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Development of Students' Critical Thinking Skills Through Guided Discovery Learning (GDL) and Problem-Based Learning Models (PBL) in Accountancy Education[*]

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ARTICLE INFO	ABSTRACT
	Purpose: Interpersonal skills and critical thinking are criteria for the success in the accounting profession, which requires both theoretical and practical knowledge and skills to think critically when practicing this profession. This study aimed to determine the differences in students' critical thinking skills using the Guided Discovery Learning (GDL) model and the Problem Based Learning (PBL) model **Method:** The study used quantitative methods through an experimental approach. A pretest and a posttest were used to collect the data. The respondents were 10 accountancy major students, who were divided into control and experimental groups.

Findings: The results of the pretest and the posttest showed the improvement and better performance of the experimental group, which had received the treatment by using the GDL approach, in contrast with the control group which was taught the subject using the conventional approach. This is evidenced by the mean, N-gain and percent value for the experimental class which were measured higher than the control class. Findings suggest that there are differences in the effectiveness of the application of cooperative learning models of Problem Based Learning (PBL) and Guided Discovery Learning with conventional methods in improving students' critical thinking. **Implications for Research and Practice:** The implication of this research is that students are expected to be able to ask questions with a higher level of analysis, and by looking at the problem and being able to solve the problem well. This is also due to the fact that students tend to want to ask a lot of questions to get added value from the tutors. This study can provide useful insights to the educationists who can be benefited by the findings of this research. Future research can be carried out on similar models of learning to judge other educational skills.

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Introduction

There is an acute shortage of professional accountants in Indonesia primarily due to non-availability of adequate knowledge and information about this profession (Suryani, Helliar, Carter, & Medlin, 2018). The number of accounting firms in Indonesia decreased from 408 in 2011 to 388 in 2014 (Finance, 2015). Such a scarcity of public accountants needs to be seen as an important question by universities, educationists and parents. Previous studies have however attempted to find out why people are reluctant to join this profession. A few reasons came to the light such as limited knowledge about the accountancy profession (Sawarjuwono, 2013), less scope of work (Suryani et al., 2018), and less job satisfaction and greater employee turnover (Wen, Yang, Bu, Diers, & Wang, 2018). Others found out that the intention of working as accountant depends on intrinsic motivation (Bagley, Dalton, & Ortegren, 2012) and parental influences (Anis & Hanafi, 2015; Law & Yuen, 2012) in Indonesia.

Apart from all these reasons leading to a disinterest in the accounting profession, it has also been observed that interpersonal skills and critical thinking are also criteria for the success in the accounting profession (Suharno, Pambudi, & Harjanto, 2020). Accounting is a profession that requires both theoretical and practical knowledge and skills to think critically when practicing this profession. This is consistent with Locke and Lowe (2008) and Mohamed and Lashine (2003) who asserted that accounting knowledge is the conceptual knowledge and skills that students must develop to satisfy the stakeholders. The demands of skills in the 21st century are also needed on students (Yuliani & Saragih, 2015), the number of programs and majors as well as the learning process requires students to think critically, including in the Department of Accounting in higher education, students have the ability to think critically in understanding accounting knowledge. This major will produce an accountant profession, with the ability to make financial reports and be able to understand business values (Wells, 2018). A need was therefore felt to identify learning models based on critical thinking skills which can help accountant to become accustomed to dealing with problems faced in practicing this profession (Eveleth, Baker-Eveleth, & Stone, 2020; Holmes & Rasmussen, 2018).

Critical thinking is a logical way of thinking and has a focus on decision making (As' ari, Mahmudi, & Nuerlaelah, 2017). The purpose of critical thinking itself is to test ideas, to consider the thoughts conveyed. Critical thinking skills are largely determined by many factors, one of which is the appropriate learning model. Critical thinking is also related to the level of literacy orally and in writing. This literacy ability will determine whether students are sensitive to the problems around them. This ability to think critically is absolutely necessary for students, because at every opportunity they will find and decide various problems related to their professional field. However, students face the literacy crisis which results in their inability to develop critical thinking skills and the required creativity. The Indonesian students lack the ability to read texts and their course related material which results in their poor imaginative power and lack of creativity (Yuliani & Saragih, 2015). The ability to think creatively is also helpful in developing their other competencies such as critical

thinking skills, collaborative thinking, and communicativeness ((Cheng & Ding, 2021) (Noviyanti, Rusdi, & Ristanto, 2019)).

Studies have emphasized to initiate learning processes on students' critical thinking skills in order to improve the quality of education (Yee et al., 2015). When students go through a thinking process, it affects their learning ability, the speed and the effectiveness of learning (Heong et al., 2020). This enables them to develop the ability to learn independently and nurture critical thinking skills. Students' critical thinking skills can be known through the ability to ask questions and respond to problems. In other words, students develop a problem-based learning style, that can be converted into a learning model, namely a Problem-Based Learning (PBL) Model (Fogarty, 1997). This model uses a problem-solving approach, involving the interaction of teachers and students to form a learning process, requiring students to solve problems, raised either by teachers or real facts from the environment. The problem-solving approach also develops students' critical thinking skills as they are involved in questioning process based on the information or situation. The information first gets processed in the students' mind, before it triggers questions.

PBL model turns students active toward the information and makes it easier for them to construct their own new knowledge based on their understanding of the information. According to Dewey (quoted in (Thomassen & Jørgensen, 2021)), problem-based learning is the interaction between stimulus and response, a relationship between two directions of learning and the environment. The environment provides input in the form of problems while the brain interprets it and enlarges the problem for further investigation, assessment and analysis until a solution is reached. In the process, students develop the critical thinking skills needed for solving the problem.

PBL model in accountancy adopts a similar problem-solving approach and process, i.e., process of first applying the previously acquired knowledge into new unknown situations and then critically think to reach a solution. Like in any other discipline, the characteristics of a problem in accountancy also involves three steps: identify the challenges in the problem, devise a procedure as the problem cannot be solved using routine procedures; and consider problem solving as a thinking model to reach the solution. These steps can also be understood as a problem-solving approach in accountancy where a PBL model acts as a learning concept that helps teachers create a learning environment, it starts with important and relevant problems and exposes students to get a more realistic learning experience.

Closely associated with the PBL model is the Guided Discovery Learning (GDL) model (Fischer & Hänze, 2019; Manu, Ying, Oduro, & Boateng, 2021). The GDL model depends on the guidance of instructors in order to achieve learning outcomes (Guimarães, Pohl, Bina, & Varanda, 2019; Hämäläinen et al., 2021). The guidance and the related instructions are something new for students and therefore it requires development of critical thinking skills, to enable students to interpret and analyze the instructions from educators (Živković, 2016). For this purpose, the development of critical thinking skills in learning needs to be optimized by applying appropriate and

innovative learning strategies, so that the learning process takes place optimally and eventually students' critical thinking skills are developed (Bray, Byrne, & O'Kelly, 2020). The Guided Discovery Learning model serves one of such strategies (Fischer & Hänze, 2019);(Manu et al., 2021).

With GDL model, students are expected to find and solve problems in life, as well as being able to think critically about the knowledge gained (Soler, Soler, & Araya, 2017). In addition, GDL model is also suitable for accounting learning needs for students who must be able to find their own knowledge and problems, and lecturers who can play a guiding role when learning after gaining knowledge (Fischer & Hänze, 2019; Soler et al., 2017). Several studies have shown the influence of the GDL model on students' critical thinking skills (DeDonno, 2016; Al-Balushi, Ambusaidi, Al-Balushi, Al-Hajri, & Al-Sinani, 2020; Fischer & Hänze, 2019; Minniti, Melo, Oliveira, & Salles, 2017). These studies suggest to devise an application or a model for a guided discovery learning in order to improve students' critical thinking skills. Yuliani and Saragih (2015) advocated the use of such learning tools based on the GDL model in order to improve the concept of understanding and critical thinking in students' accounting abilities. Noviyanti et al. (2019) have even found a close relationship between Internet-based GDL model and students' critical thinking skills.

The above study of previous writings helped formulate the research objectives of the current study. It was evident that students tend to lack critical thinking skills during the learning process. They do not know how to identify or formulate problems, formulate question sentences, structure an argument, give reasons, and make observations with correct evidence and recordings. Teachers are also usually not active in front of the class while students passively listen (Quinn, Hogan, Dwyer, Finn, & Fogarty, 2020). There has not been a learning atmosphere that is able to provoke student curiosity and provoke students' critical thinking skills and which involves thinking, exercising the heart, feeling and exercising at the same time. The thinking skills of our students are still in the low category (lower order thinking skills) (Živković, 2016).

Therefore, this study attempted first to examine the level of critical thinking skills possessed by prospective teacher students in accountancy. Following this objective, the study tried to understand whether Problem Solving approach can generate students' interest in accountancy, and increase their accountancy learning abilities. The research questions needed to answer this research, therefore, was whether a PBL model can help develop students' critical thinking skills in Accountancy. This study also aimed to measure and interpret the application of Guided Discovery Learning model to develop students' critical thinking skills in learning accountancy. Critical thinking indicators used in this study to analyze both PBL and GDL models, according to (Ennis, 2011), included the ability to formulate questions, analyze arguments, ask and answer questions, assess the credibility of information sources and make observations. This study epitomized these indicators during the course of this study.

Theoretical Framework

As mentioned in the review, a GDL model can be one of the learning models that can improve students' critical thinking skills (Guggemos, 2021); (Hundial, 2020). According to (Quinn et al., 2020), learning with GDL model, students are encouraged to learn mostly through the active involvement of information (Fischer & Hänze, 2019); (Lingyi, 2010). In another research (Boa, Wattanatorn, & Tagong, 2018) further stated that GDL model could lead to students' own construction of concepts and principles. In addition, GDL helps students develop independent problem solving and critical thinking skills because they can analyze and manipulate knowledge (Syazali, 2019). This is the beginning of autonomous learning, critical thinking and scientific attitude. Furthermore, (Lingyi, 2010) the PBL model, closely associated with GDL, enables the teachers to improve students' physical abilities and their critical thinking skills. Teachers determine assignments and design a sequence of questions or problems, and the PBL approach leads students to one correct answer ((Dring, 2019; Seibert, 2021)). While teachers only guide students to reach the correct answer but do not give them answers, the students' success depends on the ability of teachers skills to arrange questions in a logical order and ensure students become active participants in the learning process (Soler et al., 2017).

Research Hypothesis

Based on identification of research objectives and the theoretical framework, it can be concluded that GDL and PBL models affect students' critical thinking skills ((Al Hakim, Sariyatun, & Sudiyanto, 2018; Quinn et al., 2020)). Hence, the following hypothesis is proposed:

H1: There are differences in students' critical thinking skills using Guided Discovery Learning (GDL) and Problem Based Learning (PBL) models compared to conventional models.

Method

Research Design

The study used a quantitative research design methods (Sugiyono., 2014) through an experimental approach to test the effects of one variable on another variable. This served as a good framework to examine the application of Guided Discovery Learning (GDL) and Problem Based Learning (PBL) models in the learning process of accountancy subject.

Research Sample

A sample of 10 students was used in this study taken from two accountancy classes and formed in two groups. Each group consisted of 5 students and represented an experimental group (a combination of GDL and PBL approaches) and a control group (only PBL approach) respectively. The control group was named as

Accounting Class I and coded as S while the experimental group was called Accounting Class II, coded as P.

Data Collection Instruments and Procedures

As a part of this experiment, both experimental and control groups were given a pretest and a posttest to find out the state of critical thinking skills of students. the pretest was given at the beginning of the learning process and the post-test at the end. Each test used in this study was a written test consisting of 7 questions that required an answer in the form of an essay (description). These questions were subjected to an empirical validation process. Out of the total 7 questions, 4 questions showed moderate reliability, distinguishing a value of moderate and very good levels. The difficulty levels of these questions were easy, medium, and difficult. In addition to tests, observation sheets were also used to record the implementation of both GDL and PBL models.

Data Analysis

For the purpose of data analysis, a descriptive statistics design was used to measure improvement/gain, where gain was the difference between the pretest and posttest scores/values. The validity and reliability test of the pretest and posttest instrument was also carried out as a prerequisite before testing the hypothesis. The hypothesis (H1) of this was tested by using a homogeneity test and a data normality test. The results of H1 test was recorded in the form of N-Gain Score and Independent Sample T-Test value (Ghozali, 2011).

Results

The research procedure was carried out by first dividing the sample into experimental and control groups. The experimental class was given treatment using a combination of PBL and GDL models, while the control class used conventional methods of simply PBL. The research process (experiment), which took six months to complete, was carried out in the form of applying the GDL and PBL models in both classes in the Accounting Education Study Program through lectures, discussions, assignments and evaluation at the end of the experiment. After completing the treatment, both control and experimental groups were given a posttest to determine the final critical thinking ability of students. The data from the pretest and posttest results are shown in Table 1.

Table 1

Critical Thinking Skills

Class	Average Score	
	Pre-Test	**Post Test**
Control	**47.6**	**75.6**
Experiment	48.4	87.8

Table 1 shows the average pre-test score in the experimental class to be 48.4 and that of the control class 47.6. However, the post-test results show the value of 75.6 and 87.8 for the control and experimental class respectively. A significant increase is seen in the critical thinking skills of experimental class in the posttest. As the next step, a normality tests for both experimental and control group was conducted. The results are presented in Table 2.

Table 2

Normality Test Results

	Shapiro-Wilk		
	Statistics	**df**	**Sig.**
Pretest (Experimental)	.946	5	.243
Post Test (Experimental)	.934	5	.132
Pretest (Control)	.939	5	.170
Posttest (Control)	.937	5	.158

Table 2 presents the results of the normality test for students' critical thinking. Each has a value of Sig. > 0.05, which suggests that the data was normally distributed.

Table 3

Homogeneity Test Results

	Levene Statistics	**df1**	**df2**	**Sig.**
Based on Mean	1.321	1	44	.257
Based on Median	.807	1	44	.374
Based on Median and with adjusted df	.807	1	39.8 35	.374
Based on trimmed mean	1.178	1	44	.284

Table 3 presents the Homogeneity Test results, where the score based on Mean is significantly 0.257 and based on Median is 0.374, both are > 0.05. It can be concluded that the data is homogeneous.

Table 4

N-Gain Score Test Calculation Results

N-gain Score Test Calculation Results			
No	**Experiment Class**	**No**	**Control Class**
	N-gain Score (%)		**N-gain Score (%)**
Average	57.9563	Average	53.0631
Minimum	27.27	Minimum	12.5
Maximum	81.82	Maximum	83.33

Based on the calculation results of the N-Gain Score test, Table 4 shows that the average value for the experimental class is 57.9563 or 58% with a minimum N-Gain Score value of 27.27% and a maximum value of 81.82%. Meanwhile, the control class shows 53.0631 or 53% with a minimum N-Gain Score of 12.5% and a maximum value of 83.33%. This value is interpreted in the following table (Table 5) to measure N-Gain effectiveness interpretation. Based on Table 5, the interpretation of the effectiveness of N-gain showed a gain value with a percentage of <40%, interpreted as ineffective, 40-55%, interpreted as less effective, 56-75%, interpreted as quite effective, and >76% is interpreted as effective.

Hypothesis Testing

An independent sample t-test was also used to test the hypothesis of the study and to determine whether there was a significant difference in the posttest scores in the experimental class in comparison with the control class. The t-test also presented the same results, showing a higher increase in the critical thinking skills of the experimental class

Table 5

N-Gain Effectiveness Interpretation

Percentage (%)	Interpretation
< 40	Ineffective
40 – 55	Less effective
56 – 75	Effective enough
>76	Effective

Table 6

Group Statistics of T-Test

Class	N	Mean	Std. Deviation	Std. Error Mean
NGain_percent Experiment	5	57.9563	15.51574	3.23525
Control	5	53.0631	16.21021	3.38006

Table 6 displays the value of the mean N-gain Percent for the experimental class is 57.9563 or 58% while for the control class shows 53.0631 or 53%. Based on these results, the effectiveness of the N-gain value (%) can be interpreted. These results suggest that the application of the PBL and GDL cooperative learning models in the experimental class was quite effective for improving critical thinking, while the use of conventional methods (only the PBL model) in the control class was less effective for improving students' critical thinking. Both the Independent t-test for the N-Gain Score were carried out with the help of the SPSS 25.0 program, which compared the differences (significance) in terms of the level of effectiveness of implementing the PBL and GDL

as cooperative learning models in improving students' critical thinking. From Tables 7 and 8, the average score of students in the PBL (control group) class is 12.6 and in the PBL +GDL (experimental) class is 13. For the average value, the PBL class scored 79 and the GDL class scored 81. It can be seen that the average value of critical thinking skills in a lecture process for the Accountancy Education study program in the experimental class is greater than in the control class. Therefore, we can say that the critical thinking skill value in the pretest scores are different for both the groups, however, this difference is only of 2 points.

Taking the hint from the comparison, it is however still possible to compare the two groups to see whether this increase suggests any improvement. for this purpose, the pretest value was used to determine the distribution of students into the control and experimental classes. By sorting ten students from the highest value to the lowest value, we can again group into 2 classes, namely the upper class and the lower class. This is because the number of students < 30, the distribution would be taken by 50% each of upper and lower class. This means that 5 upper class students and 5 lower class students could be identified from 2 groups.

They can further be divided into 2 new groups again at simple random method or by lottery technique. Table 9 and Table 10 shows the average posttest value of critical thinking skills in the lecture process for Accountancy Education Study Program for the PBL class is 94 and the PBL+ GDL class is 95. From this result, we get that the average posttest value for critical thinking skills for the Accountancy Education study program in the PBL+GDL class is greater than in the PBL class. There are 4 students in each class who get a posttest score higher than their score in the pretest. Meanwhile, 1 student in each class got the same score as his pretest score. Overall, the average posttest score increased as compared to the pretest.

Table 7

Pretest Data for PBL Class of Accountancy Education Study Program

No	Learners	Question Item Score				Total Score	Value
		1	**2**	**3**	**4**		
1	S1	4	4	3	4	15	93.75
2	S2	2	4	4	4	14	87.5
3	S3	2	4	4	4	14	87.5
4	S4	2	4	3	2	11	68.75
5	S5	2	3	2	2	9	56.25
	Total	12	19	16	16	63	393.75
	Average	2.4	3.8	3.2	3.2	12.6	79
	Score / Max.	4	4	4	4	15	93.75
	Min Score/Score.	2	3	2	2	9	56.25
	Standard Deviation	0.89	0.45	0.84	1.10	2.51	15.94

Table 8

Pretest Data for PBL+ GDL Class of Accountancy Education Study Program

Learners	Question Item Score				Total Score	Value
	1	**2**	**3**	**4**		
P1	2	4	4	4	14	87.5
P2	2	4	4	4	14	87.5
P3	4	4	3	2	13	87.5
P4	2	4	4	4	14	87.5
P5	2	3	3	2	10	62.5
Total	12	19	18	16	65	406.25
Average	2.4	3.8	3.6	3.2	13	81
Score / Max.	4	4	4	4	14	88
Score / Min.	2	3	3	2	10	63
Standard Deviation	0.89	0.45	0.55	1.10	1.73	10.83

Table 9

Posttest Data for PBL Class of Accountancy Education Study

No	Name	Question Item Score				Total Score	Value
		1	2	3	4		
1	S1	4	4	4	4	16	100
2	S2	4	4	4	4	16	100
3	S3	2	4	4	4	14	87.5
4	S4	4	4	4	2	14	87.5
5	S5	4	4	3	4	15	94
Total		18	20	19	18	75	468.75
Average		3.6	4	3.8	3.6	15	94
Score / Max.		4	4	4	4	16	100
Score / Min.		2	4	3	2	14	87.5
Standard Deviation		0.89	0.0	0.45	0.89	1.0	6.0

Table 11 consolidates the data on improving critical thinking skills of the students in Accounting Education Study Program of both the control and the experimental group.

Table 11 consolidates the data showing the increase in the critical thinking skills of the students in the Accounting Education Study Program. The distributed data reveals there was an increase in the attainment of the critical thinking skills in the experimental group as compared to the control group.

Table 10

Posttest Data for PBL+ GDL Class of Accountancy Education Study

No	Name	Question Item Score				Total Score	Value
		1	2	3		4	
1	P1	4	4	4	4	16	100
2	P2	4	4	4	4	16	100
3	P3	4	4	4	2	14	87.5
4	P4	2	4	4	4	14	87.5
5	P5	4	4	4	4	16	100
Total		18	20	20	18	76	475
Average		3.6	4	4	3.6	15.2	95
Score / Max.		4	4	4	4	16	100
Score / Min.		2	4	4	2	14	87.5
Standard Deviation		0.89	0.0	0.0	0.89	1.10	6.85

Table 11

Consolidated Data for Control and Experimental Classes

Class	Value	*Pretest*	*Posttest*	Enhancement
Control (PBL)	Average	79	94	15
	Maximum Value	93.75	100	6.25
	Minimum Value	56.25	87.5	31.25
Experimental (PBL+GDL)	Average	81	95	14
	Maximum Value	87.5	100	12.5
	Minimum Value	62.5	87.5	25

Discussion

The descriptive statistics of the data showed differences in the effectiveness of the application of collaborative learning models of Problem Based Learning (PBL) and Guided Discovery Learning (GDL) with conventional methods in improving students' critical thinking skills. Based on the results, it was revealed that the critical thinking skills of students who were taught using the GDL model (experimental class) were higher than the students who were taught using the conventional PBL model (control class). This was because the GDL model provided opportunities for students to seek and find for themselves the information they need.

For example, the descriptive statistics revealed that at the time of the pretest, the average value of experimental class was greater than the value of the control class (81 > 79). The research experiment was carried out to see whether there could be any improvement by using the GDL model. In the posttest, the GDL value was found

greater than PBL (87.8 > 75.6). The results of this study indicate that the GDL learning model has an average score greater than the average score of the PBL model.

Likewise, the mean N-gain percent value for the experimental class using the GDL model was of 57.9563 or 58% while for the control class using the PBL model was 53.0631 or 53%. So based on the category table for the interpretation of the effectiveness of the N-gain value (%) it can be concluded that the application of cooperative learning models of Problem Based Learning (PBL) and Guided Discovery Learning in the experimental class was quite effective in improving critical thinking, while the use of conventional methods in the control class was less effective to improve students' critical thinking.

While measuring the improvement, the average improvement score of the control class using the PBL model was greater than that of the experimental class using the GDL model (15 > 14). Numerically, this shows that the critical thinking skills of students who study with the PBL model and the GDL model have differences. Likewise, the application of the collaborative learning model of Problem Based Learning and Guided Discovery Learning is more effective than the application of the conventional learning model with a p value > 0.05 (275). The difference in the average learning outcomes of the experimental class and the control class on the critical thinking of class students shows the average post-test score for the experimental class is 77.83, which is greater than the post-test average value of control class which is 75.65. This can be interpreted that student who study with the PBL model have a lower mastery of the critical thinking skills in the Accountancy classes as compared to those who studied using the GDL model. This also suggests that students in the control class, in general, have not been able to make decisions, namely through communicating decisions to others. This has an impact on learning, namely students feel not accustomed to leading and making decisions on a problem both in learning groups, and personally in learning because of the difficulty of communicating their decisions or opinions to others.

These results are in line with the results of researches by Hijjah and Minarni (2017) which showed that there was a difference in the improvement of students' communication and critical thinking skills between students who studied the PBL and GDL models, where the communication and critical thinking skills of students who studied with the GDL model were better than those who studied the PBL model. This result is also consistent with the findings of Moreno-Guerrero, Aznar-Díaz, Cáceres-Reche, and Alonso-García (2020) and Mulenga and Marbán (2020) which studied the good impact of e-learning method and found a positive influence on the study of mathematics subject. These two studies showed how online or e-learning helped students demonstrate excellent performance and achievements.

Both Guided Discovery Learning and Problem Based Learning have a character that can develop problem solving abilities. But the curiosity of students is increased by the problems given by the teacher. These questions relate to the Accounting Education Program and needed to be solved using the application of the GDL and the PBL models. These questions can provoke students to find appropriate, reasonable, and

rational solutions. Proper analytical processes are needed to recognize assumptions, inferences, evaluations and interpretations in order to solve problems. While delivering the problems, lecturers can use more interesting methods, do something more interesting such as showing pictures, videos, and so on. In problem solving, the teacher does not have to ask questions, students are asked to see a unique phenomenon and express their opinion.

In the problem-solving phase, students are trained to practice almost all sub-fields. Students are guided by teachers to discuss together how to deal with problems and then look for various relevant competent information and filter useful information. Students are expected to be able to see the material from various points of view, although it is difficult for students to at least be able to open their minds. After students had searched for information, they interpret, assimilate, and organize it in the problem-solving phase with their groups, and finally present it in front of the class. During the process, students may also share their views with one another accompanied by constructive arguments related to the questions. They express opinions expressed in discussion activities oriented to the knowledge previously obtained, namely the problem-solving phase. In addition, students can also make conclusions that can be accepted by both students and teachers. While making a selection between two models, the teacher can play an important role in guiding students and providing feedback to ensure that students understand the material. Discussion activities make students practice their ability to argue, make inferences and communicate well.

Conclusion and Recommendations

It can be concluded that the application of cooperative learning models of Problem Based Learning (PBL) and Guided Discovery Learning in the experimental class is quite effective in improving critical thinking, while the use of conventional methods in the control class is less effective. to improve students' critical thinking. This conclusion is based on the descriptive statistics, where differences in the effectiveness of the application of cooperative learning models of Problem Based Learning (PBL) and Guided Discovery Learning with conventional methods have been found in improving students' critical thinking skills. The

Student learning motivation also influence students' critical thinking skills. Students with high learning motivation certainly have better critical thinking skills than students with moderate or low learning motivation. It is expected that teachers can improve the learning motivation of students in various ways according to the ability of teachers. The results also revealed that the highest influential indicator was asking questions. Teachers should apply appropriate learning models in order to create a fun, active, and effective learning atmosphere. The results of this study also reveal that the lowest influential indicator was making decisions. Not only Guided Discovery Learning (GDL) and Problem Based Learning (PBL) can build critical thinking skills for students, but there are also many other learning models such as Project Based Learning, Inquiry Based Learning, Blended Learning, and others. Future researchers should be able to apply these models in their research, in order to get more

varied results and be able to develop the self-potential of students to a greater extent in the future.

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