Mathematical Problem Posing Ability in Terms of Student Learning Styles

N Puspitasari¹, D Suryadi², U Sumarmo² and A Margana¹
¹Institut Pendidikan Indonesia, Jl. Pahlawan No.32 Tarogong Garut, Jawa Barat, Indonesia.
²Universitas Pendidikan Indonesia, Jl. Dr. Setiabudi No. 229, Bandung 40154, Indonesia.

*Email: puspita6881@gmail.com

Abstract. Asking question is an expression of the thought process. Question arises when someone gets new knowledge that is not in accordance with previous knowledge, through the thought process arises the question to get complete information so that the new knowledge he has becomes more meaningful. This study aims to examine and analyze the ability of students in problem posing based on their learning style. The method carried out in this study was a quasi-experiment on 80 high-school students. The results showed that there is significant difference for the achievement of mathematical problem posing abilities based on visual, auditory, and kinesthetic learning styles, contrary there is no significant difference in the improvement mathematical problem posing skills based on visual, auditory, and kinesthetic learning styles.

1. Introduction

Basically, mathematical ability problem posing is an ability that needs to be owned and developed in students who study mathematics. Rational importance of ownership of these capabilities is needed by students in facing the progress of science and technology that is increasingly rapid and challenges, demands, and increasingly tighter global competition. The rational importance of ownership and development of mathematical abilities in problem posing among high school students is included in the statements of several experts. The statements in question include: (1) KMMM is essential content in mathematics and the nature of mathematical thinking, and is an important part of mathematical problem solving [1, 2]; (2) Problem formulation is more essential than the solution [3]; (3) The development of mathematical abilities requires the ability to imagine creative mathematics, which among others is developed through submitting new questions, creating new opportunities, and looking at old questions from a new perspective [4]; (4) Students tend to prefer to solve mathematical problems rather than propose mathematical problems, the task of compiling mathematical problem posing is the first experience for students; and (5) Mathematical problem posing tasks help understand mathematical concepts, and are challenging tasks [5].

In mathematical problem posing activities consist of compiling new problems, or reformulating the original problem based on a series of data or information presented. Judging from the many possible responses or answers and their quality, mathematical problem posing tasks are open-ended, which means there are various responses and varying quality of responses. Each individual can provide many responses with the same quality or maybe also with diverse qualities. In addition, the quality of the problem produced by an individual may be different from that produced by other individuals, depending on the extent to which mastery of mathematical concepts relates to the problem in question. Individuals with good or strong mathematical abilities are expected to produce more, more diverse, mathematical
Problem posing and higher quality compared to mathematical problem posing of students with lower mathematical abilities. From the point of view of learning, mathematical problem posing can be a tool to access teacher understanding in developing students' cognitive processes, finding misconceptions, and obtaining information about student learning levels to advance the teaching-learning process.

Some studies report diverse findings regarding the development of mathematical problem posing abilities. The findings of some of them are: (1) Problems raised by students promote student creativity; and (2) Mathematical problem posing activities have a positive influence on student learning [6]. In addition, mathematical problem posing examines complex problems that support the growth of complex problem-solving abilities and mathematical problem posing tasks help understand mathematical concepts, and are challenging tasks [5].

This study will examine the mathematical problem posing abilities in terms of student learning styles. Learning styles show the focus of one's preferences on various types of information, how to understand different information, and the level of understanding of information. Although assessing student learning preferences can be time-consuming and sometimes difficult, determining children's learning styles can help them grow and succeed now and in the future. Having an understanding of the preferences of student learning styles can provide effective learning strategies for teacher use [7]. By using individual specific learning styles in the classroom, the teacher introduces problem solving skills [8]. By introducing problem solving skills in the classroom, problem posing skills can be developed. The majority of learning style theories believe in four learning styles: mastery-style learners, learner learning styles, learners of self-expressive styles, and interpersonal style learners [9].

People use their five senses to gather information and then channel it through three separate routes, called representational systems, to understand it. This representational system includes types of visual, auditory and kinesthetic students. Visual students will prefer to read, observe, and display data and visual aids. Visual students prefer to learn by watching movies, film strips, images and graphics that help integrate the subject. Auditory students prefer sound and make better decisions on what they have heard. By allowing auditory students to listen to material recordings, they are more likely to ask questions about what they have learned and may not understand. Students with kinesthetic learning preferences communicate with the environment through feeling and curiosity. Kinesthetic students prefer to learn with direct experience that helps them create and develop what they have learned [8].

Based on the characteristics of each of these styles, to find out how the tendency of student learning styles, then at the beginning of this study students were given a questionnaire about the tendency of learning styles. After students fill out the learning style questionnaire, then the students' answers are analyzed to determine the tendency of whether the student has a visual, auditory, or kinesthetic learning style. In this study will measure the achievement and improvement of mathematical problem posing abilities. Ideally the relationship between the value of achievement and the improvement of student abilities is directly proportional [10]. However, the fact that achieving high scores is not followed by a high increase [11].

2. Methods
This research is a quantitative study with a quasi-experimental method that aims to determine whether there are differences in achievement and improvement of mathematical abilities of problem posing students based on learning styles. The subjects of this study were 80 students of class XI. Test kits used are learning style questionnaires and tests of mathematical problem posing abilities. Learning model used in this study is direct learning.

3. Result and Discussion
3.1. Result
Based on the results of the learning style questionnaire analysis, the distribution of students is based on the learning style in Table 1.
Table 1. Distribution of Student Learning Styles

| Category  | Frekuensi |
|-----------|-----------|
| Auditory  | 12        |
| Visual    | 54        |
| Kinesthetic | 14      |

After obtaining learning style data of each student, then the problem posing ability score data was analyzed using SPSS version 24. Based on the results of data analysis to measure mathematical achievement and improvement, problem posing according to the learning style was stated in the following table.

**Figure 1.** Mathematical Problem Posing Ability Achievement Based on Learning Style

| Achievement | Sum of Squares | df | Mean Square | F    | Sig. |
|-------------|----------------|----|-------------|------|------|
| Between Groups | 246 266        | 2  | 123.143     | 12.767 | .000 |
| Within Groups  | 742.714        | 77 | 9.546       |       |      |
| Total         | 989.000        | 79 |             |       |      |

The results of statistical tests in Figure 1 show probability values (Sig) = 0.000 <0.05, which means that there are differences in achievement of mathematical problem posing skills based on learning styles. To see which learning styles groups are different, anova test is carried out by using the Post Hoc Scheffe test.

**Figure 2.** Post Hoc Test Results Achievement of Mathematical Problem Posing Ability Based on Learning Style

| i) Learning Style | j) Learning Style | Mean Difference (i-j) | Std. Error | Sig. | 95% Confidence Interval Lower Bound | 95% Confidence Interval Upper Bound |
|-------------------|-------------------|-----------------------|------------|------|-------------------------------------|-----------------------------------|
| 1.00              | 2.00              | 4.94444               | .95117     | .000 | 2.4703                              | 7.4186                            |
| 3.00              | 1.00              | -4.94444              | .95117     | .000 | -7.4186                             | -2.4703                           |
| 2.00              | 3.00              | 4.7126                | .93145     | .221 | -3.9600                             | 1.6901                            |
| 3.00              | 2.00              | -3.0052               | 1.22179    | .030 | -6.3593                             | -2.698                            |
| 2.00              | 1.00              | 1.63492               | .93145     | .221 | -6.3593                             | 1.6901                            |

*, The mean difference is significant at the 0.05 level.

Based on the results of the Post Hoc test (see Figure 2) obtained probability values (Sig.) <0.05 on the comparison of auditory learning styles with visual and kinesthetic learning styles. This means that different learning styles have different influences on the achievement of mathematical problem posing abilities. However, for auditory learning styles with kinesthetic probability values (Sig.) > 0.05 are obtained which means that there is no difference in achievement of mathematical problem posing abilities.
The results of statistical tests in Figure 3 show probability values (Sig) = 0.112> 0.05, which means that there is no difference in achievement of mathematical problem posing skills based on learning styles. To ascertain whether there were no significant differences for each learning style group, followed by the Post Hoc test.

Figure 4 shows the probability values (Sig.)> 0.05 on the comparison of auditory learning styles with visual and kinesthetic learning styles. This means that different learning styles do not have a different influence on improving mathematical problem posing abilities.

3.2. Discussion
Based on the results of data analysis, in terms of aspects of learning styles did not show a significant difference in the increase in mathematical problem posing abilities significantly. However, in the achievement of mathematical abilities, problem posing is only a comparison between visual and kinesthetic groups whose values of achievement are the same. This shows that students can develop mathematical abilities of problem posing even though they have different learning styles, because in mathematical abilities problem posing can relate to other math skills, for example: by understanding mathematical concepts and attitudes and self-confidence in learning mathematics [12, 2], with mathematical creative thinking skills [2, 9, 13, 14], with mathematical critical thinking skills [2]. All of these abilities can be developed because they are in accordance with the characteristics of each learning style. In other words, students will be able to develop their abilities as long as the student feels comfortable following the learning process. Therefore, the teacher must be able to understand the learning style of his students in order to be able to adjust and prepare a learning environment that suits the student's unique learning style. They can learn better and more comfortable with their own learning styles rather than having to adjust to different teacher teaching styles [8]. Research has shown that the compatibility between learning and teaching styles has a positive impact on achievement and satisfaction [15].
Students with kinesthetic learning styles will be very interested in facing challenging mathematical problem posing assignments, because through challenging problems they can get new experiences from the knowledge they already have. Mathematical problem posing assignments will be able to increase creativity and high-level mathematical thinking skills in students with visual, auditory and kinesthetic learning styles as long as teachers are able to understand student learning styles so that they can carry out the learning process well.

4. Conclusion
Based on the results of data analysis performed on the achievement and improvement of mathematical problem posing skills, it can be concluded that: 1) there are significant differences for the achievement of mathematical problem posing abilities based on visual, auditory, and kinesthetic learning styles; 2) there is no significant difference in improving mathematical problem posing skills based on visual, auditory, and kinesthetic learning styles. Knowing the learning style of students will be able to help the teacher in preparing the learning plan that will be carried out in the classroom, so that students will be better at improving their abilities.

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