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ANALYSIS OF STUDENTS' MATHEMATICAL CONCEPT UNDERSTANDING ABILITY IN ALGEBRA

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ABSTRACT
Understanding of mathematical concepts is an ability that understand mathematical ideas that are comprehensive and functional. So understanding concepts is an important element in learning mathematics. This study aims to determine students' understanding of mathematical concepts in algebraic material. The type of research used by researchers is descriptive qualitative. The subjects in this study were seventh-grade students in one of the public junior high schools in Karawang district, totaling 40 students. The results of the study found that students still have difficulty in working on test questions due to a lack of understanding of the concepts given, especially in linking various mathematical concepts internally or externally. It can be concluded that students have an understanding of mathematical concepts categorized as "Medium" in algebraic material.
Keywords: algebra; mathematical concept understanding; student comprehension

ABSTRAK
Pemahaman konsep matematika adalah suatu kemampuan yang memahami ide – ide matematika yang menyeluruh dan fungsional. Sehingga pemahaman konsep merupakan unsur penting dalam belajar matematika. Penelitian ini bertujuan untuk mengetahui pemahaman konsep matematis siswa pada materi aljabar. Jenis penelitian yang digunakan peneliti yaitu kualitatif deskriptif. Subjek dalam penelitian ini siswa kelas VII di salah satu SMP negeri yang ada di kabupaten karawang yang berjumlah 40 siswa. Hasil penelitian ditemukan siswa masih mengalami kesulitan dalam mengerjakan soal tes karena kurangnya pemahaman terhadap konsep yang diberikan, terutama dalam mengaitkan berbagai konsep matematika secara internal atau eksternal. Dapat disimpulkan bahwa siswa memiliki pemahaman konsep matematis yang berkategori "Sedang" dalam materi aljabar.
Kata kunci*: aljabar; pemahaman konsep matematis; pemahaman siswa*

Introduction

Understanding is the ability to understand something so that it can be translated into another form, while a concept is an idea that has been planned in the mind (Hoiriyah, 2019). Concept understanding according to Hibert is the ability that is bound between the information contained in a concept that has been understood with a previously planned idea. Meanwhile, understanding mathematical concepts is an ability to understand mathematical ideas that are comprehensive and functional (Lestari & Yudhanegara, 2018).

Concept understanding is an important element in learning mathematics. Mastery of various concepts allows a person to solve problems more effectively,

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because in the problem-solving process, rules are needed that are based on concepts that have been mastered. Concepts are abstract ideas that help a person classify objects or events and determine whether an object or event is an example or not of the idea (Fajar et al., 2018).

In reality, mathematics learning is developed with a pattern of learning theory, giving examples of problems and exercises. Students tend to rush to record every concept conveyed without really understanding its content. When given practice problems, they often have difficulty understanding the concepts that have been recorded again. If this condition continues, students can become less independent in learning, which in turn will have a negative impact on their learning outcomes. Learning mathematics is an active process for students to construct mathematical meanings or concepts (Fajar et al., 2018).

Based on the results of field observations when participating in Teaching FKIP activities in one of the State Junior High Schools in Karawang district, where many students have difficulty understanding and applying mathematical concepts, especially in algebraic material. Students still experience problems in distinguishing between constants, variables, and coefficients, which are fundamental elements in algebra. This difficulty has an impact on students' ability to organize and solve algebraic forms systematically. In addition, a limited understanding of these concepts hinders students from interpreting and manipulating algebra correctly. In line with Hayati and Marlina's research (2021), students often have difficulty distinguishing elements in algebra, this causes students to often be wrong or mistaken in solving problems.

Based on the description above, researchers are interested in researching students' mathematical concept understanding of algebra material to find out the extent of students' mathematical concept understanding of this material. To analyze concept understanding, students will solve problems based on understanding mathematical concepts in the material.

Research Methods

This study uses a descriptive qualitative method to analyze students' mathematical concept understanding ability. The research subjects consisted of 40 seventh-grade students in one of the public junior high schools in Karawang Regency. Data collection techniques using tests. The research instrument is a test question in the form of a description of a total of 6 questions. The question was adapted from Sari (2022). The indicators used in this study are indicators of students' mathematical concept understanding ability.

Indicators of concept understanding ability are restating concepts, classifying concepts that have been learned, applying concepts algorithmically, giving examples or counter-examples of concepts learned, presenting concepts in various representations, and, linking various mathematical concepts internally and externally (Sari, 2022). The question indicator in the test of students' mathematical concept understanding ability is algebra. The data is then processed and analyzed using a 100 scale based on student scores. This is done with the following formula.

$$x = \frac{\text{Number of scores obtained}}{\text{Maximum number of total scores}} \times 100 \qquad (1)$$

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The test data obtained were then grouped into three categories based on Arikunto's categories (Purwaningsih & Marlina, 2022). Categorization is given the mean and standard deviation of mathematical understanding ability which can be seen in Table 1.

Table 1. Categories of Mathematical Concept Ability

Assessment Requirements	Categories
$x \geq \bar{x} + SD$	High
$\bar{x} - SD < x \leq \bar{x} + SD$	Medium
$x \leq \bar{x} - SD$	Low

The data in this study were collected through a description test consisting of six questions to measure students' mathematical concept understanding. After the data was collected, the analysis was carried out using a 100 scale based on the scores obtained by each student. The results of the analysis were then categorized into three levels of understanding, namely high, medium, and low. Furthermore, the number of students in each category was calculated and converted into a percentage using the formula:

$$P = \frac{f}{N} \times 100\ \% \quad (2)$$

Description:

P: Percentage of students' mathematical understanding ability

f: Frequency of students in each category

N: Total number of students

Results and Discussion

Based on the test analysis, students were classified into high, medium, and low categories based on the results of the mathematical concept understanding ability test. Students in the high category have scores above the mean plus the standard deviation, students in the low category have scores below the mean minus the standard deviation, and students in the medium category have scores between the low and high categories (Arikunto, 2010). The following is a grouping of student answer results based on 3 categories, shown in Table 2.

Table 2. Test Results of Students' Mathematical Concept Understanding Ability

Assessment Requirements	Categories	Number of students	Percentage (%)
$x \geq 76{,}18$	Tinggi	5	13%
$41{,}57 < x \leq 76{,}18$	Sedang	25	63%
$x \leq 41{,}57$	Rendah	10	25%

The results of the assessment and grouping were 3 students who were included in the high, medium, and low mathematical understanding ability categories. The following is an explanation of the results of the student's mathematical concept understanding ability test.

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Indicator 1: Restate the Concept
The following student answers to item 1 questions with high categories can be seen in Figure 1.

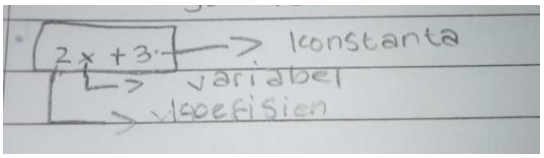

Figure 1. High-category student answers

Figure 1. shows that students can restate the concepts that have been learned. This can be observed from the answers of students who write the number 2 as a coefficient, x as a variable, and the number 3 as a constant. Thus, students can solve the problem correctly. According to Fitri, Agustina, & Septian, (2023) based on the results of interviews, students who understand the concept can articulate forms in algebra. The following student answers to item 1 questions with moderate categories can be seen in Figure 2.

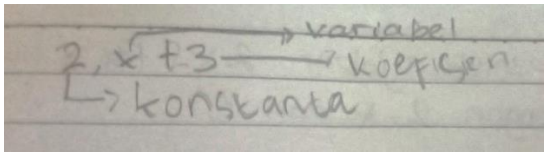

Figure 2. Medium-category student answers

Figure 2. shows that students can determine variables by providing arrows in their explanations. However, students here are mistaken in determining constants and coefficients. It can be seen from the student's answer by giving an arrow to the number 2 as a constant not as a coefficient and vice versa, the student gives an arrow to the number 3 as a coefficient, not a constant. Based on these answers, students seem to be able to restate the concepts they have learned but not yet appropriate. In line with the research findings of Ambarawati (2018) students still have difficulty in articulating terms, constants, variables, and coefficients in algebraic form. The following are students' answers to item 1 questions with low categories which can be seen in Figure 3.

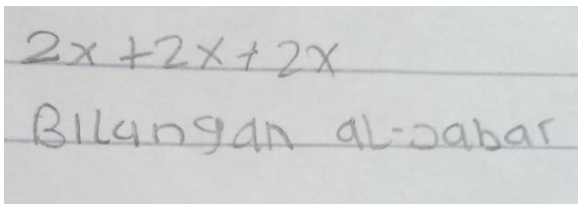

Figure 3. Low-category student answers

Figure 3. shows that students cannot restate the concepts that have been learned. It can be seen that students write 2x + 2x + 2x, which is irrelevant to the question posed in the problem. The correct answer should be that students write 2 as a coefficient, x as a variable, and 3 as a constant according to the basic concepts

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of algebra. The students' answers identify that their understanding of this concept is still very minimal (Gustiadi, Agustyaningrum & Hanggara, 2021).

Indicator 2: Classifying Objects Based on Mathematical Concepts

The following are students' answers to item 2 questions with high categories which can be seen in Figure 4 below.

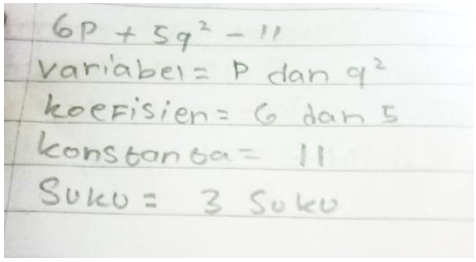

Figure 4. High-category student answers

Figure 4. shows that students can classify objects based on mathematical concepts. It can be seen that students can clarify p and q^2 as variables, 6 and 5 as coefficients, and 11 as constants and the number of terms in the algebraic form is 3 terms. Based on the results of research (Klorina & Prabawanto, 2023) show that the student's answer can classify objects based on mathematical concepts. The following is a student's answer to item 2 with a moderate category which can be seen in Figure 5.

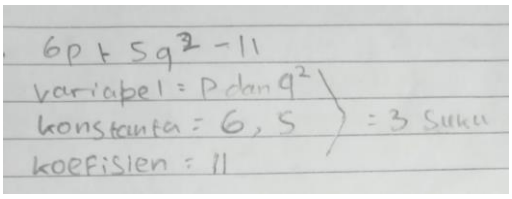

Figure 5. Medium Category Student's Answer

In Figure 5, it can be seen that students have correctly determined the variables, namely p and q^2 and the number of terms in the algebraic form of 3 terms. However, students are still mistaken in identifying constants and coefficients. It can be seen from the student's answer that the coefficient of the algebraic form is 11, instead, the student shows that the constants of the algebraic form are 6 and 5. It should be 11 as a constant, not a coefficient, and 6 and 5 as coefficients, not constants. In line with Hayati and Marlina's research (2021), students often have difficulty distinguishing elements in algebra, this causes students to be often wrong or mistaken. Based on these answers, students are still lacking in classifying objects based on mathematical concepts. The following are students' answers to item 2 questions with low categories can be seen in Figure 6.

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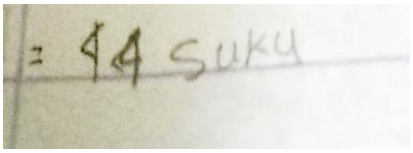

Figure 6. Low-category student answers

Figure 6. shows that students cannot classify objects based on mathematical concepts. This is shown from the student's answer which only writes 44 terms without showing which variables, constants and coefficients are in the algebraic form. The correct answer should be that students write p and q^2 as variables, 6 and 5 as coefficients, and 11 as a constant and the number of terms in the algebraic form is 3 terms. From the student's answer, it shows that his concept understanding is still minimal (Gustiadi, Agustyaningrum & Hanggara, 2021).

Indicator 3: Applying Concepts Algorithmically

The following student answers to item 3 questions with high categories can be seen in Figure 7.

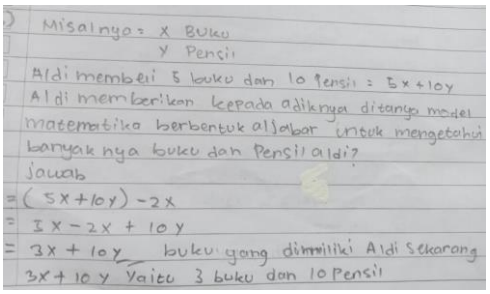

Figure 7. High-category student answers

Figure 7. shows that students can apply the concept of algorithm. This is shown from the student's answer by writing the solution steps in sequence by using the x memorization, namely books, and y, namely pencils to determine the mathematical model in algebraic form to find out the number of books and pencils. This is where the number of books known is 5 and the number of pencils known is 10, then Aldi gave his sister 2 books. Thus, students can determine the appropriate mathematical model, namely (5x+10y)-2x. Next, students rearrange the expression by grouping terms that have the same variable, so that 5x-2x+10y is obtained. After the simplification process is carried out, the final result is 3x + 10y. Therefore, based on the mathematical model compiled, it can be concluded that Aldi has 3 books and 10 pencils. In line with Tata and Haerudin's research (2022) category students can solve problems correctly, starting from the known information stage to the conclusion and producing the correct answer. The following student answers to item 3 questions with moderate categories can be seen in Figure 8.

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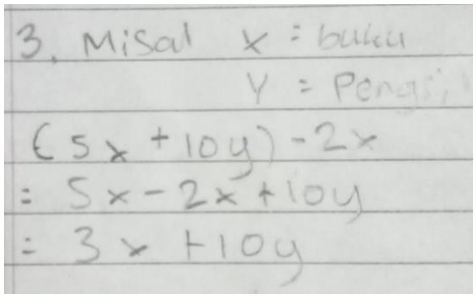

Figure 8. Medium-category student answers

Figure 8. shows that students apply the concept of algorithm, but not yet right. This is shown from the results of his answer which writes the memorization for books as x and pencils as y. Where the number of books known is 5 and the number of pencils known is 10. Where the number of books known is 5 and the number of pencils known is 10, then Aldi gives 2 books to brother. Thus, students can determine the appropriate mathematical model, namely (5x+10y)-2x. Next, students rearrange the expression by grouping terms that have the same variable, so that 5x-2x+10y is obtained. After the simplification process is carried out, the final result is 3x + 10y. However, students here do not conclude from the mathematical model they compiled. Students should conclude the mathematical model they have compiled by writing the books obtained by Aldi now are 3 books and 10 pencils. In line with the results of his research Putra et al (2018) students do not understand the information in the problem because students lack mastery of the concepts and materials provided. The following student answers to item 3 questions with low categories can be seen in Figure 9.

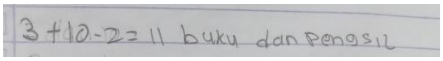

Figure 9. Low-category student answers

In Figure 9. it can be seen from the answers of students who do not solve the problem gradually starting from the known to the conclusion, from the answer the student only writes 3 + 10 - 2 = 11 books and pencils. The correct answer should be that students write x as a book and y as a pencil to determine the mathematical model in algebraic form to find out the number of books and pencils. Where the known number of books is 5 and the known number of pencils is 10, then Aldi gives 2 books to Adaiknya. Thus, students can determine the appropriate mathematical model, namely (5x+10y)-2x. Next, students rearrange the expression by grouping terms that have the same variable, so that 5x-2x+10y is obtained. After the simplification process is carried out, the final result is 3x + 10y. Therefore, based on the mathematical model compiled, it can be concluded that Aldi has 3 books and 10 pencils. In line The results of his research (Nurjanatin & Manurung, 2017) revealed that students' errors in filling out the problem were caused by a lack of understanding of the problem, inaccuracy when reading the problem, haste, and lack of mastery of the problem-solving procedure.

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Indicator 4: Provide Examples or Counterexamples of the Learned Concepts

The following student answers to item 4 questions with high categories can be seen in Figure 10.

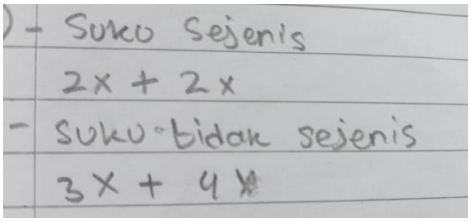

Figure 10. High-category student answers

Figure 10. shows that students can provide examples or counterexamples of the concepts learned. This can be seen from the way students give examples of similar and dissimilar terms in algebraic form correctly, namely 2x + 2x for similar terms and 3x + 4y for dissimilar terms. In line with the results of the research by Annisa et al., (2021) students with high and medium mathematical understanding can solve problems correctly. The following student answers to item 4 questions with moderate categories can be seen in Figure 11.

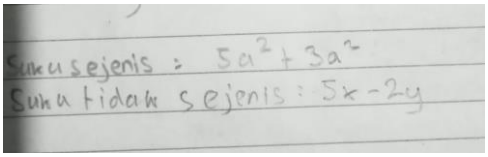

Figure 11. Medium Category Student Answers

In Figure 11. shows that students can provide examples and counter-examples of the concepts learned. this can be seen from the answers of students who write correctly $5a^2 + 3a^2$ as similar terms and 5x - 2y as unlike terms. Students with moderate to high mathematical concept understanding abilities tend to be able to estimate answers with confidence (Annisa et al., 2021). The following student answers to item 4 questions with low categories can be seen in Figure 12.

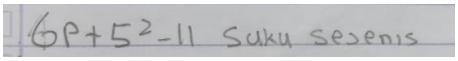

Figure 12. Low-Category Student Answers

In Figure 12. shows that students are not able to provide examples and counter-examples of the concepts learned. This is indicated by student answers that only write 6p + 5^2 - 11 similar terms. The correct answer should be that students write 2z + 5z as similar terms or can write others that have the same variables or constant terms in algebra, then students can write 3x + y as unlike terms or can write others with terms whose variables are not the same or the degree is not the same. From the students' answers, it can be concluded that students have not mastered the concepts they have learned, so they do not understand the concepts well (Gustiadi, Agustyaningrum & Hanggara, 2021).

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Indicator 5: Presenting Concepts in Various Representations

The following student answers for item 5 questions with high categories can be seen in Figure 13.

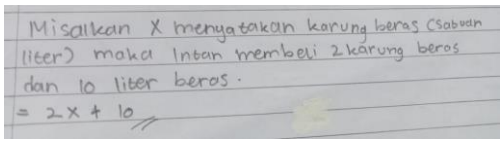

Figure 13. High category

Figure 13 shows that students can present concepts in various representations. This can be seen from the answers of students who write it correctly in solving the problem by using memorization first, namely by memorizing x as a sack of rice (liter unit). In line with the results of his research (Klorina & Prabawanto, 2023) based on student answers, it can be concluded that students can express ideas in a mathematical context. The following student answers to item 5 questions with moderate categories can be seen in Figure 14.

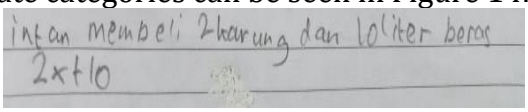

Figure 14. Medium Category Student Answers

In Figure 14. shows that students can present concepts in various representations but not yet appropriate. This can be seen from students who immediately provide answers without including mathematical explanations in the problem. The student should have assumed that x is a sack of rice (liter unit). So, if diamonds buy 2 sacks of rice and 10 liters in algebraic form, that is 2x + 10. It can be seen from the answer that students immediately write diamonds buy 2 sacks of rice and 10 liters of rice with the algebraic form 2x + 10 without providing a memorization first. In line with the results of his research (Nurjanatin & Manurung, 2017) states that the mistakes made by students in solving problems, among others, are caused by incomprehension of the problem, lack of accuracy, haste, and inability to understand the problem-solving procedure. The following student answers to item 5 questions with low categories can be seen in Figure 15.

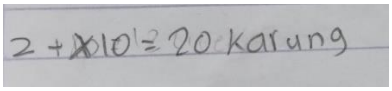

Figure 15. Low-category student answers

In Figure 15. shows that students are not able to present concepts in various representations. This can be seen from students who only write 2 x 10 = 20 sacks. The question given in the problem does not match the student's answer. In the

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question, students are told to express the algebraic form of the rice that Diamond bought. According to Salido (Tata & Haerudin, 2022) if students face difficulties in understanding and mastering the concepts of the material being taught, then this will hinder their ability to solve subsequent problems.

Indicator 6: Linking various Mathematical Concepts Internally or Externally

The following student answers for item 6 questions with high categories can be seen in Figure 16.

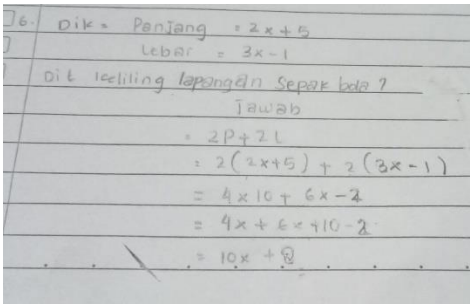

Figure 16. High Category Student Answers

In Figure 16. shows that students can relate various mathematical concepts internally or externally but are still inaccurate. This is shown from the student's answer which solves the problem in stages starting from what is known as the length of the soccer field as 2x + 5 and the width as 3x - 1, asking for the perimeter of the soccer field then the correct answer is 10x + 2. However, in this answer, students do not include conclusions from the results obtained which shows a lack of presenting the final result more clearly and structurally. Students should have concluded the results of their work by writing so, the perimeter of the soccer field (rectangle) is 10 x + 8. The following student answers to item 6 questions with moderate categories can be seen in Figure 17.

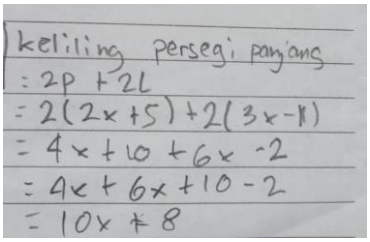

Figure 17. Medium-category student answers

In Figure 17. shows that students can relate various mathematical concepts internally or externally but not as expected. This can be seen that students immediately answer the questions in the problem without writing the information contained in the problem. Students should answer the known length of the soccer field 2x + 5 and its width 3x - 1 and ask about the circumference of the soccer field then conclude the answers obtained. (Nurjanati & Manurung, 2017) Revealed that students' mistakes in filling out the problem were a lack of understanding of the problem, inaccuracy when reading the problem, and inability to master the steps of

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solving the problem. The following student answers to item 6 questions with low categories can be seen in Figure 18.

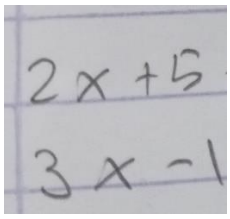

Figure 18. Low-category student answers

Figure 18. shows that students have difficulty in linking various mathematical concepts, both internally and externally. This difficulty can be seen from the student's answer which only writes the information contained in the problem, namely the length of the soccer field is expressed as 2x + 5 and the width as 3x - 1. Although the problem states that the field is rectangular, students do not use the formula for the perimeter of a rectangle, namely 2P + 2L. This shows that the story problem form is a challenge for students in applying the appropriate mathematical concepts. Thus, students not only have difficulty in understanding the problem but also in connecting relevant concepts to solve it. In line with Damayanti's opinion (Klorina & Prabawanto, 2023), difficulties in understanding story problems can cause concept errors, so students cannot apply the appropriate formula.

Conclusions and Suggestions

Based on the test results, students still have difficulty in working on test questions due to a lack of understanding of the concepts given, especially in linking various mathematical concepts internally or externally. This difficulty indicates that students' conceptual understanding has not been fully developed optimally, which has an impact on their ability to solve more complex mathematical problems. So, it can be concluded that students fall into the "Medium" category of students' mathematical concept understanding ability of algebra material. Based on the analysis and conclusions obtained, it is recommended that students be actively involved in the learning process in class to improve students mathematical concept understanding ability.

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