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Increased Critical Thinking Ability through Problem Based Learning with Determining Factors

Slameto✉

Faculty of Humanities, President University Cikarang Baru, Bekasi Indonesia
✉ slameto@president.ac.id

Abstract. Critical thinking is an essential ability for all aspects of human life. Learning practices in schools do not encourage critical thinking. The problem of this research are: 1) is the problem-based learning model developed in the feasible category? 2) How high is the level of critical thinking of students? 3) Among the factors: learning motivation, equilibration, and/ discipline, which one is the determinant? The method used is Research Development; this study collected data from 37 students participating in Learning Assessment Lectures from 2 classes. Data were collected using a rating scale consisting of 41 items, which tested valid and were 37 items reliable. Data processing assisted by SPSS version 25. This research successfully developed a Problem Based Learning Model that was declared feasible; Achievement of students' critical thinking skills at a high level. Obtained 2 models determining students' critical thinking skills. This finding is very useful for the management of education quality within the framework of the effectiveness and productivity of Higher Education Learning.

Keywords: Equilibration, Critical Thinking, Problem Based Learning, Learning Motivation, Discipline

INTRODUCTION ~ In this global era, awareness of the importance of critical thinking skills is increasingly higher, because critical thinking is an essential ability to live, work, and is very effective in all other aspects of life. Therefore the teacher's role becomes more complex than before, for example, how teachers respond to the changing needs of students as a result of rapid technological developments and demands for excellence from the community, as well as changes in social construction in society and globalization [1]. The quality of students in the future is largely determined by the role of teachers in schools today. Until now the school is still a social institution that is organized to develop students to prepare the future of this nation's generation. Therefore schools and teachers are expected to develop and renew themselves continuously in order to be able to offset the rapid changes in students and the needs of the community.

Related to the development of critical thinking, the practice of teaching and learning by teachers

in schools does not encourage the achievement of critical thinking skills needed. There are many

factors that have caused critical thinking to develop less in education so far; but can be prioritized into two: first, a curriculum that is generally designed with broad material targets so that teachers are more focused on completing (absorbing) material, and second, the lack of teacher understanding of learning methods that can improve critical thinking skills [2]. By becoming a critical and inspiring teacher there is expected to be someone who is able to motivate and inspire students, so that students are able to optimize the potential of their critical thinking so that it

is useful for the future. Critical and inspirational teachers are drivers of change; but what about the condition of our teacher described by [3] and the second causal factor as [4] revealed? Therefore it is necessary to empower teachers far from the lecture bench.

Lectures to develop critical thinking habits emphasize the importance of emphasizing on students' efforts to actively analyze and solve various problems that are around including in their learning process; Ref. [5] states that the teacher's lack of understanding about critical thinking

causes a tendency not to teach or assess students' thinking skills. The teaching of critical thinking is often interpreted as problem solving, even though the ability to solve problems is part of the ability to think critically [6].

Lecture strategies that can improve critical thinking skills, namely: 1) group learning through small group discussions 2) The use of relevant contexts such as the problems in the training material understood by participants can improve critical thinking skills, and 3) assessment methods that require study deeper, encouraging participants to learn more meaningfully not just memorizing [7]. Methods of group learning together and/ the ability to work together are urgently needed. In addition to overcoming the weaknesses of personal learning, which usually collides with limitations within oneself, working in groups is also a

feature of recent modern developments. Effective collaboration is usually balanced with personal skills in ongoing inquiry.

Even though it has not yet been developed, lecture management which emphasizes the importance of program productivity (in this case critical thinking), enables lecturers to make reflections on the lecture process, both at the individual and group level (for example, in conferences and joint self assessment products). Stimulating lecturers and students to think critically about the lecture process can make some aspects of lecturer pedagogy more accurate, effective and efficient (compare with [8].

The problem in this study is limited to the development of critical thinking of the Elementary School Teacher Education Study Program of one of the private universities in Central Java; Problem formulation: 1) Is the problem-based learning model developed included in the feasible category? 2) how high is the level of critical thinking as student learning success? 3) what are the accompanying factors in lecturing what determines critical thinking? In educational perfective as a system, the results (the success of students' critical thinking) are directly influenced by the process (lecture management); in this case students and lecturers play the main role that needs attention. Student factors in this case are: motivation to learn (X_1), Equilibration (X_2), and discipline (X_3). Lecturer factors include the ability to

create and develop problem-based lectures (PBL).

Ref. [9] provides a definition of critical thinking, namely reflective thinking that focuses on making decisions about what must be believed, and needs to be done. Based on this definition, the ability to think critically according to Ref. [9] consists of 12 components, namely: formulating the problem, analyzing arguments, asking and answering questions, assessing the credibility of information sources, making observations and evaluating reports of observations, making deductions and evaluating deductions, making induction and evaluating induction, evaluating, identifying and assessing identification, identifying assumptions, deciding and implementing, and interacting with others. Furthermore [10], citing critical thinking skills developed by the Intercollege Committee on Critical Thinking consists of: the ability to define problems, the ability to select information for problem solving, the ability to assume assumptions, the ability to formulate hypotheses, and the ability to draw conclusions.

Critical thinking is a cognitive activity related to the use of reason. Learning to think critically means using mental processes, such as observing, categorizing, selecting, and judging/ deciding. The ability to think critically provides appropriate direction in thinking and working, and helps in determining the relationship of something with others

more accurately. Ref. [11] suggested several reasons for the need for critical thinking skills, namely: knowledge based on memorization has been discredited; individuals will not store knowledge in their memories for future use; information spreads so rapidly that each individual needs abilities that can be distributed, so that they can recognize various problems that occur; the complexity of modern work requires thinking that is able to show understanding, and make decisions in the world of work; and, modern society needs individuals who are able to combine information from various sources, and are able to make decisions.

In ref. [11] stated another reason for the need for a culture of critical thinking, namely that the world expresses their interest in, and concern for, the ability to learn thinking, because they find the inability of tertiary education graduates to make their own decisions with independent. Because the welfare of a country depends on its people, it is considered necessary and reasonable, if the mind becomes the focus and development of education. Therefore critical thinking skills are needed in problem solving/ finding solutions, and managing tasks [6].

The problem-based lecture approach will be one right solution; because it emphasizes the importance of students' efforts to actively analyze and solve various problems that are around including in their lecture process; Lecture strategies that can improve critical

thinking skills, namely: 1) Group learning through small group discussions 2) Use of relevant contexts such as the problems in the lecture material, and 3) ways of assessment that require deeper study, encourage participants to learning more meaningfully is not just memorizing [7]. Often lectures on critical thinking are interpreted as problem solving, even though the ability to solve problems is part of the ability to think critically.

Problem-based learning is one form of learning based on the philosophy of constructivism; that knowledge will develop through experience. Basically the principle of constructivism is: knowledge is built by students themselves, both individually and socially, knowledge cannot be transferred from teacher to student, except with the activeness of students themselves to reason, students actively construct continuously, so there is a change in concept which is more detailed, complete and in accordance with scientific concepts, and the teacher functions to assist providers of facilities and situations so that the construction process of students runs smoothly [12]. Problem-based learning is designed a learning procedure that begins with a problem and uses lecturers as trainers metacognitive; According to ref. [13] learning based on problems is the interaction between stimulus responses, a relationship between two directions of learning and the environment, so that students are asked to be able to solve

problems related to everyday life. Problem-based learning is designed based on real life problems that can improve students' understanding of the material being studied, the ability to solve problems, and the skills to apply concepts, so that they can train at a higher level of thinking. Problem-based learning can provide active learning conditions for students to solve a problem through the stages of scientific methods so that students learn knowledge related to these problems, as well as having the skills to solve problems. The application of problem-based lectures demands [14] consists of: orienting students to problems, organizing students to learn, guiding individual and group investigations, developing and presenting work, and analyzing and evaluating problem solving.

Motivation is an impulse arising from a person whether realized or not realized, to carry out an action with a specific goal [15]. Motivation comes from the word motive, interpreted as a driving force within the subject concerned to carry out certain activities in order to achieve a goal. Even motives can be interpreted as internal conditions (preparedness); thus motivation can be interpreted as a driving force that has become active, at certain times, to achieve the goal is felt/ urgent. For students who are in college, the main activity is learning. According to ref. [8] motivation is a driving force or impetus to achieve goals. Student Learning

Motivation is a condition in students that encourages and directs their behavior towards the goals of the lectures they want to achieve [16]. Thus student learning motivation is the overall driving force within students that lead to learning activities [17]. Student learning motivation, should be manifested in the following behavior: always come in lectures, follow lessons actively, diligently make notes, doing assignments given by the lecturer, on his own initiative and awareness, reading or borrowing books in the library and/ utilizing free time or free time to study. In addition, students who have high motivation to learn have targets to be achieved, there is an appropriate award from himself, the achievement competition between friends, because for him college is very important to stock in the future.

Ref. [18] explains that assimilation is a process of gaining new information and adjusting it to previous knowledge about objects or the world; accommodation means adjusting new experiences by improving previous plans to obtain new information, and adaptation is a process of finding a balance (equilibration) between self and the environment to form a scheme. The scheme is a simple pattern of mental action, a form of information organization that someone uses to interpret things through the five senses. Equilibration is a process of equilibrium which refers to the fourth stage of cognitive development. Equilibration is the driving force behind intellectual growth. He assumed that all organisms have an innate tendency to create a harmonious relationship between themselves and their environment. In other words, all aspects of the organism are directed towards optimal adoption/ Equilibration (balancing) is the tendency that to organize experiences in order to obtain maximum adaptation. The balance that students go through certainly becomes a determining factor for the cognitive development of students themselves. In the course of development and in repeated interactions and various environments students often encounter conflict situations. Students will regulate themselves through their cognitive abilities to reach the balance process. Equilibration influences one's cognitive development and Piaget states that a person's potential to develop and succeed is due to the construct itself. Thus, equilibration affects the development of one's thinking, including critical thinking. Furthermore, the equilibration process drives progress towards increasingly complex thinking abilities [19].

Discipline is an important aspect of an individual's life. With discipline, the individual will be able to behave as expected and be able to actualize himself well. One place that can form individuals to behave in discipline is the school. Schools are educational institutions to educate students into individuals who have discipline,

intelligence and noble character [20]. Discipline in schools is important to train students to become responsible, independent, and able to regulate and control every behavior. According to ref. [21] discipline is a condition that is created and formed through a series of processes and behaviors that demonstrate the values of obedience to God, order and order in gaining knowledge. Thus the discipline in this opinion describes a condition that is formed due to the compliance process by students in obtaining the knowledge they want. One form of discipline is learning discipline.

Learning discipline is a process of student adherence to the rules that exist on campus that must receive the attention of lecturers who are teaching their students so that students have a good attitude, are educated, and can keep the time in carrying out their respective responsibilities [22]. Learning discipline is a form of student obedience and obedience in carrying out academic regulations that have been set by the University; with the creation of disciplined learning, students are expected to be able to behave according to regulations. Learning discipline is a complex thing because it is influenced by many factors. Internal factors are self-awareness, interests, motivation and emotional maturity, while external factors are family and campus environment. A student must learn to be responsible for these tasks and parents provide adequate

training and encouragement to children [23]. But in reality today, the problem of student learning discipline is decreasing, therefore it is necessary to have an appropriate method to improve student learning discipline. One of them is through lectures that are considered appropriate, namely problem-based lectures.

METHOD

The research was conducted at the Elementary School Teacher Education Study Program of one of the private universities of Central Java in the course of the assessment of learning courses last year. In general, the research steps were carried out in three steps, namely; preparation, implementation and reporting of results. Student involvement in this study includes (1) implementation of learning, (2) learning reflection in limited reflection, and (3) learning reflection in broad.

The method used in this research is the first Research Development (RD) method. This method was chosen to meet the needs of research that requires the process of developing and collecting data in various aspects. In addition, this method is very supportive of the process of developing the learning model.

The research data were analyzed using descriptive statistics in the form of tables, percentages, and/ graphs. For the second purpose of this study, we collected data from 47 students

participating in the Elementary Learning Learning course.

Based on the formulation of problem 2 proposed, it turns out that this research is inferential quantitative research. Quantitative research reveals an inferential relationship between two or more variables that can explain symptoms, which examines the effects of variables X_1 (student learning motivation), X_2 (equilibration ability), X_3 (their learning discipline) on critical thinking skills as learning outcomes (Y); and then find the determinant variables of the three independent variables concerned.

Statistical Hypothesis

On the ordinal scale, the variable critical thinking skills as learning outcomes (Y), there is one dominant level among the four categories: low, medium, high and very high. Among the 3 independent variables, there is a positive significant determinant of the ability to think critically as a learning outcome (Y). In other words, the coefficient of predictive determination of regression (b1) is significantly positive. The statistical hypothesis proposed is:

H_0: b_1 = 0 (there is no determinant effect on critical thinking skills as a result of learning)

H_1: b_1 ≠ 0 (there is an influence that determines the ability to think critically as a learning outcome)

An individual or multiple effect is found by looking at the value of b in the determinant variable. Furthermore, the significance of the value of b will be tested by t-test. The significance of T is seen in its value. If b is positive, and t is significant at an error rate of less than 0.05, the H_1 hypothesis will be accepted.

Data Analysis Techniques and Instruments

This research data is quantitative data in the form of numbers; Ordinal data is data expressed in the form of categories and ranks. Ordinal Scale used is a ranking scale (Likert Scale) consisting of statements and answers with low, medium, high and very high in accordance with the measurement objectives. Data were collected using a student rating or self-evaluation scale consisting of 41 items. The validity score is 0.198 to 0.700, with Cronbach's alpha reliability index = 0.925. Next, the researcher creates a causal model. The pattern of influence of the independent variable (determinant) on the dependent variable was tested with the F test at the 0.05 level. This calculation is done with SPSS version 20. In the trial model, the determinant coefficient of the independent variable on the dependent variable is calculated. The results of the calculation of the coefficient of determination of the three independent variables in this study on the dependent variable are adjusted for the coefficient R2. If the significance of r is less than or equal to 0.05, this model is

declared significant, because X_{1-3} (selected) affects Y, just as the adjusted R^2 coefficient. Data processing with multiple regression models step wise aided by SPSS version 20, then the results are discussed narratively by comparing the results with previous findings.

Research result and discussion

The development of Problem Based Learning models is carried out through several steps, namely: preparation of models, expert testing, empirical testing, refinement of the model and determination of the final product (final model).

Development of Problem Based Learning Model

Through the study of theories and learning models on various references (books, journals, internet, research results, and good practices), the Draft Model of Problem Based Learning is designed along with research products that include Problem Based learning tools which include: RPS supplemented with learning media, learning material, and learning assessment as an attachment.

The draft Problem Based Learning Model is contained in a set of papers consisting of 3 parts, namely the French page, the core part, and the supporting part. This draft model is then ready to be tested further.

The draft Problem Based Learning Model that has been printed is then subjected to an expert test, namely the validation

test conducted by learning technology experts, senior lecturers and managers of the Elementary School Teacher Education Study Program of Satya Wacana Christian University Salatiga; Validators consist of 5 people, using instruments that have been prepared. Based on the results of the 5 validator evaluations above, the developer needs to improve by completing the model implementation guidelines in both classical and group learning; besides improvement in writing and settings. Results of Problem Based Learning Models, which are theoretically valid, results after this improvement are ready to be used for limited trials.

Limited trials are conducted through lecture practices from 1 lecturer in 2 classes. After the lecture, the FGD was followed by 12 students and 2 lecturers. Based on the results of the FGD after the empirical test, overall this model is actually considered feasible. Even so it still needs to be equipped with a concept map, to clarify the implementation of the developed model; In addition the arrangement and setting of the draft model also needs to be done. This empirical test results in improvements to the Problem Based learning model based on limited implementation results. Given the limited time and place where the trial is expanding, this activity cannot be carried out. Therefore, the results of the revision after the limited empirical test were determined to be the final model.

Learning Achievements in the Form of High Level Thinking Skills

Learning Achievements in the form of critical thinking skills achieved by students through Problem Based Learning can be presented as the following table and graph.

Table 1. Distribution of Critical Thinking

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	1	2.1	2.1	2.1
	2.00	6	12.8	12.8	14.9
	3.00	30	63.8	63.8	78.7
	4.00	10	21.3	21.3	100.0
	Total	47	100.0	100.0	

Learning outcomes in the form of critical thinking skills as presented in table 1, are mostly achieved at a high level and tend to be very high.

Determinants of Learning Outcomes

Three variables that are used to determine critical thinking skills (Y) in this study are: variables X_1 (motivation to learn), X_2 (students' Equilibration ability), and X_3 (their discipline). Descriptions of these 3 variables are presented in table 2 as follows.

Table 2. Frequency distribution of 4 research variables

Variables	Mean	Median	Sd.	Min.	Max.
Motivation	3.0851	3.0000	0.71717	2.00	4.00
Equilibration	2.9574	3.0000	0.65798	1.00	4.00
Discipline	3.3085	3.5000	0.71135	1.50	4.00
Critical thinking	3.0426	3.0000	0.65798	1.00	4.00

Based on the results of the analysis presented in Table 2, it turns out that of the 3 accompanying variables studied, only 1 accompanying variable experienced a significant increase, namely learning motivation (X_1). The ability to think critically (Y) also experienced a significant increase. There are 2 variables: Equilibration ability (X_2) and student learning discipline (X_3) that are not well developed through this Learning.

Hypothesis testing

Furthermore, to find the determinants of learning achievements in the form of critical thinking skills (Y), a step wise regression test is performed, the results of which are presented in Tables 3 and 4.

Table 3. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.557[a]	0.310	0.294	0.55266
2	0.664[b]	0.441	0.416	0.50302

a. Predictors: (Constant), Equilibration
b. Predictors: (Constant), Equilibration, Motivation

Based on the results of the regression analysis as in table 3, it turns out that 2 influential models were obtained variables X_2 (Equilibration ability) and X_1 (student motivation) according to their respective error standards. The magnitude of the effect of variable X_2 (Equilibration ability) on critical thinking skills (Y) is 29.40% (Model 1). The magnitude of the effect of variable X_2 (Equilibration ability) and variable X_1 (student learning motivation) on critical thinking skills (Y) is 41.60% (Model 2). To find out how high the level of significance of each model can be checked in Table 3.

Tabel 4. ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6.170	1	6.170	20.201	0.000[b]
	Residual	13.745	45	0.305		
	Total	19.915	46			
2	Regression	8.781	2	4.391	17.352	0.000[c]
	Residual	11.133	44	0.253		
	Total	19.915	46			

a. Dependent Variable: Critical thinking
b. Predictors: (Constant), Equilibration
c. Predictors: (Constant), Equilibration, Motivation

Based on the ANOVA test results as presented in table 4, Model 1 obtained F = 20.201 with a significance level = 0,000; this means variable X_2 (Equilibration ability) becomes a significant determinant of critical thinking ability (Y); The magnitude of the effect of X_2 (Equilibration ability) on the ability to think critically (Y) is 29.40%. Model 2 obtained F = 17.352 with a significance level = 0.000; this means that variable X_2 (Equilibration ability) and variable X1 (student motivation) become significant determinants of critical thinking skills (Y);

The magnitude of the effect of X₂ (Equilibration ability) and X₁ variable (student learning motivation) on critical thinking skills (Y) is 41.60%.

DISCUSSION

This research has successfully developed a Problem Based Learning model that is otherwise feasible; the developer is carried out through a number of steps, namely: model preparation, expert testing, empirical testing, refinement of the model and determination of the final product (final model). Achievement of learning outcomes in the form of critical thinking skills in this problem-based lecture, most students at high level and tend to be very high. Ref. [24] defines the skills involved in critical thinking into three types: meta components, performance components, and knowledge-acquisition components. The study of critical thinking combines educational, philosophical, and psychological thinking traditions. Critical thinking consists of mental processes, strategies, and representations that people use to solve problems, make decisions, and learn new concepts [24].

The equilibration ability becomes the determinant of students' critical thinking skills by 29.40%. This is possible because there is an influence of problem-based learning models on students' critical thinking skills [25]. In addition, in problem-based learning, there is an increase in the ability of students to research while learning. Lecturers can develop equilibration skills with more research

assignments (through problem-based learning activities) and less factual information provision (lecture material), then test their new abilities to see the development of their critical thinking [26].

What do the two results of this research mean? In line with the findings of [25], problem-based learning is a predictor of critical thinking! Thus, equilibration becomes the moderator; The findings of this study place equilibration as a determinant (besides student motivation). Equilibration can be a moderator whose function is to increase the influence of problem-based learning on critical thinking. For this purpose, the role of scaffolding becomes very important; what else can increase student motivation!

Lately, many teachers already know about Piaget's analysis related to the development of children's thought processes, but less than half the number of teachers who understand how students' knowledge is acquired, what more is skilled at developing it through constructive learning [27]. This new finding is very useful for the management of education quality within the framework of the effectiveness and productivity of Higher Education Learning. The main determinant of critical thinking is the role of the lecturer in developing a problem-based context that enables a new situation that is equilibration. This important characteristic of the problem-based lecture management approach - even though it

has not yet been developed - enables lecturers to make reflections on the planning, implementation and evaluation process of their lectures, both at the individual and/ group level. By stimulating students to develop assimilation, accommodation and towards equilibration will lead to the development of critical thinking; lecturers can make some aspects of pedagogy more accurate, effective and efficient (compare with [28]). These new findings will be very useful for the management of education quality within the framework of Higher Education effectiveness and productivity.

CONCLUSION

This research successfully developed a Problem Based Learning model that was declared feasible; the developer is carried out through a number of steps, namely: model preparation, expert testing, empirical testing, refinement of the model and determination of the final product (final model). Achievement of learning outcomes in the form of critical thinking skills in this problem-based lecture, most students at high level and tend to be very high. The equilibration ability becomes the determinant of students' critical thinking skills by 29.40% (Model 1). The ability of equilibration and student learning motivation is also a determinant of students' critical thinking skills of 41.60% (Model 2). The role of discipline in learning does not become a

determinant/ determinant of students' critical thinking supported by data.

This new finding is very useful for the management of education quality within the framework of the effectiveness and productivity of Higher Education learning. The main determinant of critical thinking is the role of the lecturer in developing the context of problem-based learning that enables new situations namely the development of equilibration abilities; both as a determinant or moderator that enhances the influence of problem-based learning on critical thinking

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