunakan desain the non-equivalent pretest-posttest. Data dianalisis menggunakan statistik inferensial Analisis Varian dua jalur dan analisis regresi. Hasil penelitian menunjukkan bahwa strategi Predict Discuss Explain Observe Discuss Explain dan Small Group Discussion berpengaruh terhadap kemampuan berpikir kritis, rata-rata kemampuan berpikir kritis siswa yang menggunakan strategi Small Group Discussion lebih baik daripada siswa yang menggunakan strategi Predict Discuss Explain Observe Discuss Explain. Selain itu, motivasi belajar berpengaruh terhadap kemampuan berpikir kritis. Rata-rata kemampuan berpikir kritis siswa yang mempunyai motivasi belajar tinggi lebih baik daripada siswa yang mempunyai motivasi belajar rendah. Berdasarkan analisis regresi, motivasi belajar dan kemampuan berpikir kritis memiliki hubungan yang positif. Motivasi belajar memberikan pengaruh sebesar 6,4% terhadap kemampuan berpikir kritis.

#### ABSTRACT

The study aimed to determine the effect of Predict Discuss Explain Observe Discuss Explain and Small Group Discussion strategies toward critical thinking skills and the influence of learning motivation toward critical thinking skills. This study was a quasi experiment with the non-equivalent pretest-posttest design. Data were analysed by inferential statistics of two way analysis of variance and regression analysis. The results showed that Predict Discuss Explain Observe Discuss Explain and Small Group Discussion strategies were influential toward critical thinking skills and the average of students critical thinking skills using Small Group Discussion strategy was better than those experiencing Predict Discuss Explain Observe Discuss Explain strategy. Furthermore, learning motivation were also influential toward critical thinking skills. Students having high learning motivation were better than students having low learning motivation. Regression analysis showed learning motivation and critical thinking skills have positive correlation. Influence of learning motivation toward critical thinking skill was about 6.4%.

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**Keywords:** critical thinking skills, learning motivation, predict discuss explain observe discuss explain, small group discussion.

#### INTRODUCTION

Essence of science is about nature events studied by combination of process called scientific process. Science is built based

on scientific attitude and the results are materialized as scientific product consisted of three important components: concept, principle, and theory that recognized universal (Trianto, 2011).

According to appendix of Regulation of Cabinet Minister National Education No. 22 of 2006 about Content Standard called that sub-

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stance of science lesson in junior high school curriculum is "Integrated Science" (Permendiknas, 2006). Integrated is a combination or composite of two or more objects (Trianto, 2011). Thus, Integrated science learning is science learning combining several concepts and or discipline knowledge. Integrated Science learning emphasizes on giving direct experience to increase competence in order to roam and understand natural phenomena in everyday-life using scientific approach (Puskur, 2006). Furthermore, Content Standard mentioned that the group of subjects in science and technology (in this case Integrated Science), intended to obtain basic competencies in science and technology and cultivate scientific thinking critically.

Critical thinking is an organized process to evaluate evidence, assumption, logic, and language underlying person statement (Johnson, 2012). Critical thinking requires students to think at a higher level. In the process of learning, if students are given the opportunity to use the thinking in the higher levels in every classroom, they will use it to distinguish between truth and falsehood, appearance and reality, facts and opinions, knowledge and belief in the end (Kurniawati, et al, 2014).

Based on interview result, the evaluation of the Science learning showed that students in MTsN Yogyakarta II were less familiar and happy working on the essay questions that require analysis and reasoning. This showed that students were less encouraged to develop the ability to think critically. Teacher tends also to use conventional methods such as lectures and class discussion. This caused learning motivation of student was low. In line with statement of Djamarah and Zain (2002), it is argued that if the learning process in the classroom uses conventional methods (lectures) only, it can cause passive students.

According to Atkinson, et al (1997) motivation refers to the animating factor, strengthens and directs behavior. Motivation is also defined as the process of realizing and maintaining the continuity of activities oriented targets (Schunk, 2012). In the learning process, motivation can be said to be a driving force in the overall student learning activities, which ensures continuity of learning activities, so that the desired objectives can be achieved by the students. Thus, the motivation to learn has a role in arousal, happy, and a passion for learning (Sardiman, 2007).

The participation of students actively

in the learning process makes students more trained for initiative, critical thinking, and responsiveness in daily life problem solving through meaningful information retrieval. Also, it can eliminate boredom and foster a sense of delight in learning, so that ultimately impact with increased learning motivation (Susilo, et al, 2012; Siregar & Nara, 2010).

There is a relationship between learning motivation and critical thinking skills. The result of Sitepu's research (2011) founded that the critical thinking skills of students that learned using problem-based learning strategy is better than the students that learned using conventional learning. In addition, critical thinking skill of students who have high learning motivation better than students with low learning motivation. Thus, in addition to learning strategies used, learning motivation can also influence learning strategy to strengthen critical thinking skills.

Integrated Science teaching combining various disciplines or concepts can be used as a means to develop critical thinking skills. There are ten types of integrated learning according to Fogarty (1991). Type of integrated learning used in this study is the webbed. That is an integration of some Basic Competencies with regard to the different subjects in one theme. Practically, teacher can use the models, approaches, strategies and methods specified in accordance with the learning materials. In this study, the strategy used is Predict Discuss Explain Observe Discuss Explain (PDEODE) strategy compared with Small Group Discussion (SGD) strategy.

PDEODE learning strategy consists of six steps. There are Predict, Discuss, Explain, Observe, Discuss, and Explain (Costu, 2008). SGD strategy is a way of teaching that divides students into small groups of four to six members to discuss a topic, and the teacher moves from one group to another, to guide students in discussion (Slavin, 2014) ,

Both of these strategies require active student involvement in learning, interacting with study groups, observed, searching information from a variety of credible sources, comparing the initial knowledge and observations, so as to support to develop the critical thinking skills of students. The basic difference of PDEODE and SGD strategies is their procedures. In PDEODE, there are two processes of discuss and explain. But, in SGD is only one process of discuss and explain.

There are two intentions of this study.

First, this study aimed to determine the effect of PDEODE and SGD strategies toward critical thinking skills. Second, this study intended to determine the influence of learning motivation toward critical thinking skills.

## METHODS

This research was the quasi experiment with the non-equivalent pretest-posttest design. In this design, researcher can use a comparison group without the control group. The first and the second group was given a different treatment, but equivalent. The sample used in this study used an existing class without scrambles students and create a new class (Best, 1982). Both the two experimental classes were attempted to have the same of state or condition. Integrated Science learning webbed type in the first experimental class implemented PDEODE strategy. The second experimental class applied SGD strategy.

The population was the seven classes of grade 8 grade of MTsN Yogyakarta II. The participants were selected by Simple Random Sampling based on a lottery. Random sampling allows sample drawn has the same characteristics as the population. It does not give an opportunity to select a sample, so the resulting sample has a higher representativeness. Therefore, the conclusion of the sample can be generalized to the population (Purwanto, 2008). This technique can be used if the population was homogeneous (Sugiyono, 2012).

The variables in this study were two independent variables, one dependent variable, and one moderator variable. The independent variables in this study were PDEODE and Small SGD strategies. The dependent variable was critical thinking skills and moderator variable was learning motivation.

The technique of data collection was using test (essay) and non-test with questionnaire. The instruments of data collection used paper of test: pretest-posttest of critical thinking skills, and motivation questionnaire paper. The data of learning motivation were analyzed by using Mean and these were classified according to the theory of Widoyoko (2012). The level of learning motivation in this study can be seen in Table 1.

**Table 1.** Classification of learning motivation

Space of average skor	Criteria
$2,50 < Mean \leq 4,00$	High
$1,00 \leq Mean \leq 2,50$	Low

The analysis of the data to test the hypothesis in this study used statistical parametric two ways ANOVA without interaction with different cells (Budiyono 2009 and Siregar. S, 2013). This was because difference of the number of two experimental classes.

Furthermore, data of learning motivation and critical thinking skills were also analysed by regression analysis in this study. This was used to predict how far the alteration of critical thinking skills value, if learning motivation value was changed (Sugiyono, 2012).

## RESULTS AND DISCUSSION

Data obtained from this study included data of critical thinking skills and learning motivation before and after treatment. The average score of critical thinking skills pretest of the experimental class I was 47.16 and 42.21 for the experimental class II. The average score of the initial learning motivation of the experimental class I and the experimental class II were 74.57 and 74.84 respectively. One Way Anova test results (Sig. (2-tailed)) indicated that the data pretest scores of critical thinking skills and initial learning motivation in both the experimental classes were normally distributed and homogeneous. Thus, the initial ability of students in terms of both critical thinking skills and learning motivation of the experimental classes were equivalent.

The average of posttest score of the experimental class I and the experimental class II were 60.71 and 72.00 respectively. The level of learning motivation after being given the treatment showed that both the experimental class I and the experimental class II, had same average learning motivation relatively. That were 76.42 and 76.90. Similarly, the data pretest, based on analysis of One Way Anova (Sig. (2-tailed)), the data of posttest were normally distributed and homogeneous.

The hypotheses in this study were whether learning strategies (PDEODE and SGD) which were used in science teaching and learning motivation (high and low) affect students' critical thinking skill. The analysis used was the average difference test ANOVA of two ways with different cell without interaction. This was because the research was limited only to see the effect without considering the interaction between learning strategy and learning motivation toward critical thinking skills. The data used to test the hypothesis was posttest data of critical thinking skills and learning motivation

after given treatment.

Based on Table 2, it appears that the value of  $F_{calculation} > F_{table}$  with significance (2-tailed) is 5%. When reviewing Table 2, based on the strategy used, PDEODE and SGD, value  $F_{calculation}$  (9.67) is greater than  $F_{table}$  (3.89). It can be concluded that the use PDEODE strategy in the experimental class I and SGD strategy in the experimental class II influence on critical thinking skills. This is consistent with research result of Costu (2008) which stated that PDEODE learning strategies help students to understand the concepts well, can foster cooperation in the experiment, and develop the ability to think, in this case is critical thinking skills. The research of Sa'idah and Suyono (2012) also mentioned that PDEODE strategy can reduce misconceptions. This means that the critical thinking skills fosters the students to understand the concepts in greater depth based on the fact that students have encountered, resulting in a better understanding of the concept.

In addition, several other studies regarding SGD strategy, including research Afandi, et al (2009) stated that SGD learning is better in improving knowledge than conventional learning. This is in line also with Applebee, et al (2003) who found that SGD enables the achievement of high achievement in the classroom. According to Applebee, et. al., SGD students can develop their knowledge because students are required to have a good knowledge and are required to be actively involved in the discussions.

Seeing strategies of both experimental classes that were designed for observation, then both classes support the students to have a scientific attitude and conduct scientific process. According to Rahayu et. al (2013), the scientific process is a skill that students used in conducting integrated learning science through the discovery process, observation, hypothe-

size, and inference. This thinking process is also called critical thinking skills. Discussion on each of the experimental class also requires students to think, argue, compare the initial understanding of the facts found in the observations, and reorder new understanding. These activities can foster critical thinking skills. Thus, the learning process in SGD and PDEODE strategies can support the students in developing their critical thinking skills.

The first up to the third stage of PDEODE learning is Predict-Discuss-Explain. In this stage the teacher presents the problems presented in PDEODE worksheet. Each student revealed predictions about the problems that will occur. Then the students in each group discussed the results of their predictions, reflected, and tried to reach mutual solutions and reasoning, then explained the result in front of the class (Rane and Kolari, 2003).

The fourth step is Observe. At this step the students in each group do observations to test whether the previous prediction is correct or not. Students observe the possibilities of events that can be used as a reference in making conclusions.

The fifth stage is Discuss. At this stage the teacher and student groups discussed what they found in the observation stage as well as what is relevant and irrelevant according to predictions and observations. Furthermore, students constructed new understanding and compared it with the previous understanding.

The sixth stage is Explain. At this stage the student gives an explanation about their misunderstanding based on the observation and group discussions to be presented in front of the class. Presentation in front of the class was used as a means for discussion with other groups, so if one group does not agree, then other groups can convey the results of their discussion. After completion of the presentation,

**Table 2.** The results of average difference ANOVA two way different cell without interaction test

Data source	Source	JK	dk	RK	$F_{calculation}$	$F_{table}$ Significance (2-tailed) 5%
Posttest	Learning motivation	1226,08	1	1226,08	10,62	3,89
	Learning Strategies	1115,69	1	1115,69	9,67	3,89
	Error	6810,70	59	115,44	-	-

**Table 3.** The average each cell from posttest data

Learning Motivation	Learning Strategies		Marginal average
	PDEODE	SGD	
High	63,18	74,60	137,78
Low	54,67	62,71	117,38
Marginal average	117,85	137,31	-

teachers convince and emphasis whether the students have adopted a new understanding (clarify students' assumptions). The teacher asks the students to conclude the result.

Learning process using PDEODE strategy consists of six stages, while learning process using SGD strategy consists of four stages. First and second steps are presenting a problem and the division of the group. At this stage, before the teacher presents a problem, the teacher guides students toward the material to be learned through apperception. These activity encourages students to express their opinions and stimulate students to ask and try to answer the questions delivered by other students, so that students will be ready to follow the activity of learning.

In the next stage students was divided into small groups of four students. After gathering with the groups, the teacher gives the problems presented in SGD worksheet.

The third stage is discussing problem in a small group. The students make observations to decide solution. In this case they were doing a simple experiment using the tools and materials that had been provided by the teacher or the other relevant materials. In addition, students are searching information from variety of sources, so the problem solving is obtained based on the facts (observations) and reliable source.

The next step is presentation of the discussion results. Representative from each group presented it in front of the class. At this stage the students analyze, compare, and criticize the other group's presentations, so if they do not agree, the other groups can present their results of discussion. After that, the teacher clarifies the discussion results then gives attention on the important things in the material. The teacher asks the students, then, to conclude the learning result.

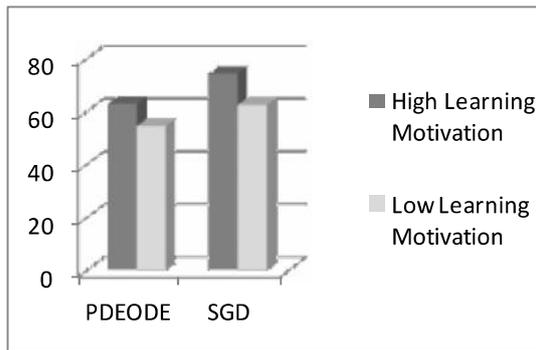
Thus, if it is seen from the steps of learning strategies, both PDEODE and SGD require involvement of students and develop students' thinking skills, including critical thinking.

Furthermore, strategy which gives better effect can be seen based on the marginal average. From Table 3, it can be concluded that the students' critical thinking skills in the experimental class II are better than the experimental class I. In the webbed type of Integrated Science teaching with "Light In The Life" theme, the critical thinking skill of student in Small SGD strategy is better than PDEODE strategy. This is because the marginal average column

which is the marginal average of SGD strategy: 137.31 is higher than 117.85 which is the one strategy.

Critical thinking skills are also reviewed based on learning motivation classified into students who have high learning motivation and the low one. If the notice is based on it, value of  $F_{calculation}$  is greater than  $F_{table}$  (10.62 > 3.89). Thus, we concluded that learning motivation (high and low) gives effect to critical thinking skills. It is similar to Hamdu and Agustina (2011) research results which showed that there is significant influence between learning motivation on student achievement. The Sitepu research (2011) also showed same result that there are significant learning motivation for critical thinking skills. In addition, the invention of Sitepu research is also in line with the results of this study which concludes that the critical thinking skills of students who have high learning motivation is better than critical thinking skills of students who have low learning motivation. It is based on the row marginal average in Table 3. The marginal average of high learning motivation (137.78) is higher than the one of low learning motivation (117.38).

And then, data of learning motivation and critical thinking skill were also analyzed by regression analysis to predict the effect of learning motivation on critical thinking skill. If it is seen from the pretest score, the average of learning motivation in both of experimental class is increase. In other word, PDEODE and SGD strategies give effect on learning motivation causing difference on critical thinking skills. In line with the result of regression analysis, learning motivation and critical thinking skills can be expressed in linear regression model. That is based on Sig. of regression  $0.045 < 0.05$ . It means that there is a positive correlation between learning motivation and critical thinking skills. The higher learning motivation, the better critical thinking skills. If R square is seen from Table 5 about model summary, it can be concluded that the contribution of learning motivation to effect on critical thinking skill which is about 6.4%, and 9.36% is effected from other factor. In other word, in this study influential of learning motivation toward critical thinking is weak.



**Image 1.** Trunk diagram of posttest scores of critical thinking skills viewed from learning motivation of students.

**Table 4.** Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.253 <sup>a</sup>	.064	.049	12.42016

Based on the description, it can be concluded that either PDEODE or SGD strategies, affect positively on critical thinking skills. This is because the learning activities in experimental classes, students are trained continuously to be able to solve the problems given in the discussion. Teacher is a facilitator and motivator. He/she provides clarification as well as emphasis on the material that the student has not understood.

In addition, students are also trained to conduct observation, to explain what they got from the results of discussions and observations, to make hypotheses (predicting), to evaluate the other groups explanation, and to derive conclusions. Therefore, students get a deeper understanding.

SGD and PDEODE learning activities require the involvement of students actively in acquiring knowledge of direct observation. Students are given the opportunity to express their thoughts to response the opinion of the students or other groups. It is not independent of critical thinking and the students who responded were demanded to defend their answer and show credible evidence.

When reviewing the results of the study, it is showed that the experimental class II which applied SGD strategy gave better effect than PDEODE strategy toward critical thinking skills. If it is reviewed from the learning motivation after students were given treatment, the statistics of average score of learning motivation in experimental class I is as same as one in experi-

mental class II.

If learning motivation in the field was seen, which is based on observations during the study, the learning motivation in experimental class II was higher than the experimental class I. It is proven from the number of students who collect assignments in the experimental class II which are more than the experimental class I. In addition, the spirit of learning of students in the experimental class II is higher than the one in the experimental class I. It is marked by conditions in experimental class II which is more conducive than the other one during learning in classroom. There are more students who ask and try to answer the question. This can be a factor that causes the average of critical thinking skills in the experimental class II is higher than the one in the experimental class I.

The number of PDEODE learning procedures cause learning motivation of the experimental class I is low. This is because students are less familiar with these procedures. The statistically difference average of learning motivation and real condition was due also to less serious students in filling out a learning motivation questionnaire.

If it is seeing from the learning output, the results of critical thinking skills posttest in the experimental class I is only 6.45% of students who completed, while the experimental class II is only 9.38% of students who complete on the Integrated Science with "Light in The Life" theme. It is caused by several factors: the students did not familiar with learning by discussion, observation, problem solving, so the result of study cannot be maximized. In addition, students psychology during the conducted research was in unfavorable conditions. Students already feel the tension about Semester Exam held approximately one week after the study is completed.

The number of assignments and examinations which are given by the other teacher subjects make students stress and they cannot learn optimum in the classroom. Moreover, the posttest done in the day that the condition of students was not fresh and their concentration has decreased.

These factors were based on observations of researcher and comments and complaints of students during the study. Therefore, it is important for teacher to motivate the students in order the students are able to pass the processes of learning in the classroom or outside the classroom. The teacher must be able to design an interesting and fun learning, so that

students can really enjoy to learn with full of spirit to pass any kind challenge.

### CONCLUSION

PDEODE and SGD strategies were influential toward critical thinking skill with  $F_{\text{calculation}}$  of learning strategies sell (9.67) is greater than  $F_{\text{table}}$  (3.89). The average critical thinking skills students who use SGD strategy (137.31) is better than students who use PDEODE strategy (117.85). In addition, there is the effect of learning motivation on critical thinking skills with  $F_{\text{calculation}}$  is 10.62 that is greater than  $F_{\text{table}}$  (3.89). For both students using PDEODE and SGD strategies, the ability average of critical thinking of students who has high learning motivation is better than the lower one.

There is an increase in average of learning motivation before and after treatment in both of experimental class. In other word, PDEODE and SGD strategies give effect on learning motivation causing difference on critical thinking skills. Based on Sig. of regression  $0.045 < 0.05$ , learning motivation and critical thinking skills can be expressed in linear regression model. It means that there is a positive correlation between learning motivation and critical thinking. According to R square, the contribution of learning motivation to effect on critical thinking skill is about 6.4%, and 93.6% is effected from other factor. In other word, in this study influential of learning motivation toward critical thinking is weak.

Suggestion that can be delivered based on the research that has been conducted is steps of PDEODE and SGD strategies are designed in order to that students find their own concepts with discussion and observation. It takes a long time for one lesson. Therefore, while the students do observations and other activities, teacher should pay more attention to time management so that learning can be implemented effectively and does not interfere with future learning. In the process of discussion, it needs regular monitoring in order topic of discussion is not diverge. Then, in order that all students really involved in groups discussion, the teacher should appointed chairman of the group to coordinate the discussions in each group.

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