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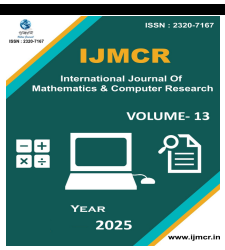

The Effectiveness of the Realistic Mathematics Education (RME) Approach Assisted by Monopoly Games in Terms of Students' Mathematical Literacy and Mathematical Resilience

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ABSTRACT

Realistic Mathematics Education (RME) is a mathematics learning approach that relates mathematical concepts to real-life situations or students' daily experiences. Mathematical literacy is the ability of students to formulate, apply, and interpret mathematics in various contexts of life that enable them to play an effective role in society. Mathematical resilience is the ability of students to persevere, remain motivated, and be persistent in facing challenges or difficulties that arise during the mathematics learning process. This study aims to analyze the effectiveness of the Monopoly game-based Realistic Mathematics Education (RME) approach on students' mathematical literacy skills. The method used was a pre-experimental design with a one-group pretest-posttest design. The research sample consisted of 30 students from a particular class selected at random. Before the treatment, students were given a pretest to measure their mathematical literacy skills. Students were taught using the Monopoly game-based RME approach during four meetings. After the intervention, students were given a final test to evaluate the improvement in their mathematical literacy skills. The results of the study concluded that the Monopoly-based Realistic Mathematics Education (RME) approach was effective in terms of mathematical literacy skills, as seen from the N-gain score of 58.93% in the moderate category.

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KEYWORDS: The Effectiveness of Monopoly Games, Mathematical Literacy Skills, Mathematical Resilience, Realistic Mathematics Education.

INTRODUCTION

Education is a conscious and planned effort to realize the learning process so that students are active in developing their potential, such as self-development, intelligence, personality, noble character, skills, and religious and social skills. develop their potential, such as self-development, intelligence, personality, noble character, skills, and religious spirituality, as well as skills within themselves, and in society or the state (Zahro & Purwaningsih, 2018). In life, there is one important component that must be fulfilled, namely education. To create high-quality human resources, every human being must first receive an education, because in any situation, education must continue to be implemented. With this in mind, teachers and students must work together to create a pleasant learning atmosphere so that learning can continue to take place (Meilinda, 2022).

Rahmadhani (2023) also said that education plays an important role in helping to develop knowledge and skills in dealing with information and communication technology. Therefore, the world of education is expected to be able to adapt wisely to technological developments in order to improve the quality of education, especially in the learning process. Today, all aspects of life are related to mathematics.The philosophy of mathematics education is a reflective thought containing things related to mathematics education, by understanding the components in mathematics education, such as 1) mathematics subject matter, 2) students learning about mathematics, 3) schools as places of learning, and teachers who are tasked with “teaching”, and 4) the school environment (Maghfiroh et al., 2021). Then the components mentioned must be interrelated with one another. As we know, mathematics education always undergoes changes in teaching methods and undergoes changes in its meaning.

Mathematics is one of the subjects that is considered unique and forms the basis of the curriculum because mathematics is a reference for the development of other subjects. Mathematics education is provided at the early stage of entering school, namely “elementary school,” in order to provide children with the functional numerical skills that will be needed by a child throughout his or her life as he or she enters adulthood. This is done to provide a foundation for further study at the next level of education, namely secondary education. throughout their lives as they reach adulthood. This is done to provide a foundation for further study at the next levels of education, namely junior high school, senior high

school, and higher education. Because every aspect of our lives always involves mathematics, so that students can apply mathematics in their future lives and in the world of work. Not only that, by studying mathematics, a person will become accustomed to thinking logically and critically, and can increase their confidence and creativity (Ikhsan, 2019). Mathematics is also an important part of education throughout the world, but it is also said to be a discipline that can cause anxiety in those who study it (Arslan et al., 2015).

Mathematics is a compulsory subject that must be taught in education from elementary school to university level. In countries, schools that follow the national curriculum that has been established require children to learn about numerical functions, namely (subtraction, addition, division, and multiplication) as well as geometry, fractions, and measurement for 6 years from the time they first enter school (Putwain & Wood, 2023). The purpose of mathematics education is to train students to think critically, logically, analytically, creatively, and systematically, so that students are expected to be able to work together effectively to process, discover, and utilize the information they have obtained so that problems in daily life can be solved (Dina Julya, 2022). Therefore, mathematics is referred to as a science that has many principles and concepts within it. It should be noted that mathematics has a tendency to cover emotions, motivation, beliefs, and values with a very broad scope. Specifically, the fear triggered by mathematics is identified as a factor in low motivation, avoidance of mathematics, and low student achievement.

By studying mathematics consciously and intentionally, one will gain direct or indirect knowledge from the environment, which will provide an experience and then bring about a change in one's behavior (Aan Putra, 2021). The fact that mathematics plays an important role in daily life, yet most students still dislike the subject of mathematics and consider it difficult and frightening.

Thus, one of the factors that is considered to contribute to the low achievement of Indonesian students in mathematics is their lack of mathematical literacy skills. One important aspect of mathematics learning is mathematical literacy skills. According to Jailani et al., (2020), mathematical literacy skills are one of the student competencies that are still an issue internationally. Mathematical literacy is the ability of individuals to apply, formulate, and interpret mathematics in solving problems in everyday life (Ramadhan et al., 2023). Mathematical literacy does not only include mastery of concepts, but also the ability to use mathematical reasoning in solving problems in the real world.

There are three words in mathematics, namely "formulating," "interpreting," and " working," which are a meaningful structure for each individual in connecting the context of mathematical problems (Apriandi et al., 2020). Mathematical literacy refers to a person's ability to use and understand mathematics in everyday life. Students who have high mathematical literacy facing challenges in life today. This is because individuals who have high mathematical literacy can predict, interpret data, communicate effectively using mathematics, and solve everyday problems. Maysarah et al., (2023) state that students' mathematical literacy skills refer to the ability to reason mathematically in accordance with concepts and procedures and refer to the use of mathematics in real-world contexts.

In addition to mathematical literacy, mathematical resilience is also an important factor in student success and can improve student achievement. Resilience is an individual process to achieve success by adapting even though a person is in a situation full of challenges and high risks with a frightening atmosphere. According to (Attami et al., 2020), mathematical resilience is the ability of high-quality students to face mathematics learning, such as students' belief in success through hard work, students' desire to discuss, research, and reflect, and students' attitudes that show strength in facing difficulties. to persevere and bounce back from difficulties in learning mathematics (Hutauruk & Priatna, 2017). In an era full of challenges and increasing complexity, mathematical resilience is increasingly important for every student to possess. Students with high resilience tend to be more persistent in facing difficult mathematical problems and, of course, have a positive attitude toward mathematics.

Resilience is a resilient attitude in positive attitudes, emotional reactions , and is useful for academic and social development challenges, such as the desire to try to find new strategies, find solutions to problems appropriately, and be able to make new contributions ('Athiyah et al., 2020). Mathematical resilience is considered important because it can be seen in mathematics learning when students experience obstacles, anxiety, and difficulties in facing mathematics learning, which results in students disliking mathematics (Wahyugi & Fatmariza, 2021).

Efforts to improve students' mathematical literacy and mathematical resilience require a learning approach that can relate mathematics to real life. Resilient Mathematics Education (RME) is an approach that emphasizes learning mathematics in contexts that are meaningful to students because RME views mathematics as a human activity that must be linked to reality. The Realistic Mathematics Education Education (RME) is a theory of teaching and learning mathematics that covers many things, including ideas about social constructivism, as well as ideas by Skemp (1978) related to relational and instrumental (Heuvel-Panhiuzen, 2019). According to Farah Ayyun Taqiya & Juandi, (2023) learning with the Realistic Mathematics Education (RME) approach will increase students' enthusiasm during the learning process so that students' mathematical literacy and mathematical resilience can improve.

The Realistic Mathematics Education (RME) approach is mathematics that emphasizes meaning in science as a human activity (Basuki & Wijaya, 2018). The RME approach also provides opportunities for students to broaden their knowledge (Cendekiawaty & Sugiman, 2020). By allowing students to imagine various situations presented in the form of questions, of course in mathematics that exist in everyday life that are close to the life of a student.

According to Farah Ayyun Taqiya & Juandi, (2023) learning with the Realistic Mathematics Education (RME) approach will increase student enthusiasm during the learning process so that students' mathematical literacy can improve. The basic principle of the Realistic Mathematics Education (RME) learning approach is that students must have the opportunity to review their mathematical ideas. Because the RME approach uses real-world contexts, the problems given in learning with the Realistic Mathematics Education approach certainly use contexts in everyday life (Farah Ayyun Taqiya & Juandi, 2023). Mathematics Education approach certainly use contexts from everyday life (Farah Ayyun Taqiya & Juandi, 2023).

Certainly, the characteristics of the RME approach can be used as fun learning by using the game of Monopoly. Monopoly is a game (board game) that can be played by two or more people. This game is designed to simulate investment activities in the form of purchasing, renting, and trading property using play money. The main objective of the Monopoly game is to become the richest player at the end of the game by buying, renting, and building as many properties

as possible and collecting rent from other players who land on properties you own.

The Monopoly board game can be used as an educational game in a learning approach and modified appropriately according to needs. By presenting lesson materials in the Monopoly box and including evaluations. The Monopoly game has many functions; it is not only a game, but can also be used as a medium for innovative learning by modifying it in an interesting way.

Previous research conducted by (Farah Ayyun Taqiya & Juandi, 2023) states that learning with a realistic mathematics education (RME) approach to mathematical literacy has improved and had a positive impact on students. The basic principle of the Realistic Mathematics Education (RME) learning approach is that students must be given the opportunity to review the mathematical ideas they have. Because the RME approach uses real-world contexts, the problems given in learning with the Realistic Mathematics Education approach Realistic Mathematics Education approach naturally use contexts from everyday life (Farah Ayyun Taqiya & Juandi, 2023).

Research conducted by (Setiawan et al., 2022) found that students' mathematical resilience affects mathematical literacy by 30.4%, which is related to mathematical resilience affecting students' mathematical literacy. Such as For example, research conducted by (Saleh et al., 2018) found that the RME approach can improve students' mathematical communication skills, which is an important aspect of mathematical literac.

However, there is still little research that examines the effectiveness of the RME approach based on the monopoly game in terms of students' mathematical literacy and mathematical resilience. The integration of the monopoly game in mathematics learning can provide a context that is close and meaningful to students. Based on this background, this study aims to examine the "Effectiveness of the Realistic Mathematics Education(RME) Approach Based on Monopoly Games in Terms of Students' Mathematical Literacy Abilities."

METHOD

The type of research used in this study is Pre-Experimental Design. The researcher used this type of research because there were time constraints on access to research subjects. Therefore, the researcher only wanted to see changes in one group before and after treatment, without
comparing it to a control group.

The research design is a One-Group Pretest-Posttest Design, which is a research design where one group is given treatment and then observed for results, eliminating the pretest given before treatment.

Table 1. One-Group Pretest-Posttest Design

Pretest	Treatment	Posttest
O_1	X	O_2

Description:
X: Treatment (independent variable)
$O1$: Pretest score before treatment
$O2$: Posttest score after treatment

This research was conducted in class VII of SMP Negeri 2 Depok in the 2024/2025 academic year. This research was conducted in the even semester, and the material tested was statistics (data centralization).

The population and sample in this study were seventh grade students at SMP Negeri 2 Depok in the 2024/2025 academic year. The population consisted of all seventh grade students, including classes VII A, B, C, and D. The sample in this study was class VII B at SMP Negeri 2 Depok. Depok. Sampling in this study used the Simple Random Sampling technique to select classes randomly without considering the strata in the population.

In this study using two categories of variables, namely independent variables and dependent variables. Independent variables are variables that influence or cause changes in other variables. These variables are independent, meaning that they do not depend on other variables in the study, but are factors that are manipulated or observed for their effects. The independent variable is the Realistic Mathematics Education (RME) approach assisted by the Monopoly game. Meanwhile, the dependent variable is a variable that is influenced or changed as a result of the manipulation of the independent variable. This variable is the result or effect measured in the study. The independent variable in this study is students' mathematical literacy skills.

To answer the research questions in this study, there are two The data required was students' mathematical literacy and mathematical resilience. The following are the data collection techniques and research instruments:

Data Collection Techniques

The data collection technique in this study was to administer tests and non-tests as follows:Test TechniqueThe data collection technique in this study was to administer tests. This study used test techniques on subjects to measure students' mathematical literacy skills. From the results of this test, the researcher hoped to obtain information on students who had good mathematical literacy, students who had moderate mathematical literacy, and students who had poor mathematical literacy. This test was created by the researcher to see the extent of mathematical literacy possessed by students after being taught using the Realistic Mathematics Education (RME) approach assisted by the monopoly game.

The mathematical literacy test can be used to collect pre-test and post-test data that has been given to the subjects. The pre-test is conducted to determine the initial abilities of students in the experimental class. Then, the post-test is given to determine whether the effectiveness criteria given in the experimental class are effective. The test used in this study consisted of five essay questions. This test was developed based on the following mathematical literacy indicators:

Table 2. Student Mathematical Literacy Indicators

No.	Indicators	Indicators Questions
1	Formulate	Write downinformation Create a mathematical model based on the situation problem
2	Employ	Manipulating mathematical information, applying concepts, facts, reasoning, and procedures to solve problems
3	Interpreting	Providing arguments based on interpretation results

Non-Test Techniques

This study also provided questionnaires to subjects in order to determine students' mathematical resilience based on the categories provided. Based on these questionnaires, the researchers obtained information about students who had high, moderate, and low mathematical resilience.By providing questionnaires to By giving questionnaires to subjects, the aim was to find out the extent of mathematical resilience possessed by students after applying learning with the Realistic Mathematics Education (RME) approach assisted by the Monopoly game.

Measurement of students' mathematical resilience using a questionnaire. The purpose of administering this mathematical resilience questionnaire is to obtain data on student resilience before and after treatment. The mathematical resilience questionnaire in this study was created using a Likert scale containing 5 alternative answers. Students filled out this questionnaire by checking one of the 5 alternative answers listed. This mathematical resilience questionnaire consisted of 10 questions. The grid Mathematical resilience questionnaires such as the one below:

Table 3. Mathematical Resilience Questionnaire Grid

Aspect	Indicator	Item Questionnaire
Perseverance, confidence, hard work, and not giving up easily	Having a persistent, confident, hard-working attitude, and not giving up easily when facing mathematicalproblems or failures in finding solutions to problems	1, 2, 3
Demonstrating a high level of curiosity	Demonstrates curiosity, enjoys researching mathematics, and is willing to utilize various sources to satisfy his curiosity.	4,5,6
Able to motivate oneself from failure	Able to motivate oneself from failures experienced in solving mathematical problems	7,8
Possess good social skills	Possess good social skills,are willing to help others, discuss things with peers, and adapt to the environment	9, 10,11,12
Possess the ability to find creativesolutions	Possess the ability to find creative solutions to mathematical challenges.	13,14,15

The following is a Likert scale with five alternative answer choices as follows:

Table 4. Likert Scale for the Resilience Questionnaire Mathematics

Options	Negative	Positive
Strongly Agree (SA)	1	5
Agree (A)	2	4
Somewhat Disagree (SD)	3	3
Disagree (D)	4	2
Strongly Disagree (STG)	5	1

To calculate the level of students' mathematical literacy, namely the normalized gain value/score (nGain) calculated using the Maltzer formula

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

Table 5. n-Gain Scores

Skore n-Gain	Category
$g \geq 0{,}7$	High
$0{,}7 > g \geq 0{,}3$	Currently
$g < 0{,}3$	Low

Hypothesis testing was performed with the aid of data processing applications. To find the critical value, use the one-sample t-test. With the criteria If tcount < ttable then H0is accepted and H1 is rejected, it does not have a significant effect. If tcount > ttable then H0 is rejected and H1is accepted, it has a significant effect.

RESULTS AND DISCUSSION

This study aims to determine the differences in mathematical literacy and mathematical resilience of students before and after using the Realistic Mathematics Education (RME) learning approach assisted by the Monopoly Game. This study was conducted at SMP Negeri 2 Depok Yogyakkarta with class VII B consisting of 32 students were given treatment using a Realistic Mathematics Education (RME) approach based on Monopoly. The data collected in this study were data on students' mathematical literacy and mathematical resilience, which were obtained using test instruments in the form of pretest and posttest sheets and questionnaires.

Descriptive Statistical Analysis Results

The results of the descriptive analysis are in the form of data from observations of the implementation of learning and test results of mathematical literacy and mathematical resilience of students before and after the implementation of the Monopoly-based Realistic Mathematics Education (RME) approach.

Description of measurement results of mathematical literacy and mathematical resilience of students

Descriptive data analysis was conducted on pretest and posttest data. Pretest and posttest data were used to examine the Monopoly-based Realistic Mathematics Education (RME) approach on students' mathematical literacy abilities. Pretest and posttest data for each variable are presented in the following table:

Table 6. Data on Students' Mathematical Literacy Ability Pretest and Posttest Results

Description	Mathematical literacy		mathematical resilience	
	pretest	posttets	pretest	posttest
Average	51.91	78.87	50.81	78.81

Standard deviation	10.967	14.938	10.177	14.938
variance	120.281	223.145	103.577	223.145
maximum value	68	98	67	98
minimum value	34	52	34	52

The following table describes the descriptive data of the pretest, posttest, and normalized gain (N-gain) of students' mathematics.

Table 6. Hail N-gain

Score	Skills	
	Literacy Mathematics	Resilience Mathematical
N=30		
Pretetst	51.91	50.81
Postest	78.87	78.81
N-gain	59.93%	59.10%
Category N-gain	Currently	Currently

Based on the above, the average pretest score for students' mathematical literacy was 51.91. Meanwhile, the average posttest score for mathematical literacy was 78.87. This shows that there was a difference in students' mathematical literacy before and after receiving instruction.

Next, the normality test aims to determine the normality of the sample data on students' mathematical literacy abilities. In testing normality, the researcher used the Kolmogorov Smirnov statistical test with the help of data processing applications. If the significance level is greater than 0.05, then the data is normally distributed and can be accepted. Meanwhile, if the significance level is less than 0.05, then the data is not normally distributed and cannot be accepted.

Table 7. Data Normality Test Results Pre-test and Post-test

Shapiro-Wilk	Mathematical literacy	mathematical resilience
Sig.	0.200	0.200
Decision	Normal	Normal

Testing the Effectiveness of Learning Realistic Mathematics Education (RME) Based on Monopoly on students' mathematical literacy skills.

Hypothesis testing to examine the first criterion of influence, namely whether the average score of Realistic Mathematics Education (RME) learning based on monopoly has a greater effect on students' mathematical literacy and mathematical resilience after treatment than before treatment. The hypothesis to be tested is: Before conducting this test, a univariate hypothesis test will be performed first.

This test aims to see whether there is a difference between the average scores of Realistic Mathematics Education (RME) learning based on monopoly on students' mathematical literacy skills before and after being given treatment. The results of the test of the average learning of Realistic Mathematics Education (RME) based on monopoly on students' basic mathematical literacy skills using the paired samples t test on SPSS software are presented in the following table

Table 8. Paired Sample t Test of Mathematical Literacy Skills

Statistics	t	df	Sig.(2tailed)	Description
Paired Samples Test	-14.865	31	0.000	H0 Rejected

Hypothesis test results using paired sample t-tests, learning with a Realistic Mathematics Education (RME) approach based on Monopoly on mathematical literacy skills obtained a significant value of 0.000<0.05, indicating that there was a difference in the average learning scores with the Realistic Mathematics Education (RME) approach based on Monopoly on students' mathematical literacy skills before and after the treatment was given.

The increase in the average score from 51.91 on the pretest to 78.87 on the posttest shows a significant effect of using the game-assisted RME approach on students' mathematical literacy skills. This result is in line with the characteristics of RME, which focuses on contextual problem solving, enabling students to better relate mathematical concepts to real-life situations. In the context of the monopoly game, students are faced with scenarios involving calculations related to money, purchasing strategies, and determining probabilities, which require them to process information, make mathematical decisions, and formulate solutions.

The standard deviation increased from 10.967 in the pretest to 14.938 in the posttest, indicating greater variation in student achievement after the treatment. This indicates that this approach allows students with different ability levels to experience improvements according to their individual potential.

In addition, an N-gain of 58.93% in the moderate category indicates that although the increase is not yet optimal, this approach is quite effective in building students' mathematical literacy skills. The use of the Monopoly game encourages students to thinking creatively, interpreting data in tables or numbers, and solving mathematical problems in a fun and contextual way. Thus, learning does not only focus on mastering concepts but also how students can use mathematics in their daily lives.

Testing the Effect of Realistic Mathematics Education (RME) Learning Based on Monopoly on Students' Mathematical Resilience.

Hypothesis testing to examine the second criterion of influence, namely whether the mean scores of Monopoly-based Realistic Mathematics Education (RME) on students' mathematical resilience were greater after the treatment than before the treatment. Before conducting this test, a univariate hypothesis test will be conducted first. This test aims to see whether there is a difference between the average scores of Monopoly-based Realistic Mathematics Education (RME) on students' mathematical resilience before and after the treatment. The results of the test of the average of Monopoly-based Realistic Mathematics Education (RME) learning on students' mathematical resilience using a paired samples t-test on SPSS software are presented in the following table:

Table 9. Paired Sample t-test Resilience Ability

Statistics	t	df	Sig.(2tailed)	Description
Paired Samples Test	-14.861	31	0.000	H0 Rejected

The results of hypothesis testing using a paired sample t-test, learning with a Realistic Mathematics Education (RME) approach based on Monopoly on mathematical resilience obtained a significant value of 0.000<0.05 , thus indicating that there is a difference in the average score of learning with the based on Monopoly on students' mathematical resilience abilities before and after the treatment.

The average mathematical resilience score of students increased from 50.81 on the pretest to 78.81 on the posttest, indicating that the RME approach assisted by the monopoly game was also effective in increasing students' resilience when facing mathematical challenges. Mathematical resilience is the ability of students to remain resilient, focused, and motivated in solving problems even when faced with difficult situations. In the monopoly game, students often face situations such as running out of money, needing to make strategies to win, or deciding on the most profitable move. These situations indirectly train them to think critically, make wise decisions, and try various solutions to overcome problems.

The results of the paired sample t-test showed a significant value of 0.000 (< 0.05), which confirms that the difference between the pretest and posttest in mathematical resilience was not a coincidence, but rather the result of the treatment given. The N-gain of 59.10% in the moderate category also reflects that RME-based learning is quite effective in helping students build mental resilience.

Increased standard deviation from 10.177 to 14.938 shows that there is variation in student response to this learning method. However, this variation can be considered part of the student adaptation process to a new approach that provides more challenges than conventional methods. Overall, these results show that the RME approach not only builds mathematical understanding but also students' character, such as persistence and mental resilience.

Effectiveness of the RME Approach Assisted by the Game of Monopoly

The RME approach based on the monopoly game proved effective in improving both aspects measured, namely students' mathematical literacy and mathematical resilience. This effectiveness was proven through the results of a paired sample t-test, where the significance value for both variables was 0.000 (< 0.05), indicating a significant difference between the results before and after the treatment.

The effectiveness of this approach is due to the basic principle of RME, which integrates mathematics learning with real-life situations, making learning more meaningful for students. The game of monopoly as a learning tool not only provides entertainment, but also creates an interactive and collaborative learning environment. In this game, students are encouraged to use mathematical concepts directly, such as addition, subtraction, and estimation, to achieve the objectives of the game.

In addition, this approach also addresses students' emotional aspects, such as self-confidence and the courage to try various solutions. The learning process involving group discussions, healthy competition, and independent decision-making creates an experience that supports the formation of mathematical resilience. In the long term, this strategy not only improves learning outcomes, but also helps students develop important life skills such as critical thinking, problem solving, and cooperation.

The results of this study indicate that the monopoly game based RME approach can be an effective learning alternative to improve students' cognitive and affective skills, especially in mathematics. With proper implementation, this approach has the potential to improve the quality of mathematics education in junior high schools.

CONCLUSION

Based on the results of research on mathematics learning that has been conducted at SMP Negeri 2 Depok Yogyakarta, the final data shows that there is a difference in students' mathematical literacy abilities before and after being taught using the Realistic Mathematics Education (RME) approach based on Monopoly. The research results concluded that the Monopoly-based Realistic Mathematics Education (RME) approach was effective in terms of mathematical literacy skills, as seen from the N-gain score of 58.93% in the moderate category.

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