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Critical thinking ability in solving triangle problems based on lesson study for learning community (LSLC)

D Indrawanti^{1*}, Hobri², A F Hadi³, E W Fauziah⁴

^{1,2,3,4} Faculty of Teacher Training and Education, Jember University

denique.ahmad@gmail.com

Abstract. Critical thinking is one of the important skills students must possess in 21st century education. This purpose of this research is to analyse the difference of students' critical thinking ability in learning with Discovery Learning model based on *Lesson Study for Learning Community* (LSLC) with class using conventional learning. This study applies mixed method, which combines qualitative and quantitative method. Qualitative method in this study is operative on developing instructional instrument with Discovery Learning mode based on LSLC. The quantitative methods in the study is applied in the form of quasy experimental design. The research result shows that (1) the instructional instrument ; valid, practical and effective criteria (2) there is difference of critical ability of control class and experiment class. This is indicated by the significant influence of application of Discovery Learning model based on LSLC on students' critical thinking ability

1. Introduction

The improvement of science and technology must be balanced with the availability human resources. The complexity of science and technology implementation in solving daily problems requires the higher order thinking skills. If the availability of this higher order thinking skills is not positively correlated with the development of science and technology, then humans will be crushed by the civilization. It is also aligned with three 21st century learning concepts that have been adapted by the Indonesian Ministry of Education and Culture to developing the new curriculum at primary and secondary education levels. The concepts are 21 st Century Skill, scientific approach, and authentic assessment [1]. So, the thinking skills must be develop since early age, one of which is through learning process.

One of thinking skills that must be be improved in education is critical thinking skills [2]. It is an ability of thinking critically, creatively, the ability of arguing, discussing, making decision and solving problems [3]. Critical thinking influences person's ability to a) provide an effective reason, b) ask questions and solve problems, c) analyze and evaluate from a particular point of view, and d) reflect the process and make critical decisions. The ideal critical thinker is habitually inquisitive, well informed, open minded, flexible, fair minded in evaluation, honest in facing personal biases, prudent in making judgment, orderly in complex matters, diligent in seeking relevant information, reasonable in the selection of criteria, focused in inquiry and persistent in seeking result which are as precise as the subject and circumstances of inquiry permit [4]. Yildirim and Kahraman said : “Critical thinking is



the process of searching, obtaining, evaluating, analyzing, synthesizing and conceptualizing information as a guide for developing one's thinking with self-awareness and the ability to use this information by adding creativity and taking risks" [5].

This critical thinking skill can be grown in school, one of which by teaching mathematics lesson. According to the Regulation of the Minister of National Education of Indonesia No. 23 of 2006, it is states that mathematics has to be taught to all students at every level of education. This is in line with Permendiknas No 22 which stipulated that students must learn (1) understanding the problem (2) designing mathematical model (3) solving mathematical model and (4) interpreting the solution [6] Mathematics is a systematic and structured science that can be developing logical, analytical, systematic, critical, and creative thinking.

This critical thinking is closely related to the critical thinking process and its indicators. Facione said that four major critical thinking skills included: interpretation, analysis, evaluation and inference. Interpreting means understanding and expressing the meaning of different experiences, situations, data, events, judgments, customs, customs, beliefs, rules, procedures, or criteria. Analyzing means identifying relationships between statements, questions, concepts, descriptions or forms intended to express beliefs, experiences, information or opinions. Evaluating means assessing the credibility of statements or representations that are reports or descriptions of perceptions, experiences and assessing the logical power of inferential relationships. Inference means identifying and obtaining the elements necessary to make sensible conclusions, summing up the consequences of data, situations or other forms of representation. [7].

Mathematics learning approach in this research is scientific approach based on Lesson Study for Learning Community (LSLC) using discovery learning model. Discovery Learning is a model of learning that begins by stimulation, problems statement, data collection, verification and generalization [8]. There are three important elements in the LSLC concept: Collaborative Learning, Learning Community, and Jumping Task [9]. Collaborative Learning is reflected in the involvement of all students in learning.. Students involved learning activities, receive material or information [10]. In designing collaborative learning, there are learning processes that build caring community, learning community with dialogue and collaboration [11].

Learning community has three philosophies: public philosophy, means that all parties are actors of school reformers, democratic philosophy, means the purpose of school education is how students learn and collaborate with each other, excellent philosophy means do the best for learning and teaching [12]. While Jumping Task is a matter with a more developed level where not all students must be able to solve it. Through jumping task, students are taught to think independently and grow up with each other [13].

2. Method

The type of this research is mixed – method, that is research method which combine qualitative method (development research) and quantitative method (experimental research) [14]. The mixed-method models in this research is sequential exploratory design. The sequential exploratory model is a combination research model which combines qualitative and quantitative methods. Qualitative methods serve to find hypotheses in certain cases or limited samples, while the quantitative method serves to analyse the hypothesis in a wider population.

The subjects in this study are the seventh grade students of Ma'arif 08 Junior High School. The object in this study is the critical thinking skills and response of students in grade VII of Ma'arif 08 Junior High School on triangle material using Discovery Learning model based on Lesson Study for Learning Community (LSLC). There are two instruments that are used; THB and questionnaires. Essay test that consists of 3 questions to measure students' critical thinking skills. Indicators of critical thinking skills include interpretation, analysis, evaluation and inference [15]. The characteristic level of critical thinking is shown in the following table:

Table 1: The Level of Critical Thinking Skills

Level	Characteristics
Level 4 (Very Critic)	Students are able to interpret, analyze, evaluate and inference each problems accurately
Level 3 (Critical)	Students are able to interpret, analyze, evaluate but can not inference problems accurately
Level 2 (Quite Critical)	Students are able to interpret, analyze, but can not evaluate and inference problems accurately
Level 1 (Less Critical)	Students are only able to interpret the problem and can not analyze, evaluate and inference problems accurately
Level 0 (Not Critical)	Students are unable to show all aspect of critical thinking ability in solving problems.

3. Result and discussion

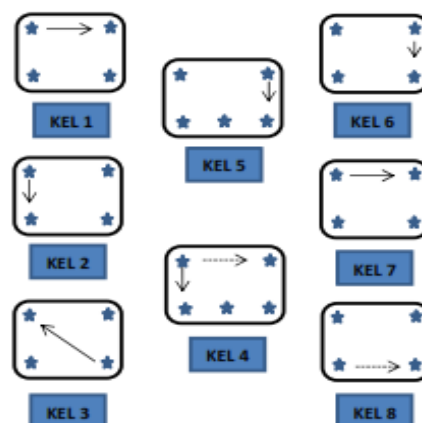
The first phase of this research using qualitative method is the development of instructional instrument using Thiagarajan model with four phases ; define, design, development and dissemination [16]. The instructional instrument developed in this study are Lesson Plan (RPP), Student Learning Worksheet (LKPD), and Achievement Test (THB). The instructional instrument is validated to determine the device's validity and reliability. Validation is done by 2 expert lecturers and 1 mathematics teacher. The results of validation of learning devices in the form of lesson plan. student learning worksheet and achievement test respectively are 3.82, 3.76, 3.78. These results indicate the validity of the instructional instrument. The instructional instrument is declared valid and feasible are then applied in learning activities. The second phase of this study is quantitative methods. The type of study is experimental research.

The population in this study is the seventh grade students of Ma'arif Junior High School. After doing homogeneity test, the researcher determines two classes as control class and experiment class in this research. The experimental class is a class that in its learning uses the Discovery Learning model based on Lesson Study for Learning Community (LSLC). The instructional instrument used in this lesson is also an instructional instrument that has been proven valid and feasible by the validator. While the control class is taught using conventional models.

Learning process

Meeting 1

In this first meeting, “plan 1” was conducted with a mathematics teacher. The illustration chart of the learning process at the first meeting can be seen in the following figure.

**Figure 1.** Illustration of learning process in meeting 1

Information : \longrightarrow : students asking or responding
 \longrightarrow : students expressing opinions

In this learning process there are observers of teacher activity and student activity. At stage 1, the teacher performs reflection in tandem with the observer on teaching process. In this learning process, researchers are also model teachers. Teachers prepare lesson plans and student worksheets. Furthermore, at “do 1”, the teacher has conditioning the student. The teacher starts the learning process, divides the students into several groups and applies the student worksheets to the LSLC based Discovery Learning model. In this first meeting, many teachers give directions on the use of student worksheets. Activities in the group still look passive. Only a few students in the group asked questions and responded.

Meeting 2

Phase plan 2 is done based on reflection on “see 1”. Teacher prepares lesson plan and student worksheet. Furthermore, at stage 2, the teacher starts the learning process by giving aperseption.. Teachers divide students into groups and apply student worksheets to LSLC-based Discovery Learning models. In this second meeting the students' communication in the group gets better. Students more actively ask each other and give their opinion about triangle being studied. In this”do 2”, the teacher carried out a reflection on the learning process at the second meeting. The flowchart of the learning process at the second meeting can be seen in the following figure.

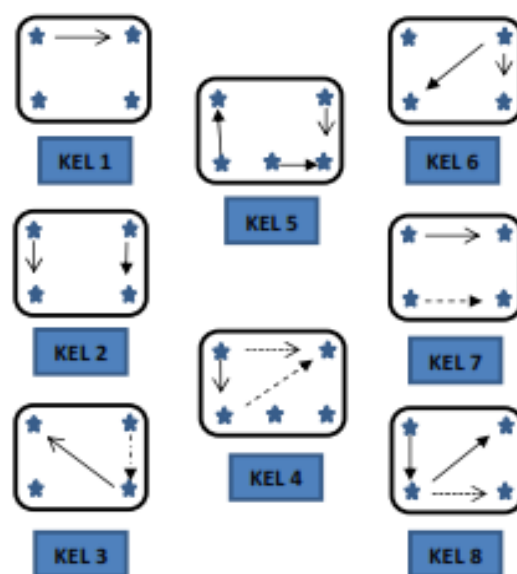


Figure 2. Illustration of learning process meeting 2

Information : \longrightarrow : students asking or responding
 \longrightarrow : students expressing opinions

In phase 2, the teacher performs reflection in tandem with the observer on teaching process. Some things are found in this second meeting. Such as students' concerns with others only appear in some students. Student communication is better than that in the first meeting. The students' understanding of the material already looks better than the previous meeting. In addition some students are satisfied with learning activities at the second meeting.

Meeting 3

The third meeting begins with “Plan 3” stage, which is based on reflection see 2. The teacher initiates this third meeting by preparing the learning implementation plan and the student worksheet. The teacher divides the class into groups, then divides the student worksheets to work together. In stage “do 3”, students are more active in asking questions, giving opinions and caring about each other. In addition to caring for the friends of one group, in this meeting 3 the students seem to concern among groups. Therefore, the atmosphere can be positive in the classroom. Some teachers observe every student activity.

In this third meeting, the student is understanding triangle better than the last meeting.. In the last stage, “see 3” is to reflecting the learning activities at this third meeting. The third reflection result of the third meeting was analyzed to find out the increase of learners activity when using LSLC based discovery learning model. The flowchart of the learning process at the third meeting can be seen in the following figure.

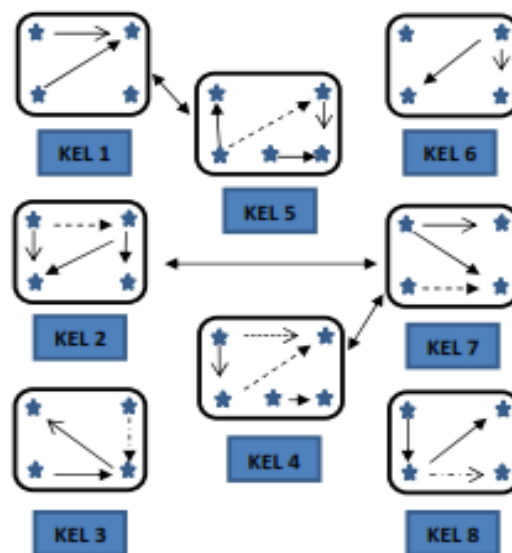


Figure 3. Illustration of learning process meeting 3

Information : \longrightarrow : students asking or responding
 \longrightarrow : students expressing opinions

At the final learning, the teacher gives achievement test in the control class and the experimental class, a test of learning result has been validated by the experts. The test result of this learning in the form of a description that is prepared to measure the level of thinking ability of learners. Students' answers are analyzed based on scoring on critical ability indicators. This is intended to classify the students' critical thinking ability in the control class as well as the experimental class. To determine the difference between the control class and the experimental class, a statistical analysis is performed with Mann-Whitney Test. The result of statistic analysis shows the value of Asymtotic Significance (2-tailed) shows the number 0,004. This means that the significance value is less than 0.05 and it can be concluded that there is a significant difference in students' critical thinking ability between the control class and the experimental class. The results of statistical analysis with Mann Whitney test can be seen in the following table.

Table 2. Mann-Whitney Test

	TBK
Mann-Whitney U	328,500
Wilcoxon W	856,500
Z	-2,882
Asymp. Sig. (2-tailed)	,004

Grouping Variable : Sample Class

Besides the Mann-Whitney test, a Chi-Square test is also conducted to test the effect on the control class and experimental class. The result of Chi-Square test shows that the value of Asymptotic Significance (2-tailed) is less than 0.05, so it can be concluded that there is significant influence on conventional learning with Lesson Study for Learning Community (LSLC) based class. The analysis can be seen in the following table:

Table 3. Chi-Square

	Class	TBK
Chi-Square	,061 ^a	20,970 ^b
df	1	4
Asymp.Sig.	,806	,000

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 33.0.

b. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 13.2.

The analysis of students' thinking skills can be seen in the following table:

Table 4. Frequency of Critical Thinking Level in Sample Class

Level Critical Thinking	Control Class (n = 32)	Experimental Class (n = 34)	Total
0	2	1	3
1	5	3	8
2	12	3	15
3	9	16	25
4	4	11	15

Table 5. Percentage of Critical Thinking Level in Sample Class

Level Critical Thinking	Control Class (n = 32)	Experimental Class (n = 34)	Total
0	6,3 %	2,9 %	4,5 %
1	15,6 %	8,8 %	12,1 %
2	37,5 %	8,8 %	22,7 %

3	28,1 %	47,1 %	37,9 %
4	12,5 %	32,4 %	22,7 %

The table above shows a significant difference in students' critical thinking skills between the control class and the experimental class. This may indicate that student-assisted learning worksheets with the LSLC-based Discovery Learning model are very effective in learning activities. In addition to increasing student activity, this learning can also improve students' critical thinking skills. A mathematics teacher should develop the use of student worksheets that in each learning activity can organize students' thinking skills appropriately. In this case each student will also have the opportunity to increase the activity in learning.

The following figure is one example of student works that meets the critical indicator. In the picture below the students were asked to calculate the area of the triangle, with the initial information presented around the triangle 98 cm and the base length of 24 cm. The student is able to interpret the problem by writing down the information that is known appropriately. Furthermore, students are also able to make mathematical model and explanation needed in solving problem. The strategy is used to solve the problem by finding the height of the triangle first using the Pythagoras theorem. In the last step, the student can calculate the area of the triangle and make the conclusion according to the context of the problem appropriately.

The student's work is written on a spiral notebook. It includes a diagram of a triangle with a dashed line representing the height. The text is as follows:

Diketahui
 panjang alas = 24 cm
 Keliling = sisi 1 + sisi 2 + alas
 $98 = \text{sisi 1} + \text{sisi 2} + 24$
 $98 - 24 = 2 (\text{sisi})$
 $74 = 2 (\text{sisi})$
 $\text{sisi} = \frac{74}{2} = 37 \text{ cm}$

tinggi segitiga $\Rightarrow c^2 = a^2 + b^2$
 $b^2 = c^2 - a^2$
 $b^2 = 37^2 - 24^2$
 $b^2 = 1369 - 144$
 $b^2 = 1225$
 $b = \sqrt{1225}$
 $b = 35 \text{ cm}$

Ditanya luas segitiga
 $* L = \frac{1}{2} \times \text{alas} \times \text{tinggi}$
 $= \frac{1}{2} \times 24 \times 35$
 $= 420 \text{ cm}^2$

Two callout boxes on the right side of the notebook page provide commentary:

- Students are able to interpreting the problems accurately
- Students are able to use appropriate strategies to solve problems

Figure 4. The answer of the student with critical thinking skill

The picture above shows the answer of the student with critical thinking skills. The student are able to interpreting the problems by finding the height of the triangle. Furthermore the student are able to use appropriate strategies using Pythagoras theorem to calculate the area of the triangle.

4. Conclusion

The developing of instructional instrument based on Lesson Study for Learning Community (LSLC) has the criteria: validity and feasible to be implemented in learning. This instructional instrument proved to give significant difference of students' critical thinking ability on triangle material. The result of the study shows 2.9% of non-critical students (TBK 0), 8.8% of students were less critical (TBK 1), 8.8% of students were critical (TBK 2), 47.1% of critical students (TBK 3) 32.4% of students are very critical (TBK 4) in the experimental class. While in the control class using conventional learning obtained 6.3% students are not critical (TBK 0), 15.6% students are less critical (TBK 1), 37.5% of students are critical (TBK 2), 28.1% students critical (TBK 3), 12.5% of students are very critical (TBK 4). This shows that the developed instructional instrument has an influence on the students' critical thinking ability.

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