Problem based learning-team teaching to improve vocational school students’ mathematical disposition

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Abstract. This research aims to determine the interaction that occurs in the process of learning mathematics process. In general, this research is about improving the ability of mathematical disposition of vocational high school students. The learning took place in 2 schools with different levels. This research was quasi-experiment research. The data analysis techniques performed by using the Gain test and ANOVA test. The result show s that there was an increase of students’ mathematical disposition ability in the class using PBL model and PBL-Teaching Teachers for both middle and low-level schools. At a medium level, improving the mathematical disposition of students with PBL-Team Teaching methods is better than PBL and conventional models. There is a significant interaction between mathematical disposition abilities based on the schools level and the use of learning models. There is no interaction between mathematical disposition ability and the use of learning model when viewed from Mathematical Preliminary Ability.

1. Introduction

Mathematical disposition relates to how students perceive and solve problems; whether the students are confident, diligent, interested, and open-minded to explore various alternatives to problem-solving strategies. Mathematical disposition is a desire, awareness, and a strong dedication to students to learn math and carry out mathematics activities [1]. Research results showed that students’ attitudes toward mathematics would affect students' learning process and outcomes [2]. The revitalisation of mathematics tree requires an interdisciplinary, multidisciplinary, and transdisciplinary mathematical package. For increase a qualification of learners, the learning needs as follow; first, the presentation of the material is arranged in problem, theme, and integrated. Second, the impact of the study include s cognitive and affective aspects, especially cooperation and social competence. Third, the teacher of team teaching with flexible procedures. Fourth, the goals of the understanding include concepts, relationships, and interconnections. Fifth, cooperative learning. Integrated perspective in PBL for math as subjects in Vocational High School can be used to create smart workers and have adequate life skills. The disposition of mathematics will be apparent at the completion of mathematical problems. Currently, most industries still apply math test as one of the requirements of recruitment of vocational graduates. The survey results from a few industries in West Java Indonesia shows that the results of math test of
Vocational School graduate are still far from the expectation. Therefore, research on mathematical disposition as a desire, awareness, and a strong dedication to students to learn math and carry out mathematics activities should continue.

Many researchers such as Maharani and Othman have studied about the implementation of PBL on a vocational school. The implementation of PBL showed that it is useful learning to improve the activity and skills of vocational school students [3,4]. Mathematical learning that integrates vocational issues, besides providing sufficient theories, it also provides examples of the real problem solving by utilising the existing theories. PBL methods can make students competitive. Especially for vocational students, which requires relevance of subject matter to industry needs. However, PBL which is packaged only by one subject teacher has not been able to accommodate the needs of the graduates as expected by the industry. Therefore, it requires team teaching methods between subject and vocational teachers. Team teaching between maths teachers and vocational teachers is a precise form of collaboration. Through the collaboration, they will develop integration between mathematics material and vocational competence. Therefore, the purpose of Vocational school can be achieved primarily in creative thinking ability and mathematical disposition aspect.

The research questions are: (1) was there any increase in students’ mathematical disposition in the class using PBL-Team Teaching models for moderate level and lower school level?; (2) was there a significant interaction between mathematical disposition abilities based on the school level and the use of learning models?; (3) was the mathematical disposition ability of the students who get the PBL-Team Teaching models is better than PBL and conventional model?; (4) is there an interaction between mathematical disposition ability and the use of learning model when viewed from Mathematical Preliminary Ability? The research objectives were: (1) to determine the increase in students' mathematical dispositions in the classroom using PBL-Team Teaching models for middle and lower levels of school; (2) to find out the significant interaction between mathematical disposition abilities based on school level and the use of learning models ?; (3) to find out whether the mathematical disposition ability of students who get PBL-Team Teaching models is better than PBL and conventional models? (4) to find out the interaction between mathematical disposition abilities and the use of learning models when viewed from the Ability of Mathematical Introduction?

2. Review of Literature

2.1. Mathematical Initial Ability

Mathematical initial ability is essential that student has in solving mathematical problems. It is a necessary prerequisite to being able to get involved in following the learning well. Student thinking can develop along with the development of the knowledge it acquire [5,6]. Students who have the low initial ability will have more difficulty acquiring new knowledge or assimilating the new concept. While students with high initial ability will tend to quickly receive information and associate with existing information on him [7,8].

2.2. Mathematical Disposition

In English, "disposition" means character, placement, arrangement and inclination. Disposition is a natural aspect of a person that includes nature, character, and personality [9]. Mathematical derived from the ancient Greek "mathematics" which means related to the study and learning of mathematics. Mathematical disposition is a conscious tendency of a person which expressed during the study of mathematics learning. Mathematical disposition related to how students perceive and solve problems; whether confident, diligent, interested and flexible thinking to explore various alternative problem-solving strategies [10–12]. The manifest of student's disposition of mathematics is through attitudes and actions in choosing an approach to accomplish the task. Whether it with confidence, curiosity to find an alternative, diligent, and challenged along with the students’ tendency reflect the way they think. Reflection is a way of thinking about what is just being learned or thinking and the connection with activity in the past.
The mathematical disposition of students is said to be good if the students like problems that challenge and involve themselves directly resolving the problem. Also, students feel experiencing the learning process while completing the challenge. Polking stated that mathematical dispositions are; first, confidence in solving mathematical problems, communicating ideas, and giving reasons. Second, flexibility in exploring mathematical ideas and trying various alternative methods to solve problems. Third, determined to accomplish mathematical tasks. Fourth, the students having interest, curiosity, and ability to discover in learning mathematics. Fifth, tend to monitor and reflect on thinking process and self-performance. Sixth, assess mathematics applications in other fields and daily life. Seventh, appreciation of the role of mathematics in culture and value, both as a tool and language [13].

2.3. Problem Based Learning (PBL)

According to Dewey, PBL is the interaction between stimulus and response. It is the relationship between the two directions of learning and the environment [14]. To gain the right knowledge, Dewey emphasized learning by doing and developing intelligence. Thus children can find problems and solve them [15]. PBL helps students to process the information that already exists in their minds and develop their knowledge of the social world and its surroundings. Problem-Based Learning is an exciting learning strategy [16]. Beyond reading or hearing about academically-defined facts and concepts in field studies, students solve real problems that reflect the decisions and choices that people faced every day. Problem-based learning is a robust method, which involves learning strategies that support and transfer the learning. The problem for students is a package in an ill-defined form. The five stages of PBL which provide orientation about the problem to students, organise students to research, help independent and group investigations, develop and present results, and analyse or evaluate the problem-solving process. However, the results of the research conducted by Hakim showed that problem-based learning could not improve students’ mathematical disposition [17].

2.4. Team Teaching

Team teaching method is a method of teaching subject done by more than a teacher [18]. In learning using this method, teachers have their roles and responsibilities. Research showed that team teaching would be successful if it involves teachers who are skilled in teaching rather than involving teachers who are experts in the different background [19]. The purpose of team teaching is to streamline the teaching and learning process [20]. Through learning with team teaching method, teachers present the same lesson material at the same time and goal. Two or more teachers work together in arranging lesson plan, carrying out lessons, and evaluating to achieve the same goals. Type of team teaching according to Yeni Artingsih is semi team teaching and full team teaching. Based on its type, described the model of team teaching as a traditional model, supported instruction model, parallel instruction model, differentiated split class model, and monitoring teacher model [21].

Team Teaching Method on Mathematics learning in Vocational school involving vocational teachers training programs as learning resources. Learning resources are such as messages, people, materials, tools, techniques, and backgrounds that learners use as a source for learning activities and can improve the quality of learning [22]. Through team teaching-learning, interdisciplinary subjects are useful in an integrated and connected manner.

The research results of team teaching in junior school students in Nigeria showed that the learning introduction of technology conducted through team teaching approach is better than the learning done by a single instructor [23].

3. Method

This study is quasi-experimental research using two experimental classes namely PBL model class and PBL model class with team teaching. An ordinary class is using as a control group. This quasi-experiment uses designs of pretest-posttest groups. The design of this study is as follows:
The population is all students of class XI vocational school in Expertise Technology & Engineering at Cirebon District Academic Year 2017/2018. The sample of the study is using stratified sampling technique. From some vocational schools in Cirebon District specialise in Technology & Engineering, are grouped into three levels of high, medium, and low-level school based on the objective condition such as the average score of the national exam (UN), school accreditation score, and Minimum Achievement Standards (SPM) schools. Subsequently, medium level school and low-level school were selected to participate in this study. From each school level, three XI classes were select randomly as a control group, experiment 1 (using PBL model), and experiment group 2 (using the PBL model with Team Teaching method). From each group, the students are then grouped based on their previous mathematics skills of students with high, medium, and low mathematical initial ability.

A questioner is useful to measure student mathematical disposition. The scale of mathematical disposition combines seven Polking’s indicators. The disposition scale consists of 30 items with four choices of answers: Strongly Agree (SS), Agree (S), Disagree (TS), and Strongly Disagree (STS) [24,25]. A questionnaire is validated to measure the validity of the content. Measurable aspects include the appropriateness of the statement with the disposition aspect, congruity with the level of development of upper secondary students (ages 15-19 years), clarity regarding language or editorial, and clarity of presentation or appearance. Before using the disposition scale, its first trial to 43 students who were not a sample group to test readability. The calculation of subsequent disposition item scores is using the Microsoft Office Excel 2007 program and the data analysis techniques performed by using the Gain and ANOVA test.

4. Results and Discussion
Student mathematical disposition analysis was obtained based on the questionnaire result after the students experience the learning process of mathematics using conventional model, PBL, and PBL - Team Teaching. The statistical of the gain for the student's responses experienced the learning process are shown in Table 1:

| SCHOOL LEVEL | MODEL | GAIN_DISPOSITION | KAM | MEAN |
|--------------|-------|------------------|-----|------|
| Conventional | Low Students | -5,4800 | Low School Level | PBL | KAM Low Students | -9,5000 |
|              | Medium | 2,5600           |      |      | KAM Medium | 1,6100 |
|              | High Level | -1,1200 |      |      | KAM High Level | -1,6900 |
|              | Total | 1,9300           |      |      | Total | 5,3300 |
| Low School Level | PBL-Team Teaching | 3,0400 |      |      | KAM Low Students | 3,0400 |
|              | KAM Medium | 3,0000           |      |      | KAM High Level | 4,3400 |
|              | Total | 3,4400           |      |      | |
Table 1. Cont.

| Medium School Level | Conventional | PBL | PBL-Team Teaching |
|---------------------|--------------|-----|------------------|
|                     | KAM Low Students | 9,1600 | 3,3900 | 3,5600 |
|                     | KAM Medium        | 3,2400 | 3,5300 |
|                     | KAM High Level    | 1,0300 | 3,6900 |
|                     | Total             | 1,8800 | 3,5600 |

From Table 1, there was an increase of average students' mathematical disposition ability in the class using PBL model and PBL-Teaching Teachers for both middle school and low-level schools. However, the highest improvement of mathematical disposition for low-level school is found in experiment groups 2 (group with PBL), while the highest rate of improvement at the medium-level school is in experiment group 1 (group with PBL-Team Teaching). Its mean improving the mathematical disposition of students with PBL-Team Teaching methods is better than PBL and conventional models.

The result of the analysis ANOVA shows the significant interaction of mathematical disposition ability based on school level and model usage. However, statistical tests illustrate that there were no differences in the increase in mathematical disposition if viewing from mathematics initial ability perspective. PBL's step which presents problems that are close to students and presented with the team teaching method makes mathematics lessons attractive to vocational students. This is in line with what was conveyed by Mergondeller & Maxwell [16].

5. Conclusion

Some conclusions from this research are: (1) there is a difference in the improvement of mathematical disposition skills with the school level; (2) there are differences in disposition abilities with Conventional models, PBL, and PBL-Team Teaching; (3) Viewing from the Basic Ability of Mathematics (KAM), there is no difference in improving the ability of mathematical disposition; (4) From overall, there is a significant interaction between mathematical disposition abilities based on school level and the use of learning models in this case PBL and PBL-Team Teaching.

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