

Mathematical Disposition and The Impact of Learning Cycle 7E on Problem-Solving Skills in Mathematics

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Abstract

The ability of Indonesian students to solve mathematical problems remains moderately low, according to PISA 2022 results. Even the desire and interest to learn mathematics are still relatively low. Hence, this study will determine the impact of the Learning Cycle 7E acquiring model on problem-solving abilities in relation to understudies' mathematical disposition. The procedure used in this assessment is quantitative. A quasi-experimental design was used for this study. The order picked in this experiment is the One Group Pretest-Posttest. The testing design in this review was a cluster random sampling method and got 31 students of 10th class SMAN 3 Kota Kediri. The data assortment process utilized a mathematical disposition survey and a trial of problem-solving abilities. In testing the hypothesis, the Wilcoxon Test result is $0.000 < 0.05$ which shows that the Learning Cycle 7E learning model has an effect on students' mathematical problem-solving ability, and the Kruskal-Wallis Test result is $0.972 > 0.05$ which shows that there is no difference in mathematical problem-solving ability between students with high, medium, and low mathematical disposition. So, the result of this study is that the 7E Learning Cycle learning model altogether influences problem-solving abilities and is powerful for all understudies' mathematical disposition levels.

Keywords: *Problem-Solving Abilities, Learning Cycle 7e, Mathematical Disposition*

INTRODUCTION

Mathematics is essential because this science underlies the improvement of every cutting-edge innovation today, plays a vital role in various fields, and can develop human reasoning. Therefore, mathematics is one of today's most important subjects (Fadillah et al., 2022). According to Permendiknas number 22 of 2006, mathematics should be studied at every level of Indonesian education (Saputra, 2022). According to Abdurrahman in Putri (2020), there are five reasons why mathematics should be studied, specifically because mathematics is a means to think logically and reliably, a method for seeing examples of relationships and speculation of involvement, a means of method for dealing with problems in everyday life, a means of increasing awareness in cultural development, also a means of developing creativity.

According to the National Council of Teachers of Mathematics, learning mathematics aims to normalize and divide basic math skills into five categories: critical thinking, thinking and verification, correspondence, association, and portrayal (Izzatin et al., 2021). In the meantime, the goals of learning mathematics referenced by the Service of Schooling and Culture 2013 include: (1) work on intellectual abilities, (2) further develop critical thinking abilities, (3) further develop learning results, (4) train correspondence, and (5) develop student character (Susriyati & Yurida, 2019). Thus, Sumarmo expressed that the capacity to tackle math issues, or the "heart of math", is vital in learning math (Putri, 2020).

As indicated by Gagne, problem-solving is the most common way of joining different ideas, rules, or equations to tackle other issues (Izzatin et al., 2021). Accordingly, mathematical problem-solving abilities are vital for understudies. However, in field practice, understudies'

problem-solving skills are still low (Azizah & Fadlikah, 2023). A few variables make math be considered troublesome, in particular, the qualities of numerical material, which is abstract, coherent, methodical, brimming with images and equations that are confounding, and the experience of learning science with teachers who are not lovely likewise add to understudies' negative mentalities towards math illustrations (Marhamah, 2018). In addition, students' interest and motivation in liking math is still low, making students think that math is difficult (Claudia et al., 2021).

According to the PISA 2022 survey findings, Indonesia's mathematics scores decreased compared to the 2018 PISA results. From the PISA 2018 and 2022 outcomes, initially, successful understudies became more vulnerable, while execution did not change fundamentally among low achievers. In Indonesia, the typical score in math was 366 out of an OECD normal of 575, and 18% of students achieved Level 2 proficiency in math, which is below the normal rate of 69% overall. The typical presentation on each numerical course of Indonesian understudies in every indicator tried: the average of "formulating" is 362 (OECD average: 469); the average of "employing" is 365 (OECD average: 472); the average of "interpreting" is 363 (OECD average: 474); and the average of "reasoning" is 354 (OECD average: 473). No Indonesian understudies succeed in math, which implies they arrive at level 5 or 6 on the PISA test. In Indonesia, approximately 25% of students report being unable to study most or all lessons, and 24% do not notice what the teacher says. (OECD, 2023a, 2023b).

Based on that description, one can conclude that Indonesian students' weak mathematical problem-solving skills on non-routine or high-level problems are one reason for their low achievement in PISA 2022. PISA test questions comprise 6 levels: level 1 is the most reduced, and level 6 is the most elevated. All of the PISA-tested questions deal with contextual problems that are taken from everyday life. Indonesian students, on the other hand, are only familiar with level 1 and level 2 routine problems. As a result, it is safe to conclude that Indonesian students' ability to solve mathematical problems remains relatively low (Pertiwi et al., 2022).

One method for further developing math question-settling abilities is cultivating self-assurance, interest, constancy, and an uplifting outlook in tolerating math learning in understudies. This is alluded to as an affective aspect. Aspects like developing self-assurance, interest, diligence, and an uplifting outlook in tolerating science learning are contained in the signs of mathematical disposition, which is full of affective aspects. Mathematical disposition can be supposed to be understudies' faith in the worth and helpfulness of math, where understudies are certain about their mentalities, capacities, and self-personality toward learning math (An et al., 2015). Kilpatrick, Swafford, and Findel portray that mathematical disposition as a demeanor of understudies who will, by and large, view math as something that can be learned and gives many benefits, so understudies have the tendency or maintain that they should do mathematical activities without any other person (A. Fadillah et al., 2020). So it tends to be reasoned that mathematical disposition is a student's deeply felt conviction and endless interest in math, which includes uplifting outlooks including interest, steadiness, diligence, energy for learning, adaptability, social communication, and reflection which makes understudies view math as something that can be learned and gives benefits so understudies want to do math exercises freely.

In Yustiana et al. (2021), Sumarsono says that the following are indicators of a mathematical disposition: (a) confidence in using mathematics to solve any problems; (b) flexibility in investigating mathematical ideas; (c) persistence in doing mathematical tasks; (d) have interest, curiosity, and inventiveness in completing mathematical tasks; (e) tend to reflect on their reasoning; (f) apply mathematics to other situations in other mathematical subjects. With this uplifting outlook toward math attitude, it is normal for understudies' mathematical problem-solving abilities to work considerably more.

It is not easy for a teacher to improve or even foster the positive nature of a student's mathematical disposition (Fitri & Hasyim, 2018). Not to mention if the teacher's learning model in the classroom still uses a conventional model where conventional learning is centered on the teacher who controls most of the learning so that students cannot argue if there are things that they want to ask related to the material contained in the student book (Superni et al., 2018). Therefore, it is necessary to have a teaching and learning process that places students at the center of the learning process or is student-centered (Putri, 2020). One learning model that prioritizes or orientates students is Learning Cycle 7E.

Marhaeni, in Superni et al. (2018), states that a learning model is a type of learning outlined in the educational experience that the educator normally presents in class. The Learning Cycle model was created by Eisenkraft in 2003. Ergin et al. expressed that The Learning Cycle learning model is a constructivist model that teaches new ideas or a profound comprehension of a known idea (Setiawan et al., 2015). The Learning Cycle has been shown to have a positive effect on math-solving skills in some studies. One is research conducted by Susanti (2016), which demonstrated that students' mathematical solution skills can be influenced and enhanced by utilizing the Learning Cycle 7E learning model. In research conducted by Putri (2020) also revealed that the Learning Cycle 7E learning model was able to significantly improve students' mathematical problem-solving skills. This is also supported by research from Putri Utami et al. (2022) and Maulani (2022) which suggests that student-centered learning models such as the Learning Cycle learning model are very important to apply in the learning process to support learning outcomes and be able to improve students' mathematical problem-solving skills.

Some of these issues will be studied to see if the Learning Cycle 7E learning model has an effect on students' mathematical problem-solving abilities and if there are differences between students with high, medium, and low mathematical dispositions.

RESEARCH METHODS

The approach used in this research is quantitative. The research technique used is a quasi-experimental design. A quasi-experimental design is the use of methods and procedures to make observations in a study that is structured similarly to an experiment, but the conditions and experiences of the participants do not have control because this study does not have randomization, including pre-existing factors or do not include comparison/control groups (Creswell & Creswell, 2022). The category chosen in this quasi-experimental design is One Group Pretest-Posttest Design. The research was conducted in one of the senior high schools in Kediri City, namely SMAN 3 Kota Kediri 10th Class. The population of this research were all understudies of the tenth Class of SMAN 3 Kediri City. The sampling technique chosen in this research was cluster random sampling. The cluster random sampling technique is a limited random sampling technique, namely sampling that is not from all population areas (Rukmana, 2019). After the cluster random sampling technique was carried out on all 12 10th Class SMAN 3 Kota Kediri classes, 31 students from Class X-3 were obtained.

Before being treated, a pre-test will be given. Then, the experimental class is given treatment, namely the Learning Cycle 7E learning model on the material of Trigonometric Comparison in Right-angled triangles. After being treated, the class will be given a post-test. After the post-test, the class will be given a mathematical disposition questionnaire as a Google Form link. The following is a model of this research design:

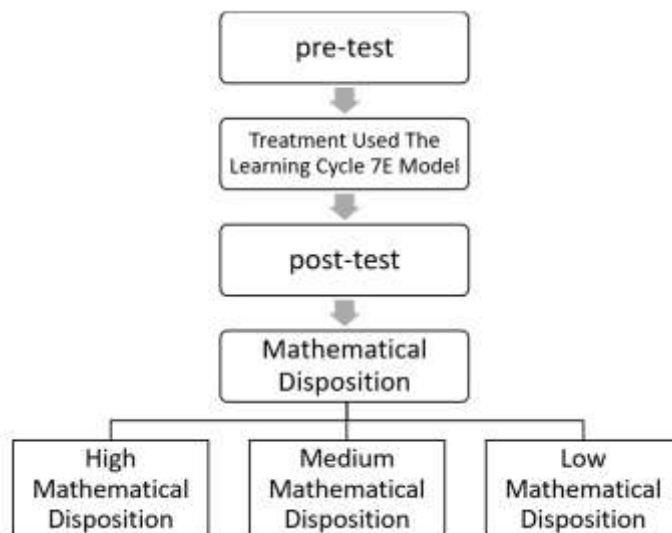


Figure 1. Research Design

The research data collection instruments were the Problem-Solving Ability Test Questions and the Mathematical Disposition Questionnaire. The problem-solving ability test consists of 2 description questions, while the student mathematical disposition questionnaire consists of 7 indicators with 26 statements. The mathematical disposition questionnaire uses a 5 Likert scale with alternative answers STS (Strongly Disagree), TS (Disagree), R (Undecided), S (Agree), and SS (Strongly agree). The study converted mathematical disposition data into an interval scale by categorizing mathematical disposition data into high, medium, and low categories. The following is the calculation of mathematical disposition data intervals through the table below:

Table 1. Mathematical Disposition Data Categorization

Value Interval	Category
Mean + Std. Deviation < X	High
Mean + Std. Deviation ≥ X ≥ mean – Std. Deviation	Medium
Mean – Std. Deviation > X	Low

Source: Lestari & Yudhanegara (2015)

After the results of the pre-test and post-test data were obtained, the N-Gain Test was conducted to determine the results of the increase in students' mathematical problem-solving skills that occurred (high/medium/low). The N-Gain formula is as follows (Lestari & Yudhanegara, 2015):

$$N - Gain = \frac{\text{posttest score} - \text{pretest score}}{\text{ideal score} - \text{pretest score}}$$

The following is the category of the acquisition of the N-Gain value of pre-test and post-test data:

Table 2. Gain Score Criteria

Gain Score	Criteria
$1,0 \geq G \geq 0,7$	High
$0,3 \leq G < 0,7$	Medium
$0,0 \leq G < 0,3$	Low

Source: Lestari & Yudhanegara 2015)

Then, the prerequisite test was carried out, namely the normality test on the data from the mathematical problem-solving ability test results and the mathematical disposition questionnaire. This normality test uses the Shapiro-Wilk Test because the number of respondents is not more than 50 (Lestari & Yudhanegara, 2015). Data normality test decisions are based on: (1) If the Sig. Value > 0,05, then the data is normally distributed, and (2) If the Sig. Value < 0,05,

then the data is not normally distributed. Non-parametric tests are used for hypothesis testing if the data are not typically distributed. Parametric tests are used for hypothesis testing when the data are normally distributed.

RESULT AND DISCUSSION

Based on the research that has been conducted, the results of the pre-test and post-test scores on the aspects of mathematical problem-solving obtained the minimum, maximum, mean, and std. deviation values. The information is introduced in Table 1 below:

Table 3. Descriptive Analysis of Test Instruments

	N	Minimum	Maximum	Mean	Std. Deviation
Pre-test	31	16,67	70,83	35,08	11,12
Post-test	31	54,17	100	75,40	14,69

The research data in Table 1 shows the mean results of students' pre-test and post-test scores. Data from students' pre-test results before applying the Learning Cycle 7E model was recorded at 35,08 in the Trigonometric Comparison of Right Triangles material, with 16,67 as the minimum value and 70,83 as the maximum value. However, after participating in learning with the Learning Cycle 7E learning model, the mean student post-test score jumped significantly to 75,40, with a minimum score of 54,17 and a maximum score of 100. This shows a mean increase of 40,32 points. This means students experience increased grades on Trigonometric Comparison Material in Right Triangles after applying the Learning Cycle 7E learning model. The results of the N-Gain test also confirm this.

Table 4. N-Gain Test Result

Gain Score	Criteria
0,62	Medium

Based on Table 4. Above, based on the Gain score criteria in Table 2, the score of 0,62 is in the interval $0,3 \leq G < 0,7$ With a Medium criteria. This means improving students' math problem-solving skills in the medium criteria.

The data obtained from the mathematical disposition results are then categorized in accordance with Table 1. From this acquisition, 5 students with high mathematical dispositions, 22 with medium mathematical dispositions, and 4 with low mathematical dispositions were obtained. Furthermore, grouping the level of mathematical disposition based on the post-test score obtained:

Table 5. Mean Test Results of Students' Math Problem-Solving Ability Based on Grouping of Mathematical Disposition Levels

Mathematical Disposition	Statistics	Post-test
High	N	5
	Mean	74,17
Medium	N	22
	Mean	75,76
Low	N	4
	Mean	75,00
SUMMARY	N	31
	Mean	75,40

Based on the data in Table 5 above, with the total number of students at 31 and the overall post-test mean being 75.40, the mean value of students with high mathematical disposition is still below the overall mean value, and the mean value of students with low disposition. This shows that students with high mathematical dispositions do not necessarily have higher scores than students with low mathematical dispositions.

Then, the pre-test, post-test, and mathematical disposition questionnaire data were tested for normality. This normality test uses the Shapiro-Wilk test with the help of IBM SPSS Statistic Version 22, which obtained the following results:

Table 6. Normality Test Results

	Statistics	df	Sig.
Pre-test	.903	31	.009
Post-test	.925	31	.033
Mathematical Disposition	.970	31	.516

Based on the normality test results in Table 6 above, the significance value of the pre-test data is $0.009 < 0.05$, so the data is not normally distributed. Then, the post-test data obtained a significance value = $0.033 < 0.05$, so the data is not normally distributed. Then, the mathematical disposition data obtained a significance value = $0.516 > 0.05$, so the data is normally distributed. The hypothesis test that will be applied is a non-parametric test because the data are not normally distributed. The tests that will be done are the Wilcoxon and the Kruskal-Wallis tests.

The Wilcoxon test was first applied to determine the effect of The Learning Cycle 7E model on students' mathematical problem-solving. The hypothesis used is as follows:

H_0 : Learning Cycle 7E learning model does not affect students' mathematical problem-solving ability

H_1 : Learning Cycle 7E learning model affects students' mathematical problem-solving ability

The criteria for hypothesis testing are: (1) If Asymp. Sig. (1-tailed) $> 0,05$, then H_0 is accepted, and (2) If Asymp. Sig. (1-tailed) $< 0,05$, then H_0 is rejected. The results of the Wilcoxon Test can be seen in the following table:

Table 7. The Results of The Wilcoxon Test

	Posttest – Pretest
Z	-4.864
Asymp. Sig. (1-tailed)	.000

Table 7 of the Wilcoxon Test results above shows that the Asymp. Sig. (1-tailed) value obtained by the experimental class pretest and post-test data is $0.000 < 0.05$. Therefore, H_1 is accepted. The Learning Cycle 7E learning model influences understudies' math problem-solving abilities. Then, in light of the consequences of the past N-Gain Test, which expresses that there is an expansion in understudies' math-solving ability to think, it very well may be reasoned that the Learning Cycle 7E Learning Model has an impact in further developing understudies' math problem-solving ability to think.

Besides, The Kruskal-Wallis test was utilized to decide the qualification in math problem-solving abilities of students with high, medium, and low mathematical dispositions. The following is the hypothesis tested:

H_0 : There is no difference in problem-solving ability between students with high, medium, and low mathematical disposition

H_1 : There is a difference in problem-solving ability between students with high, medium, and low mathematical disposition

The criteria for hypothesis testing are: (1) If Asymp. Sig. $> 0,05$, then H_0 is accepted, and (2) If Asymp. Sig. $< 0,05$, then H_0 is rejected. The analysis's findings are presented in Table 8 below:

Table 8. Kruskal-Wallis Test Results

	Math. Problem-Solving
Chi-Square	.056
df	2
Asymp. Sig.	.972

In The Kruskal-Wallis Test in Table 8 above, The resulting Asymp. Sig. is $0,972 > 0,05$, so H_0 is accepted. Therefore, it is possible to draw the conclusion that students with high, medium, or low mathematical dispositions do not differ in their ability to solve problems. This is also supported by the grouping of mathematical disposition levels in Table 5, which is based on the post-test results and states that students with high mathematical disposition scores are not always better than students with moderate or low mathematical disposition.

CONCLUSION

With the acquisition of the Wilcoxon Test of $0.000 < 0.05$ which shows that the Learning Cycle 7E learning model affects students' mathematical problem-solving skills and the acquisition of the Kruskal-Wallis Test of $0.972 > 0.05$ which shows that there is no difference in mathematical problem-solving skills between students who have low, medium, and high mathematical dispositions results in an important conclusion: the Learning Cycle 7E learning model improved students' ability to solve math problems at all levels of mathematical disposition. This finding shows that the Learning Cycle 7E learning model is general and can be applied actually to all understudies, no matter what their mathematical disposition level. This is uplifting news for teachers, as it shows that the Learning Cycle 7E learning model can be a fitting answer for further developing Math Problem-solving abilities for all understudies, regardless. The viability of the Learning Cycle 7E model can be ascribed to a few elements. First and foremost, this model places an emphasis on student-centered learning, in which students actively participate in learning and create their own knowledge. Second, this model gives students a variety of chances to solve real-world, difficult mathematical problems. Third, it urges understudies to team up and take care of numerical statements. Fourth, it gives students helpful advice on how to solve problems. Fifthly, it fosters a supportive and upbeat learning environment in which students are encouraged to take chances and make mistakes. In general, this study provides solid evidence that the Learning Cycle 7E model is an efficient method for enhancing the mathematical problem-solving abilities of students at all mathematical disposition levels. In order to enhance the quality of mathematics education, this model ought to be considered for widespread implementation in schools.

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