The Effect of Team Based Learning Model on Students' Critical Thinking Skills in Ecosystem

Mieke Miarsyah*, Ratna Komala, Riska

Department of Biology Education, Faculty of Mathematics and Natural Science, Universitas Negeri Jakarta, Indonesia

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Abstract 21st century education must be able to develop the students' various skills, one of which is the critical thinking skill. Critical thinking skills are reasonable and comprehensive way of thinking that are used to make decisions. The aim of this study was to determine the effect of Team Based Learning (TBL) models on student critical thinking skills in Ecosystem. The research method used in this study was a *Quasi Experimental Design* method with *pretest post test control group design*. There are 60 students on each class selected through *simplerandom sampling*. The instruments used were 15 items about critical thinking, which have been declared valid and reliable. The result showed that the average critical thinking scores of students increased significantly by using Team Based Learning (TBL) model. The highest gain score in the experiment class on first aspect (Clearness) is in gain score of 0,7 (high). Mean while the smallest increase occurred in control class on aspect accuracy, relevance, breadth and precision in gain score of 0,0 (low). A t-test indicated that TBL students' critical thinking skills significantly increased (sigvalue. 0.00). The conclusion was that there was an influence on the application of the Team Based Learning (TBL) model on students' critical thinking skills in Ecosystem.

Keywords Ecosystem, Critical Thinking Skills, Team Based Learning (TBL)

1. Introduction

Education in the 21st century must be able to prepare the students for having various skills to deal with many opportunities and challenges in life. Skills that must be possessed by the students in the 21st century such as

creativity and innovation skills, critical thinking skills and problem solving, communication and collaboration, information literacy, media and information technology, flexibility and abilities to adapt, initiative, social and cross cultural abilities as well as productivity and accountability[6]. 21st century education has made learning change from teacher center to the student center. Student are not only asked to record everything that is explained by the teacher, but also actively seek various information from any sources [5,7,23].

Critical thinking is reasonable, reflective thinking that is focused on deciding what to believe or do [8]. In this digital era, students will get a lot of information easily and quickly but the truth of the information cannot be guaranteed.. Therefore, students must have the ability to think critically, because it will make it easier to choose relevant sources and information to make a decision [26]. According to Facione people who have good critical thinking skills will have better self-confidence, deep knowledge, an open mind, able to see some alternative points of view in problem solving, strong beliefs in making a decision, able to make better judgement and consideration when making a decision [9]. Critical thinking skills are also a factor that can predict students cognitive learning outcomes [16].

In biology learning specifically in Ecosystem topic, students really need critical thinking skills. This is because on this topic a lot of materials are not enough to memorize and remember. In detail, if we want to learn the role of organism in their ecosystem such as consumer or decomposer and the problem that will come if this organism is not in stable stage or extinct, the critical thinking skills are required. This is because the topic has many problems that are relevant to daily life and must be solved by students [12]. Students will be required to make decision store solve existing problem quickly, precisely and accurately.

The fact is that students critical thinking skills have not been yet developed at school. Programme for International

Student Assessment (PISA) 2018 shows Indonesia science literacy score is 396, it is lower than OECD rate [21]. It reflects that student's skills in answering questions referring to critical, logical and problem solving skills place in low. The low critical thinking skills of students are caused by learning activities that tend to only practice aspects of remembering and understanding [17]. In these learning activities students tend to just sit and listen to the information presented by the teachers without being able to develop the information obtained or discuss it in class.

To solve the problem is by applying an active learning model that is able to invite students to process the information obtained and not just transfer the available information. One of them are Team Based Learning (TBL) model. This model refers to constructivism learning theory whereby knowledge will be formed from one's personal experience [19]. Michaelsen Larry defines Team Based Learning model as a conceptual and operational learning framework that relies on small group interactions to get concepts and problem solving [14]. The Team Based Learning model consists of six stages of learning, namely pre-class preparation, individual readiness assurance test, team readiness assurance test, appeals, mini lecture clarification and application.

Based on the purpose of this, the study improved the student critical thinking skills in Ecosystem using Team Based Learning (TBL) model.

2. Methods

The method used in this research was *Quasi Experiment with pretest posttest control group design*. This research involved two groups. The experiment group was applied by Team Based Learning model (TBL) and the control group was applied by Student Team Achievement Divisions model (STAD). This research was conducted in second semesters of the 2018/2019 in 51 Jakarta senior high school. The sample, which was selected by simply random sampling selected four classes in 10th grade of science class, two classes as an experimental class and two classes as a control class. Participants of each class are 60 students.

The instrument used was critical thinking skills test consisting of 15 items about ecosystem topic. This instrument was given during the pre-test and post-test. The indicator of critical thinking used consisted of 7 aspects, namely Clearness, Accuracy, Relevance, Sufficiency, Depth, Breadth and Precision [18]. More details can be seen in table 1.

The data will be analyzed from the result of pretest and posttest of student's critical thinking skills on Ecosystem topic with the aim at knowing the difference average between the experimental and control classes. The different

average that occurs proves that there is an effect of the treatment to students critical thinking skills. Before being analyzed, the data was tested for normality by Kolmogorov-Smirnov test and homogeneity by Fisher's test. The hypotheses test is using t-test and all the tests are using a significant level $\alpha=0.05$ and calculated with SPSS version 23. The result of students critical thinking skills will be categorized into three categories, based on means and standard deviation categories adapted from Azwar in table 2.

Table 1. Indicator of Instrument

Aspect	Indicator	items
Clearness	Provides thoughts that are easy to understand accompanied by pictures, examples or illustrations.	5, 10a
Accuracy	Deliver information based on existing data and facts.	6a, 6b
Relevance	Give statements that are interrelated or related between problems and problem solving.	2a, 7a
Sufficiency	Give reasons that match your goals and needs.	2b, 4b, 7d
Depth	Identify the complexity or depth of a problem	1, 4a
Breadth	Identify a problem from various interrelated viewpoints	7c, 8a
Precision	Provide thoughts or ideas in detail and specific.	3, 9

Table 2. Category Of Critical Thinking

categories	criteria
High	$X \geq 65,46$
Moderate	$31,37 \leq X < 65,46$
Low	$X < 31,37$

In addition, the gain score is also calculated to see the magnitude of the average increase in each aspect. After calculating the gain score, the next step was to categorize the gain score according to the criteria in Table 3.

Table 3. Criteria of Gain Score

Gain Score	Criteria
$g \geq 0,7$	High
$0,7 > g \geq 0,3$	Moderate
$g < 0,3$	Low

The Team Based Learning (TBL) model consists of six stages of learning, namely preclass preparation, individual readiness assurance test (IRAT), team readiness assurance test (TRAT), appeals, mini lecture clarification and application. More details can be seen in table 4.

Table 4. Learning stages of Team Based Learning models.

Stages	Description
Preclass preparation	Beginning of each major instructional unit, students are given reading and other assignments that should contain information on the concepts and ideas that must be understood to be able to solve the problem you identified for this unit in the backward design activity
Individual Readiness Assurance Test (IRAT)	The first in-class activity in each instructional unit is an individual Readiness Assurance Test (iRAT) over the material contained in the pre-class assignments. The iRAT typically consists of multiple-choice questions that, in combination, enable the instructor to assess whether or not students have a sound understanding of the key concepts from the readings.
Team Readiness Assurance Test (TRAT)	Students re-take the same test, but this time the teams must reach agreement on the answers to each test question and immediately check the correctness of their decision using an IF-AT.
Appeals	This phase gives students the opportunity to refer to their assigned reading material and appeal any questions that were missed on the group test. That is, students are allowed to do a focused re-study of the assigned readings (this phase is "open-book") to "challenge" the teachers about their responses on specific items
Mini Lecture Clarification	This feedback comes immediately after the appeals process and allows the instructor to clear up any confusion students may have about any of the concepts presented in the readings.
Application	The final stage in the TBL instructional activity sequence for each unit of instruction is using one or more assignments that provide students with the opportunity to deepen their understanding by having groups use the concepts to solve some sort of problems

Source : Larry and Michelsen, 2011

Table 5. Students Critical Thinking Scores Viewed From Each Aspect

Aspect	Average of control class				Average of Experiment class			
	post	pre	gain score	category	post	pre	gain score	category
Clearness	3,3	2,9	0,2	low	3,6	0,9	0,7	high
Accuracy	3,8	3,8	0,0	low	3,0	1,2	0,5	moderate
Relevance	2,2	2,1	0,0	low	2,9	1,0	0,5	moderate
Sufficiency	2,8	2,3	0,2	low	3,4	1,2	0,6	low
Depth	3,2	2,0	0,4	moderate	3,4	1,4	0,5	low
Breadth	3,2	3,2	0,0	low	2,6	0,8	0,4	low
Precision	2,7	2,7	0,0	low	3,3	1,5	0,5	low

3. Result and discussions

The result of the research showed that all items are valid and reliable. The data was described in table. Data presented pre-test, post-test, gain score and categories of student critical thinking. Calculation of the gain score is the difference between the posttest and pretest. More can be seen in table 5. In the table 5. The largest increase can be seen from the gain score, which is in the experiment class on first aspect (Clearness) in gain score of 0,7 (high). Meanwhile the smallest increase occurred in control class on aspect accuracy, relevance, breadth and precision in gain score of 0,0 (low). In experiment class there is one aspect that have high gain score (Clearness), two aspects with moderate category (Relevance, Sufficiency) and another aspect in the low category. Meanwhile in control class there is one aspect in moderate category (Depth) and the other aspects are in low category. Then the student critical thinking skills category can be seen from each test in Table 6.

Based on table 6 in experiment class students have a

large increase in critical thinking skills. It can be seen that in pre-test there are 56 students in low category and 4 students in moderate category while in post test students in this class have a large increase. There are 42 students in moderate category and 18 students in high category. Meanwhile in control class there is a slight increase. In pretest here are 57 students in moderate category and 3 students in high category while in posttest here are 55 students in moderate category and 5 students in high category. This result indicates that both in experiment and control group have an increase in students critical thinking in Ecosystem topic.

The t-test was conducted to test the significance of the difference between the experiment class and control class score. Significant test result showed the t-value is higher than t-table. In addition, if seen from Sig value < 0.05, it can be concluded that the experimental class score is significantly higher than the control class. This can be interpreted that Team Based Learning (TBL) model can enhance students critical thinking skills in ecosystem topic. Details can be seen in table 7.

Table 6. Students Critical Thinking Skills Category

categories	criteria	Experiment		control	
		Pre test	Post test	Pre test	Post test
High	$X \geq 65,46$	0	18	3	5
Moderate	$31,37 \leq X < 65,46$	4	42	57	55
Low	$X < 31,37$	56	0	0	0

Table 7. T-test result

t	df	Sig (2-tailed)	Mean Difference	Std. Error Different
6.829	118	.000	8,577	1.256

Based on the result of the research it can be said that the Team Based Learning (TBL) models can enhance student critical thinking skills in Ecosystem topics. The results are consistent with the research conducted by Huggnis & Jannet which shows that the use of Team Based Learning models can improve verbal abilities, creative thinking, and critical thinking skills of students [10]. Team Based Learning (TBL) model was an active learning, in which students carry out a more in-depth investigation of the material studied so that students' thinking skills become more honed [19].

The effect of this learning model is caused by the learning stages used. First is the pre-class preparation. This stage will encourage students to be better prepared to learn in class so that the class discussion process can go well. This statement is supported by Jabbar., Et al who argues that preparation before learning will create an active learning environment so that it can increase the value and thinking ability of students [11].

The second stage is the Individual Readiness Assurance Test (IRAT), at this stage students will be given individual tests in the form of multiple choice. IRAT is an important stage, because this test will be used to assess students' readiness in learning and class discussion. This process will encourage students to better master the material, increase the responsibility and motivation of each individual to participate in group discussions [26].

The third stage is the Team Readiness Assurance Test (TRAT), where students will take the same test as IRAT but do it in groups. The purpose of using the same test is to improve students' ability to remember material and understanding [13]. The group discussion process that occurs during TRAT will help students to get information, understand basic concepts, improve communication skills and correct misunderstandings of concepts that might arise during the learning [3]. At this stage special answer sheets are used in the form of scratch-off answer cards that

function to provide direct feedback. The use of answer sheets is able to increase the involvement of students in the discussion process [23]. Increasing the involvement of students in the discussion process will also improve students' critical thinking skill. Involvement of students in learning groups will increase their understanding and critical thinking skills compared to students who study independently [1].

In the third stage students are also asked to write down the reasons for selecting group answers. Writing these reasons also affects the increase in students' critical thinking skill where by writing students will be trained in their ability to give good reasons. This is in accordance with the statement of Bustami, Riyati & Julung who state that writing activities will require a person to have a good reason in thinking about the things they will write so that this activity will affect their critical thinking skills [4].

The fourth stage is Appeals at this stage students will write difficult questions that arise during the discussion process. This stage is able to improve students' critical thinking skills because when students receive specific and timely feedback it will help improve students' thinking abilities deeper and more critical [2]. The fifth stage is the Mini Lecture Clarification, where at this stage the teachers will provide corrections or additional explanations on concepts that are still not understood by students.

The last stage is Application. At this stage students are required to apply the concepts that have been learned. At this stage students will be given a case study that will be done in groups and presented in front of the class to get the best answer. This stage is able to improve students' critical thinking skills because the case studies provided are designed to be able to stimulate students to have a deep and critical discussion. The case studies provided are based on four criteria, namely Significant, Specific, Same Problem and Simultaneous reporting [11].

The Team Based Learning (TBL) model has several advantages including being able to teach students the skills

of working in teams, communication, and problem solving [22]. Styron, also argues that the Team Based Learning model can improve students' reasoning, the ability to think scientifically, think critically, and develop students' in-depth understanding of a material [23].

The score of students' critical thinking skills of the control class is lower than experiment class. This is caused by several factors such as the questions that arise during the learning process having not focused students to develop their critical thinking skills, the lack of application of concepts during the learning process, and the absence of direct feedback given to students.

4. Conclusions

The t-test showed that Sig value < 0.05 . Based on the result it can be concluded that there is an effect of Team Based Learning (TBL) model on students' critical thinking skills in Ecosystem topic. That is because Team Based Learning (TBL) model has the advantages including being able to teach students the skills of working in teams, communication, and problem solving, improve students' reasoning, the ability to think scientifically, think critically, and develop an in-depth understanding of a material.

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