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Mathematical Disposition of Students in Open-Ended Learning Based on Ethnomathematics

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ABSTRAK

Rendahnya disposisi matematika pada siswa menyebabkan siswa memandang matematika sebagai hal yang sulit untuk dipahami sehingga memengaruhi hasil belajar matematika. Tidak banyak siswa yang aktif karena kurang percaya diri, kurang minat belajar matematika, dan kurang rasa ingin tahu tentang matematika. Hal ini berdampak pada hasil belajar matematika yang rendah. Penelitian ini bertujuan untuk menguji peningkatan disposisi matematis siswa yang mengikuti pembelajaran open-ended berbasis etnomatematika dan mengetahui pengaruh disposisi matematis terhadap kemampuan matematis siswa. Penelitian kuantitatif ini mengacu pada one-group pretest-posttest design. Teknik pengumpulan data dalam penelitian ini menggunakan teknik nontes dan tes. Instrumen yang digunakan yaitu angket untuk mengukur disposisi matematis siswa dan soal tes untuk mengukur kemampuan matematis siswa. Teknik analisis data yang digunakan yaitu uji gain dan analisis regresi. Hasil penelitian ini menunjukkan bahwa disposisi matematis siswa yang mengikuti pembelajaran open-ended berbasis etnomatematika meningkat sebesar 47% yang berarti masuk dalam kategori sedang dan disposisi matematis memengaruhi kemampuan matematis siswa melalui penerapan pembelajaran open-ended berbasis etnomatematika sebesar 57,9%. Simpulan penelitian ini adalah pembelajaran open-ended berbasis etnomatematika dapat digunakan untuk meningkatkan disposisi matematis siswa. Implikasi penelitian ini yaitu pembelajaran open-ended berbasis etnomatematika dapat digunakan oleh guru untuk meningkatkan disposisi matematis siswa.

ABSTRACT

Students' low disposition in mathematics causes students to view mathematics as difficult to understand, thus affecting mathematics learning outcomes. Not many students are active because they lack self-confidence, interest in learning mathematics, and curiosity about mathematics. This has an impact on low mathematics learning outcomes. This study aims to test the increase in the mathematical disposition of students who take part in open-ended learning based on ethnomathematics and determine the effect of mathematical disposition on students' mathematical abilities. This quantitative study refers to a one-group pretest-posttest design. Data collection techniques in this study used non-test and test techniques. The instruments used are questionnaires to measure students' mathematical dispositions and test questions to measure students' mathematical abilities. Data analysis techniques used are gain test and regression analysis. The results study indicates that the mathematical disposition of students who participate in open-ended learning based on ethnomathematics increased by 47%, which means that they are in the medium category and mathematical dispositions affect students' mathematical abilities through the application of open-ended questions learning based on ethnomathematics by 57.9%. It is concluded that ethnomathematics-based open-ended learning can improve students' mathematical disposition. This research is that teachers can use open-ended learning based on ethnomathematics to improve students' mathematical dispositions.

1. INTRODUCTION

Mathematical disposition is one of the affective domains that play an important role in mathematics learning (Wada et al., 2020; Yaniawati et al., 2019). Disposition is a belief or tendency that drives someone to behave (Areepattamannil et al., 2015; Kezer & Turker, 2012). Mathematical disposition is needed by students so that they are able and persistent in solving problems, can like mathematics, and can learn with full responsibility. By integrating disposition into mathematics learning, it is hoped that the ability of mathematical representation will also increase (Ayyildiz & Yilmaz, 2021; Noisel et al., 2014). This is consistent with the opinion of experts who state that the mathematical disposition of students influences the success of students' mathematics learning.

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In addition to mathematical ability as a component of knowledge, mathematical disposition as one of the social competencies also needs to be developed in mathematics learning.

The importance of dispositional abilities is not in line with the current condition of students' affective abilities. The low disposition of mathematics in students causes students to view mathematics as difficult to understand so that it affects the learning outcomes of mathematics. This is shown from the results of the 2015 TIMSS report, namely attitudes towards mathematics. The results regarding attitudes towards mathematics show that Indonesian students who like mathematics are still below the international average (Rajagukguk & Simanjuntak, 2015; Setiyani et al., 2020). Previous studies examining the origins of negative mathematical dispositions have found correlations with a variety of other undesirable math learning outcomes, including math achievement and adverse math behavior (Areepattamannil et al., 2016; Crollen et al., 2020). The low mathematical disposition is also due to the lack of teacher attention to mathematical dispositions. Problems also occur in SD 1 Muhammadiyah Kudus. SD Muhammadiyah 1 Kudus is one of the schools in Kudus Regency, Indonesia. Based on information from one elementary mathematics teacher, the learning done by the teacher has not been able to make students active and students tend to get bored easily. Not many students are active because of a lack of confidence, lack of interest in learning mathematics, and lack of curiosity about mathematics. This indicates that the mathematical disposition of students is low so that it affects the learning outcomes of mathematics. The results of the expert's study concluded that this happened because the students' mathematical disposition had negatively affected the performance in doing mathematical tasks. When learning, teachers never associate mathematics with the local culture. Many teachers have difficulty connecting local culture with the subject matter (Suardana et al., 2018; Yemi, 2018; Yuniarti & Radia, 2020). Traditional teaching methods often lead to negative mathematical dispositions of students because of the tendency to: (a) give each student the same problem, (b) teach by teaching from textbooks, (c) insist on only one way to solve the problem, (d) ignore real-world applications, (e) emphasizing memorization and repetition, and (f) primarily aimed at improving scores on standardized multiple-choice tests.

Therefore, learning is needed that can create situations real student learning and make it easier for students to understand the concept as a whole. One approach that helps them to use logic and evidence on the patterns of thought and express ideas-creative ideas is the approach of open ended (Rustyani et al., 2019). Open-ended learning can be used as an alternative to changing the paradigms of mathematics learning that have occurred so far by getting students to learn actively, creatively, and fun so that student learning outcomes in mathematics are optimal (Becerra et al., 2021; Oliveira et al., 2021). Open-ended learning can give students the opportunity to gain experience and knowledge in finding, understanding, and solving problems in several different ways (Balan et al., 2019; Jiang et al., 2018; Mahmoud et al., 2020). This constructivist learning will train students to develop different methods, ways, or approaches in an effort to get the right answer. The types of problems used in open-ended learning are non-routine and open problems (Fatah et al., 2016; Mourtgos & Adams, 2019). Openness is classified into three types, namely open processes, open-end products, and ways to develop openly (Hamid et al., 2013; Kaufhold et al., 2012).

In addition to applying an open-ended learning model, ethnomathematics-based mathematics learning is also seen as effective for improving students' mathematical abilities. Ethnomathematics is a practice of mathematics that is associated with culture (Cimen, 2014; Verner et al., 2019). Ethnomathematics learning will provide direct experience for students by learning culture related to mathematical concepts (Rahayu et al., 2019; Verner et al., 2019; Waziri et al., 2010). Such learning will make students play an active role during learning and learning becomes meaningful. Thus, ethnomathematics learning is more effective in improving mathematics learning outcomes (Unodiaku & Sochima, 2013).

The results of previous studies concluded that open-ended learning had a positive influence on improving mathematics learning outcomes (Capraro et al., 2012; Wahyuni et al., 2013). In addition, learning with an open-ended approach can create learning activities in mathematics (Sari et al., 2016; Suwito, 2015). This will make students actively involved in learning so that it will have an impact on increasing positive mathematical disposition. In open-ended learning, students can be given questions or problems that require open thinking. Open questions can be used as an alternative to developing students' mathematical thinking skills and dispositions (Hafidzah et al., 2019; Setiyani et al., 2020; Sukmadewi, 2014). Based on previous research, open-ended learning that is associated with contextual situations in ethnomathematics namely the local superiority of Kudus is expected to improve students' mathematical disposition. Based on the background that has been described, the objectives in this study are: to test the increase in the mathematical disposition of students who receive open-ended learning based on ethnomathematics and to test the effect of mathematical disposition on students' mathematical abilities.

2. METHOD

The study took a case that occurred in Kudus, Indonesia. The population of this research is 78 third grade students of SD 1 Muhammadiyah Kudus, Indonesia. The random sampling technique obtained 27 research samples of grade III students. The quantitative research design used was a one-group pretest-posttest design experimental study. In this design, there is a pretest before being given treatment. Research subjects are not grouped randomly because the research conducted is adjusted to the situation and conditions in the field. Before being given treatment, students are given a pretest to measure mathematical disposition through a questionnaire.

The independent variable in this study is a mathematical disposition, while the dependent variable is mathematical ability. The instruments in this study were questionnaires and test questions. Questionnaires are used to measure students 'mathematical disposition. There are 7 indicators used in the mathematical disposition questionnaire, including: (1) confident in using mathematics, (2) flexible in doing mathematical work (mathematics), (3) persistent and tenacious in doing mathematical tasks, (4) having curiosity in mathematics, (5) reflecting on their own way of thinking and performance in learning mathematics, (6) appreciating the application of mathematics, and (7) appreciating the role of mathematics/opinions about mathematics. There are 21 items of the mathematical disposition questionnaire used. The description test questions are used to measure students' mathematical abilities. There are 10 mathematics test questions on the Perimeter and Area of Square and Rectangle material that students must complete. The mathematical ability test questions use indicators of mathematical representation abilities which include visual, symbolic, and verbal representations.

The research instrument was tested for validation by 3 mathematics learning experts. The results of expert validation showed that the disposition questionnaire and test questions on mathematical ability were very good criteria (Ulya & Rahayu, 2018). Data collection techniques in this study used non-test and test techniques. Non-test techniques use a questionnaire to measure students 'mathematical disposition and test techniques use test questions to measure students' mathematical abilities. In this study, the gain test is used to test the increase in the mathematical disposition of students who participate in open-ended learning based on ethnomathematics. The influence test is used to determine the effect of mathematical disposition on students' mathematical abilities. To do the effect test a simple linear regression formula is used.

3. RESULT AND DISCUSSION

Result

Increasing students' mathematical disposition before and after receiving open-ended learning based on ethnomathematics can be known through the gain test. Calculation of increasing mathematical disposition before and after treatment is given using the gain formula by calculating the difference between the post-test value and the pretest value, then the results are divided by the difference between the maximum value and the pretest value. A summary of the results of increasing students' mathematical dispositions individually using the gain. There are similarities in the number of students who experience an increase in mathematical disposition on the criteria of low and medium, namely 9 students (39.13%). This means that the increase in students' mathematical disposition is at least at a high level, amounting to 21.74% or only 5 students. The mean increase in students' mathematical disposition classically reaches 0.47 or 47%. This shows that the average increase in students' mathematical disposition classically fits into the medium criteria. Based on the gain test it is concluded that the mathematical disposition of students increases through the application of ethnomathematics based open-ended learning.

The effect of mathematical disposition on the mathematical representation ability of students can be tested through regression tests. This influence test uses a simple linear regression test because there is only one dependent variable (student's mathematical ability data) and one independent variable (mathematical disposition). This regression analysis was carried out with the help of SPSS. The first step in the regression test is to determine the regression equation. Based on the SPSS output, the regression equation $Y = 9{,}6 + 0{,}887X$. The second stage is to test the linearity of the regression equation. The hypothesis proposed is $H_0: b = 0$, meaning that the equation is non-linear or there is no significant influence between mathematical disposition (X) and students' mathematical abilities (Y), while $H_1: b \neq 0$, meaning that the equation is linear or there is a significant influence significant between mathematical disposition (X) and students' mathematical abilities (Y). The hypothesis testing criteria, namely H_0, are rejected if the significance value in the Sig. (2-tailed) less than 0.05. The results are obtained that the significance value is 0,000. This shows that the significance value is less than 0.05, so H_0 is rejected. So it was concluded that there was a significant influence between mathematical disposition and students mathematical abilities. Because there is a significant influence, the analysis continues to see the magnitude of the effect between mathematical disposition and mathematical abilities of students. The coefficient of determination (R square) obtained is 0.579, or $R^2 = 0{,}579 = 57{,}9\%$. This value indicates that 57.9% of students' mathematical ability is influenced by mathematical disposition through linear relationships

while 42.1% is influenced by other factors. Based on the regression analysis, it was concluded that disposition influences students' mathematical abilities through the application of ethnomathematics-based open-ended learning.

Discussion

In this study resulted that the mathematical disposition of students increased and affected students' mathematical abilities. The mathematical disposition of students increases through the application of ethnomathematics based open-ended learning. Students' mathematical disposition increases because students find their learning interesting and fun. In learning mathematics students are invited to learn mathematics that is associated with culture. This is in line that students will more easily understand the material and feel familiar with what is being learned (Fatah et al., 2016; Li et al., 2021; Rahayu et al., 2018). Students become confident in learning mathematics and know the role of mathematics in real life (Bicer et al., 2021; Fathollahzadeh et al., 2021). This causes the students' mathematical disposition to increase. Students' mathematical dispositions related to beliefs and attitudes towards mathematics are as important as their ability or knowledge to make decisions in everyday life (Areepattamannil et al., 2015; Wada et al., 2020). Disposition is one important factor that can affect mathematics learning outcomes. Disposition can be seen through attitudes and actions in solving mathematical problems. Disposition is a tendency to act consciously, regularly, and voluntarily in achieving goals (Crollen et al., 2020; Noisel et al., 2014). The same thing was also conveyed by NCTM which stated that there were seven indicators of mathematical disposition including self-confidence, flexible thinking, persistent and resilient, curiosity, reflection on systematics think, appreciate the application of mathematics, and appreciate the role of mathematics.

In the second statistical test, it was found that there was a significant influence between the mathematical disposition and mathematical abilities of students. This means that students 'mathematical disposition affects students' mathematical abilities. If students 'mathematical disposition increases, students' mathematical abilities will increase. Students' mathematical abilities are not only useful for themselves but are also needed to facilitate further mathematics learning (Bayles et al., 2021; Nugroho et al., 2018; Ulya et al., 2019). One of the characteristics of students who have a mathematical disposition is that they are involved in activities with reflective skepticism. Skeptics can encourage students to reflect so that they produce correct conclusions and make appropriate solutions (Nugroho et al., 2018; Setiawan & Ari Oka, 2020). The teacher must be able to create learning that is able to foster self-confidence, flexible thinking, persistent and tenacious attitudes, curiosity, reflection on systematic thinking, an attitude of respecting mathematical applications, and an attitude of appreciating the role of mathematics in students so that the mathematical disposition of students increases (Nurhusain, 2017; Öztürk et al., 2020). The teacher must work hard to be able to develop students' mathematical dispositions. This is due to the mathematical disposition of students already formed at the beginning of learning mathematics, so it takes hard work to change it later on (Nugroho et al., 2018; Sukmadewi, 2014).

Open-ended learning which is one type of cooperative learning can have a positive effect on student mathematics learning outcomes (Alman, 2017; Becerra et al., 2021). In implementing ethnomathematics based open-ended learning, open situations or problems are always given so that students have broad knowledge and are open-minded. Also included in the assessment of learning. The teacher measures the mathematical abilities of students using open-ended and ethnomatemically charged questions. This is intended so that students more easily understand the problems given. Through ethnomathematics, students will more easily understand mathematical problems because they relate to the environment and everyday life (Cimen, 2014; Verner et al., 2019). Besides that local culture is suitable to improve students' mathematical abilities (Demitra & Sarjoko, 2018). This research contributes to improving students' mathematical disposition through open-ended learning based on ethnomathematics. Furthermore, this study has limitations that the application of this learning cannot be applied during the pandemic. If this learning is carried out remotely, then it is done face-to-face so that teachers can interact directly with students. This can be used for further research to carry out open learning based on ethnomathematics boldly to improve students' mathematical disposition.

4. CONCLUSION

It is concluded that ethnomathematics-based open-ended learning can be used to improve students' mathematical dispositions. In addition, the positive mathematical disposition of students will affect students' mathematical abilities. it is recommended for teachers to apply ethnomathematical-based learning so that it can help students in learning mathematics.

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