Students’ mathematical understanding reviewed by gender through discourse learning assisted by mathematical bet line strategy

I M Pratiwi1*, S P D Rachman2 and V A N Ariawan3

1Pendidikan Guru Madrasah Ibtidaiyah, Universitas Islam Negeri Sunan Gunung Djati, Jl. A.H. Nasution No. 105 Cibiru, Bandung 40614, Indonesia
2Lembimjar Neutron Bandung 4, Jl. Terusan Jakarta No.19 Kiara Condong, Bandung, Indonesia
3Pendidikan Guru Sekolah Dasar, STKIP Majenang, Jl. Raya Pahonjean KM.2 Majenang, Cilacap, Indonesia

*sayainne@gmail.com

Abstract. This study aims to pilot the discourse learning assisted by mathematical bet line strategy to students’ mathematical understanding reviewed by gender. The research used quasi experimental method and the subjects are the fourth grade students. Test experiment was used to collect data of mathematical understanding ability. As for the result, the average male students’ and female students’ mathematical understanding ability showed no difference after participating in discourse learning assisted by mathematical bet line strategy. It implies that male and female students have same mathematical understanding ability. We can see the difference in the arrangement strategy of question. Male students solved the question by picture or chart. In the other hand, female students solved the question by explain some words or find a pattern.

1. Introduction

National Council of Teachers of Mathematics explains that mathematical understanding is a substantial aspect in Mathematics learning principle [1]. In line with the purpose of Mathematics learning, students are required to understand given concepts. Students can be considered as achieving when they can define, identify, and exemplify concepts. Students have a high mathematical understanding if they can identify mathematics problem and connect the theory with concrete mathematics problem in daily life [2].

As for the next step, students can develop their understood concepts by using various representations. Representation ability in Mathematics learning such as physical object, draw, graphics, and symbols can aid in students’ way of thinking and communicating. Precision in making use of representation helps students to solve problems faster and more efficiently. Many students dislike Mathematics despite it is being widely applicable in daily life. Students often see Mathematics as a difficult subject. They like Mathematics when it is easy and simple during early stage of education [3]. While difficulty level of Mathematics increase, it does not make students feel challenged but lessen students’ mathematical understanding ability instead. Other factors that lead to students’ low mathematical understanding ability are students tend too focused in getting high scores, students only listen to teacher’s explanation, teacher-centered lesson, and less innovative learning [4-7]. Despite teacher’s role to facilitate students’
learning needs, students themselves have to be self-motivated to keep practicing independently so that their mathematical understanding ability is improved.

Vygotsky explains that every learning process has to be oriented at students’ sociocultural background. It enables teachers to connect theories with recent events in students’ environment. In addition, this sociocultural orientation is useful to help students solve the problems by using theories that they learned [8]. Referring to that explanation, the researcher concludes that Mathematics discourse is appropriate to be implemented in Mathematics learning. Mathematics discourse is an interaction within lesson that is not only question-answer session and doing-reviewing problems. It also includes solving Mathematics problems through teacher-students or students-students discussion [9]. Mathematics discourse help students connect theoretical Mathematics problem with concrete Mathematics problem in daily life [10]. In simple terms, Mathematics discourse substitutes theory with Mathematics practice.

There are four components in Mathematics discourse namely exemplification, explanatory, learner participation, and object of learning [11,12]. Exemplification is needed in Mathematics discourse since Mathematics objects include not only concrete objects but also abstract entities. As a result, examples and explanation should be given by Mathematics teachers to enable students to complete problems so students’ mathematical understanding ability is developed [13]. During exemplification, teacher gives some problems as an example to explain a certain concept. Students are required to solve the problems according to their own way. As a facilitator, teacher should not judge students’ way in solving problems even if it is wrong. Teacher should clarify any misunderstandings and support students to think more deeply [14]. Once students have found a proper way to solve mathematics problem, teacher can ask students to work individually or in groups. The step is called an explanatory component in Mathematics discourse. Each student has his own style to solve mathematics problems [15].

Kiemer and Seidel, who carried out a research of the effectiveness of discourse learning towards primary students’ motivation in Mathematics and Science, have proven the effectiveness of discourse learning. The result shows that students who participated in discourse learning represented higher motivation in learning Mathematics and Science than those did not. Through discourse learning, students can complete Mathematics and Science problems more deeply using a distinctive way of thinking [16].

Another strategy that can be used in discourse learning is Mathematical Bet Line strategy. Mathematical Bet Line is adapted from Bet Line which is used by English learners as a literacy strategy to develop students’ skill in predicting based on their understanding of certain contexts. Mathematical Bet Line strategy is designed to promote discourse learning and support students’ sense making when teacher explains about word problems [17]. In literacy learning, Bet Line strategy is used as an interactive and continuous approach in involving students with a text. Specifically, Bet Line offers a chance for students to “understand how readers think and start organizing their own understanding.” [17]. At the same time, Mathematical Bet Line aims to help students understand word problems by making predictions or responding to someone else’s prediction as to what is likely to happen according to a problem elaborated by teacher.

Referring to explanation and result from previous research, the researcher concludes that discourse learning with Mathematical Bet Line is a learning that requires students to develop their own understanding through a high level discussion involving whole class members. Mathematical Bet Line-assisted strategy in discourse learning is considered appropriate to be implemented in classroom learning especially to improve students’ mathematical understanding ability. This paper used pre experimental method to investigate students’ mathematical understanding ability based on gender.

2. Method
This paper used pre experimental research method. Pre experimental research method is a design that does not fulfil certain conditions in terms of whole experimental design accomplishment [18]. Pre experimental design implements one group pre-test and post-test design. This design is applied to one experimental group who did pre-test, received treatment, and did post-test [19]. This study’s research population was fourth grade students at one of Kuningan sub-district, West Java. The sample was 27 students from one primary school. The sample was selected purposively since this study aims to compare
primary students’ mathematical understanding ability which is based on gender. Purposive sampling is a method of choosing sample that is based on specific considerations and characteristics [20]. This choice of sample is categorized as non-random sampling.

Research instrument employed mathematical understanding ability test in a form of essay. Before research instrument was given to students, construct validity test was performed to the instrument. Construct validity test is an instrument test that is meant to measure readability and difficulty of every item to match with students’ characteristics [21]. An expert can thoroughly give a consultation of an instrument that is going to be tested. Construct validity test includes validity test, reliability test, coefficient of difficulty, and coefficient of determination from all items in mathematical understanding ability test. Afterward, data was analyzed using inferential statistics test to compare gender based students’ mathematical understanding ability.

3. Results and discussion

The purpose of this research is to get a portrayal of fourth grade students’ mathematical understanding ability after receiving discourse learning assisted by gender based Mathematical Bet Line strategy. The data of mathematical understanding ability was obtained before and after the students being treated in discourse learning assisted by gender based Mathematical Bet Line strategy for fraction topic. Descriptive statistics of pre-test and post-test scores of gender based mathematical understanding ability is shown in Table 1.

|                        | Male          | Female        |
|------------------------|---------------|---------------|
| Total of students      |               |               |
| Pretest                | 13            | 14            |
| Posttest               | 13            | 14            |
| Min Score              | 7             | 11            |
| Max Score              | 23            | 26            |
| Average                | 14.77         | 20.43         |
| Total of students      |               |               |
| Pretest                | 14            | 14            |
| Posttest               | 14            | 14            |
| Min Score              | 11            | 26            |
| Max Score              | 26            | 40            |
| Average                | 29.69         | 35.36         |

Table 1 shows the test result of students’ mathematical understanding ability before and after treatment. The test result shows that there was improvement of students’ mathematical understanding ability after discourse learning assisted by gender based Mathematical Bet Line strategy was implemented. Afterward, the researcher measured students’ mathematical understanding ability based on gender by using average difference test. Before the average difference test was carried out, the researcher conducted normality test as a pre-condition test.

It was found that the result of pre-condition test was not evenly distributed. Therefore, Mann-Whitney U test was conducted to find out distribution of difference scores of mathematical understanding ability pre-test. Based on the calculation, the researcher obtained the score of Sig. (2-tailed) 0.005 less than the significance level α = 0.05. The result showed that there was a difference in the distribution of pre-test score of male students’ and female students’ mathematical understanding ability before receiving discourse learning assisted by Mathematical Bet Line strategy. Next, post-test score was analyzed to measure students’ mathematical understanding ability. The researcher used t-test in conducting average difference test since non-homogenous result was shown during pre-condition test. Referring to the result, it was acquired the score of Sig. (2-tailed) 0.051 more than the significance level α = 0.05. The results above indicate that there was no difference in the average post-test score of male students’ and female students’ mathematical understanding ability.

Based on the research result, it was found that there was no difference in the average score of male students’ and female students’ mathematical understanding ability after receiving discourse learning assisted by Mathematical Bet line strategy. It is in line with the result of previous researches that showed no difference between male and female students’ mathematical understanding ability [22,23]. Mullis and Martin have added literature regarding gender influence towards Mathematics learning outcome in various countries in Trends in International Mathematics and Science Study (TIMSS) research document at 2015. Mullis and Martin found that there were 18 out of 49 countries which showed more
achievement from male students than female students. Eight countries showed more achievement from female students. Twenty three countries proved that there was no significant difference of male and female students’ achievement in Mathematics [24].

Male and female students’ mathematical understanding ability lied on the same level after they received discourse learning assisted by Mathematical Bet Line strategy. This indicated discourse learning assisted by Mathematical Bet Line strategy is effective to improve both male and female students’ mathematical understanding ability. Improvement in students’ mathematical understanding ability cannot be separated from students’ learning activities. Mathematics discourse is seen as a tool to improve students’ learning [25]. This is due to discourse learning that enables students to expose ideas in grasping mathematical concepts, discover way of thinking, so that they can construct mathematical knowledge on their own [26].

Discourse learning makes it possible to involve whole students in the classroom during a discussion through visual, verbal, and written communication. Therefore, students can construct understanding of certain mathematical ideas through comparing one’s opinions based on different point of views in order to achieve settle in one concept. Discourse can develop students’ mathematical understanding ability since they learn to understand concepts, reason, and solve problems based on their deep thinking [27]. Discussion that is created in mathematical discourse will lead into an effective communication so that teacher and students can exchange ideas and find a solution to a problem through different point of views. Through mathematical discourse, students have freedom to find alternatives to solve problems without being required to follow example shown by teacher [28]. One thing to consider in discourse learning is teacher has to make sure that each student completes a problem according to their own capability and understanding. Teacher has to monitor and reason students regarding their chosen way in solving Mathematics problem. Through this activity, teacher can assess every student’s mathematical understanding ability as well as identify difficulty that challenges each student in learning activity [29].

The implementation of discourse learning with Mathematical Bet Line strategy emphasize on students’ involvement in finding and constructing their own knowledge through experiences and previous knowledge [30]. Teacher has to build a learning environment that supports students’ participation in a productive Mathematics discussion [31,32,33]. In discourse learning with Mathematical Bet Line strategy, learning activity begins when teacher comes up with an unsolved word problem and stops when students are able to predict what will happen. Students try to build arguments, criticize someone else’s arguments, and stand for their own arguments. There is no wrong opinions coming from students, thus teacher must appreciate students’ opinion regardless what their gender is. Both male and female students have same opportunity in expressing opinions. Teacher must be familiar with students’ way of thinking and help them find answer instead of spoon-feeding them with correct answers [34]. Learning is not supposed to be a spoon-feeding activity, but students have to be reinforced to find answers with teacher’s help in order to improve their creativity. In addition, teacher must lead students in expressing a relevant opinion based on previously discussed Mathematics problems.

Discourse learning activity assisted by Mathematical Bet Line strategy sustains the improvement of mathematical understanding ability. It can be seen from the scores’ distribution of difference in the pretest. On the other hand, after students followed the discourse learning assisted by Mathematical Bet Line strategy, there was no difference in the average score of male students’ and female students’ mathematical understanding ability. Difference was found at the strategies chosen by male and female students in solving problems. This statement is in line with the findings of previous research that discovers that genders do not have any effect on students’ mathematical understanding ability, however genders can predict the precision of problem solving the use of strategy [35].

Based on the research’s findings, it can be indicated that how both male and female students solved Mathematics problems is categorized as contrast. Contrast is solving Mathematics problems using a slightly different way than the given example; it may be either simpler or more complicated. Contrast gives two problem solving alternatives students can choose from either or both [12]. This statement was proven on how distinctive male and female students’ style in solving Mathematics problems. Male students were likely to solve problems using drawing or diagram-aided strategy. Meanwhile, female
students were likely to solve problems using the help of patterns or word explanation. This was due to males’ nature which is better in visual-spatial ability, while females are better in mathematical verbal communication ability [36]. Drawing and diagram strategy is more widely used by male students since it facilitates problem solving more easily. This is relevant with the findings of the previous research which exposed that diagram or picture making strategy can help students in solving word problems [37].

4. Conclusion
Discourse learning assisted by Mathematical Bet Line strategy enables students to construct their own mathematical understanding. After following discourse learning assisted by Mathematical Bet Line strategy, there was no difference found between male and female students’ mathematical understanding ability. Based on the findings, the researcher concludes that both male students and female students have equivalent mathematical understanding ability. When the students were partaking in discourse learning assisted by Mathematical Bet Line strategy, they were involved in a discussion through an opinion betting in order to settle in one agreed concept regardless of their gender. However, there was a difference in the strategies chosen to solve problems. Male students solve problems using drawing or diagram, female students solve problems using pattern or word explanation.

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