Lesson study: Increasing mathematical critical thinking ability?

F Ferdianto* and N B Ningrum
Mathematics Education Study Program, Faculty of Teacher Training and Education
Swadaya Gunung Djati University, Cirebon, Indonesia

*ferrymatematika@gmail.com

Abstract. The aims of this paper is determine the increase of students critical thinking ability in the material system of two-variable linear equations using the problem based learning model based on lesson study. This research is a quantitative with the method of analysis using the analysis of N-Gain test on the results of the student’s problem description test. The sample taken in this study is purposive sampling which is used only one class. The results showed that there was an increase in the critical thinking ability using the problem based learning model based on lesson study as seen from the increase in the average critical thinking ability test results of 0.70 and included in the high criteria.

1. Introduction

Education is closely related to learning. Ferdianto [1] argues that a person is said to learn when there is a change in him due to training and experience through interaction with the environment. Whereas according to Hamalik [2], learning is a process and activity not only outcome. In learning process students often have learning problems before learning, can relate to the characteristics of students in the form of interests, skills and experiences [3]. Students who are interested in mathematics will have the initiative to learn, have the desire and, one of which is the critical thinking ability. The ability is one of the very important abilities that must be possessed by students, because it trains logical thinking, systematic, critical, creative, careful and objective thinking, open when have problems of everyday life and ready to changing future. and can account for his opinions with logical reasons [4].

The observation does it by interviews with several students about matters relating to indicators of learning interest found that: students were less happy at math lessons because math lessons were difficult; students are less interested in taking mathematics lessons; many students lose focus in the midst of learning; and students are very difficult when asked to present the results of their work due to shame and fear of being laughed at by their friends if they answer wrongly.

One of learning model can be used by teachers is problem based learning. That can train and develop students' ability to solve problems in the form of authentic (real) from the actual life of students to stimulate higher-order thinking skills [5]. In addition, there must be improvements from previous learning activities so that students learn and do to improve students' ability to learn mathematics. This improvement in learning activities can be use the lesson study method, which requires teachers to collaborate to increase and improve learning.

Lesson study is an activity in which teachers work together to plan long-term learning, then apply the learning plan, and observe together, discuss, and improve learning [6,7]. Ono [8] lesson study is a
type of classroom research that involves all the teachers to investigate teaching and learning and then discussed how the learning process runs and is made as an improvement for next learning. Murtiani [6] and Subadi [9] lesson study is a model of guidance to the teaching profession in order to study collaborative learning with long-term time based on the principles of peers and learning from each other to build a learning community. Based on MGMP guidelines for the implementation of with Lesson Study pattern [6], the stages in lesson study learning activities are: 1) Planning phase; aims to design learning that makes students learn, actively participates in learning. 2) Implementation phase (do); aims to apply the learning design that has been formulated in planning, and to test the effectiveness of planned learning. 3) reflection (see); conduct discussions on observations of the learning process carried out, and all parties collaborating and other observers provide suggestions for improvement of learning.

In lesson study learning can choose and apply various types of learning models or strategies that suit the situation, conditions and problems. Learning models can change, teacher models can use more than one learning model. The learning model can be contextual, quantum, integrated, problem-based, and cooperative [9].

Duch in Shoimin [5] said that problem based learning is a learning model that challenges students in the real problems requiring students to learn to think critically, have problem solving skills and knowledge. In line with Duch's opinion, Arends [10] states that problem based learning is a learning model that provides authentic (real) problems for students to compile their own knowledge, discovery, improve high-level abilities, make students independent and increase students' self-confidence. According to Tan [11], problem based learning is an innovation in learning because it optimizes students' thinking skills in groups, so that students are able to empower, hone, test, and develop sustainable thinking skills. Problem based learning is a learning model that gives problems in the beginning of learning in order to collect and then renew into new knowledge [12].

The steps in problem based learning have five phases, namely: (1) Student orientation to the problem (2) Organizing students to learn (3) Guiding individual and group experiences (4) Developing and presenting work (5) Analyzing and evaluating problem solving process [12].

Ennis [10-13] states that critical thinking mathematic ability is the ability to think in solving mathematical problems by involving mathematical knowledge, mathematical reasoning and mathematical proof. Whereas according to Glaser [4,14] explained that critical thinking contains abilities and dispositions combined with initial abilities, mathematical reasoning, cognitive strategies to generalize, prove, and assess mathematically reflective situations. In critical thinking is supported by other abilities such as: understanding, remembering, distinguishing, analyzing, reasoning, reflecting, interpreting, seeking relationships evaluating and sometimes making temporary guesses.

Lestari [10] divides indicators of critical thinking, as follows: a) Provide a simple explanation, b) Build basic skills, c) Make conclusions, d) Make further explanations, e) Determine strategies and tactics.

Interest is a high tendency and excitement or a great desire for something [13,15] According to Slameto in [16], interest is a constant desire and arises from oneself to pay attention and remember some activities, so that it will cause feelings of pleasure and satisfaction. Interest serves to motivate learning and explore [17]. Indicators of learning interest include: a) Feelings of pleasure, b) Have an interest in learning, c) Pay attention to when learning takes place, and d) Get involved directly in learning [10].

Students who have a high interest in learning, then he will try to prepare well everything related to what will be learned. Whether or not a student interest in a lesson can be seen from the way children attend lessons, completeness of notes, and attention to the core of the lesson [18]. Interest also affects learning difficulties, if there is no interest there will be difficulties in learning because of the feeling of a dilemma in him so that the lesson cannot be processed properly by the brain, then there are difficulties.

The aims of this paper is determine the increase of students critical thinking ability in the material system of two-variable linear equations using the problem based learning model based on lesson study.
2. Method
The method used is Experiment, when we will see for a causal relationship between the variables used. Therefore, the research process carried out is to see how the application of the problem based learning model is based on lesson study on critical thinking ability and learning interests.

The population in this study 8th grade junior high school one school in Cirebon City. The sampling technique in this study was purposive sampling which was used only one class. Data collection techniques used in this study are as follows. (1) Written test, this test is in the form of a description question to test students 'critical thinking ability (2) attitude scale questionnaire is used to determine students' learning interest in the learning process.

The data of mathematics academic test scores for junior high school students were analyzed using the Normality Test to find out whether the population was normally distributed or not. Then proceed with the N-Gain test, to see an increase in the average value of students' critical thinking abilities. Analysis of attitude scale questionnaire to determine whether there is a student's learning interest in this learning.

3. Results and discussion

3.1. Analysis of pre-test and post-test normality test
Normality test is carried out to find out that the data comes from a population with normal distribution or not by performing a data normality test. The calculation of the normality test in this study uses the Shapiro-Wilk Test with the help of SPSS Statistics version 17.0.

Table 1 obtained significant values for Pretest and Posttest were 0.100 and 0.489, respectively. So that based on the testing can be concluded that the Pretest and Posttest data come from the population with normal distribution. Its mean, that student ability in the classroom is evenly.

| Subject | Pretest | Posttest | N-Gain |
|---------|---------|----------|--------|
| Total   | 583     | 2187     | 20,16  |
| Average | 20,10   | 75,41    | 0,70   |
| Minimum | 0       | 41       | 0,34   |
| Maximum | 95      | 47       | 0,93   |

3.2. N-Gain analysis
Increased critical thinking ability by using the problem based learning based on lesson study model can be found by the N-Gain test.

Table 2 Show that the average result of the pre-test is 20.10 and the average result of the post-test is 75.41 there is an increase in the test results on average by 0.70 in high criteria. It means that critical thinking ability can be increase use lesson study model, because lesson study model makes the teacher always improve teaching by using input see step (reflection). This step the teacher knows a lot about how students learn from observers.
3.3. Analysis of student interest questionnaires

Figure 1 can be shown that questionnaire interest of students who entered into the strong criteria is 12 statements, while those that entered very strong criteria just only 5 statements, it means that 20 statements from 25 statements about student interest show good results.

![Figure 1. Results of student learning interest.](image)

Table 3 we know that in statements number 13, 19, and 20, the application of the problem based learning model based on lesson study. Statement number 13 contains a statement that with the application of the problem based learning model based on lesson study students have difficulty in understanding the material with a percentage of 50% (enough). Statement number 19 contains a statement that with the application of the problem based learning model based on lesson study students are more challenged to continue learning mathematics with a percentage of 80% (strong). In addition to the statement number 25 there is a statement that the application of the problem based learning model based on lesson study makes students more eager to learn mathematics with a percentage of 73% (strong). So we can say that the application of the problem based learning model is based on lesson study even though students have little difficulty in understanding the material but the students remain enthusiastic and feel challenged to learn mathematics. In other words, the application of the learning model of problem based learning based on lesson study can foster student interest in learning.

| No | Statement                                                        | Score | Percentage | criteria |
|----|------------------------------------------------------------------|-------|------------|----------|
| 1. | I like to study mathematics.                                      | 88    | 76%        | Strong   |
| 2. | I always pay attention to the teacher when explaining the material.| 103   | 89%        | Very strong |
| 3. | Learning mathematics is a lesson I have been waiting for at school.| 79    | 68%        | Strong   |
| 4. | I lack confidence in doing the questions on the board.           | 82    | 71%        | Strong   |
| 5. | If I have difficulty working on a math problem, I will ask a friend or teacher. | 103   | 89%        | Very strong |
| 6. | I find it easier to understand math material when learning in groups with friends. | 86    | 74%        | Strong   |
| 7. | I feel compelled to follow math learning at school.              | 57    | 49%        | Enough   |
| 8. | I have my own initiative to study mathematics.                   | 95    | 82%        | Very strong |
| 9. | I always noted important parts of math material even though it was not told by the teacher. | 102   | 88%        | Very strong |
| 10. | I find it difficult to focus on learning mathematics.            | 75    | 65%        | Strong   |
| 11. | I am used to procrastinating working on math assignments given by the teacher. | 63    | 54%        | Enough   |
| 12. | I don't want to try if the math problem is difficult.           | 65    | 56%        | Enough   |
| 13. | Learning activities like this make it difficult for me to understand the material. | 58    | 50%        | Enough   |
| 14. | I feel disappointed if I don't get perfect grades in math.       | 87    | 75%        | Strong   |
Table 3. Cont.

|   | Statement                                                                 | N  | Percentage | Level   |
|---|---------------------------------------------------------------------------|----|------------|---------|
| 15| I lack confidence to express my opinion in group learning.               | 74 | 64%        | Strong  |
| 16| I rarely record the mathematics material provided by the teacher.         | 64 | 55%        | Enough  |
| 17| I was very excited if I was asked to work on the problem on the board.   | 75 | 65%        | Strong  |
| 18| I feel that math lessons are difficult to learn.                         | 65 | 56%        | Enough  |
| 19| This learning makes me more challenged to continue learning mathematics  | 93 | 80%        | Strong  |
| 20| I feel normal when I get bad grades in math.                            | 57 | 49%        | Enough  |
| 21| I feel happy and excited when the teacher teaches using media or teaching aids. | 97 | 84%        | Very Strong |
| 22| I responded to a friend who invited me to talk during the lesson.         | 60 | 52%        | Enough  |
| 23| I will ask a noisy friend to keep quiet during the lesson.               | 86 | 74%        | Strong  |
| 24| I feel happy when the teacher cancels the test.                         | 90 | 78%        | Strong  |
| 25| Learning mathematics like this makes me more eager to learn mathematics  | 85 | 73%        | Strong  |

4. Conclusion
Based on description, analysis and discussion research, the conclusions that can be taken are as follows.
There is an increase in the ability to think critically by applying the problem based learning model based on lesson study with an average gain index of 0.70 with high criteria. And there is interest in student learning in the material system of two-variable linear equations by applying the problem based learning model based on lesson study.

Acknowledgment
I am very grateful to the UPI Lesson Study team for their continued encouragement, good advice during my research and I thank the 15 junior high school cities of Cirebon for the place used in this study.

References
[1] Ferdianto F and Ghanny 2014 Meningkatkan Kemampuan Pemahaman Matematis Siswa Melalui Problem Posing *Jurnal Euclid* 1(1) 47-54
[2] Ferdianto F 2015 Media Audio Visual Pada Kemampuan Komunikasi Matematis Siswa Kelas IX *Jurnal Euclid* 2(2) 47-54
[3] Aunurrahman 2012 Belajar dan Pembelajaran (Bandung: Alfabella)
[4] Hendriana H, Rohaeti E E and Sumarmo U *Hard Skills dan Soft Skills Matematika Siswa* (Bandung: Refika Aditama)
[5] Shoimin A 2014 *Pembelajaran Inovatif dalam Kurikulum 2013* (Yogyakarta: Ar-ruzz Media)
[6] Murtiani F A and Wulan R 2012 Penerapan pendekatan contextual teaching and learning (ctl) berbasis lesson study dalam meningkatkan kualitas Pembelajaran Fisika Di SMP Negeri Kota Padang *Jurnal Penelitian Pembelajaran Fisika* 1(1)
[7] Triyanto 2015 Building Collaborative Learning Through Lesson Study *Prosiding ICTTE FKIP UNS 2015* 1(1) 586
[8] Ono Y and Ferreria 2015 A case study of continuing teacher professional development through lesson study in South Africa *South African Journal of Education* 30 59-74
[9] Subadi T, Khotimah R P and Sutarni S 2013 A lesson study as a development model of professional teacher *International Journal of Education* 5(2) 102-114
[10] Lestari A E and Yudhanegara M R 2017 *Penelitian Pendidikan Matematika* (Bandung: Reflika Aditama)
[11] Rusman 2012 *Model-model Pembelajaran* (Jakarta: Raja Grafindo Persada)
[12] Muhson A 2009 Peningkatan Minat Belajar Dan Pemahaman Mahasiswa Melalui Penerapan Problem Based Learning Jurnal Kependidikan 39(2) 171-182
[13] Sakti I, Puspita Y M and Risdianto E 2012 Pengaruh Model Pembelajaran Langsung (Direct Instruction) melalui Media Animasi Berbasis Macromedia Flash terhadap Minat Belajar dan Pemahaman Konsep Fisika Siswa Di SMA Plus Negeri 7 Kota Bengkulu Jurnal Exacta 5(1) 1-10
[14] Styron R A 2014 Critical Thinking and Collaboration: A Strategy to Enhance Student Learning. Systemics Cybernetics And Informatics 12(7)
[15] Lloyd 2010 Thinking Critically about Critical Thinking in Higher Education International Journal for the Scholarship of Teaching and Learning 4(2)
[16] Pane E R and Ermidawati 2017 Pengaruh Minat Belajar dan Penggunaan Media Video Tutorial terhadap Hasil Belajar Menggambar Proporsi Tubuh Wanita Dewasa Siswa Kelas X SMK Negeri 1 Laguboti Siluet 1(1) 65-69
[17] Siagian R E F 2012 Pengaruh Minat dan Kebiasaan Belajar Siswa terhadap Prestasi Belajar Matematika Jurnal Formatif 2(2) 122-131
[18] Silvia P J 2008 Interest-The curios emotion Current Directions in Psychological Science 17(1) 56-60