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An In-Depth Analysis of Students' Mathematical Connections in the Context of the Pythagorean Theorem

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ABSTRACT

Purpose – Mathematical connection ability is a high-order thinking skill necessary for linking mathematical concepts across topics, disciplines, and real-life contexts. Preliminary observations suggest that many students struggle to establish these connections, particularly when learning the Pythagorean Theorem.

Methodology – This study employed a qualitative descriptive research design using a case study method. The sample consisted of 22 students, with four participants purposively selected to represent varying levels of mathematical connection ability. Data were collected through a six-item written test developed based on NCTM indicators and supported by semi-structured interviews for triangulation. Data were analyzed qualitatively to identify patterns in students' mathematical connection performance.

Findings – The study found that students generally demonstrated high levels of mathematical connection ability, with a mean score of 70.26%. Most students were able to connect mathematical concepts across different topics and disciplines. However, they encountered difficulties in applying mathematical ideas to real-life situations. These findings highlight the gap between theoretical understanding and practical application.

Novelty – This study contributes to the literature by providing in-depth insights into students' levels of mathematical connection ability, particularly in contextual problem-solving involving the Pythagorean Theorem.

Significance – The findings are beneficial for mathematics educators, curriculum designers, and educational policymakers to enhance instructional strategies and support applied mathematical thinking in students.

Keywords: Case studies; Contextual learning; Higher-level thinking skills; Mathematical connections; Pythagorean theorem.

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1. Introduction

Mathematics has a strategic position in education because it is not only taught at all levels of school, but also plays an important role in shaping students' logical, systematic, and critical mindsets. According to Duma et al., (2024), effective mathematics education can improve critical and systematic thinking skills, so it is necessary to apply learning methods that emphasize conceptual understanding and real application. Mathematics not only functions as a tool to solve problems, but also plays an important role in developing a person's ability to face daily challenges logically and in a structured manner Tinambunan et al., (2023). Mathematical connection skills also support students in linking various aspects needed to solve a problem (Baiduri et al., 2020). According to National Council of Teacher Mathematics NCTM, (2000), there are five aspects of mathematical skills (doing math), namely: the ability to communicate, reason, solve problems, connect various concepts, and build a positive attitude towards mathematics. In solving a mathematical problem, good mathematical connection skills are also needed as a supporting factor to relate various ideas.

According to Yunita et al., (2024) Mathematical connection ability is the skill of students in relating a mathematical concept to other concepts, both in different subjects, other disciplines, and daily life to solve mathematical problems. As for the Lappan, (2002) Mathematical connections are the relationships between situations, problems, and mathematical concepts that allow the application of knowledge to solve various problems in an integrated manner. Proficiency in mathematical connections facilitates students in solving mathematical problems while increasing the likelihood of understanding mathematics in a more meaningful way (Amilawati, 2025).

According to NCTM, (2000), indicators of mathematical connection ability include: (1) Establishing connections between various topics in mathematics, (2) Relating mathematical concepts to other fields of science outside mathematics, and (3) Applying mathematical concepts in everyday life situations. Based on the NCTM statement, it can be seen that the ability to make mathematical connections is a student's skill in identifying and communicating relationships in mathematics, which includes the relationship between mathematical topics, relationships with other fields of science, and their application in daily life or situations of daily life (Fatunnisa & Fitri, 2021).

Thus, these skills are part of advanced thinking skills that help students understand concepts in depth and apply them in various situations (Wardhana & Fuady, 2024). As explained by Faridayanti et al., (2024) that learning that emphasizes the search for meaning and understanding concepts independently can improve students' overall mathematical thinking skills. This reinforces the importance of learning that focuses not only on outcomes, but also on critical thinking processes and connections between concepts. One of the challenges in learning mathematics is that students' mathematical connection skills are still low. According to Fahira et al., (2023) many students still have difficulty solving math problems related to daily life situations. Most of them have not been able to interpret the problem well and convert it into a mathematical model. This condition shows that students' mathematical connection skills are still weak, so they need to be strengthened through more contextual and applicative learning.

In reality, in the field, students' mathematical connection skills are still low, especially in Theorem material *Phytagoras*. Based on research conducted by Haryanti, Lastini, Setyaningsih, (2024) Analysis of students' learning difficulties in mathematical connection ability in theorem material *Phytagoras* indicates that most students are in the medium category. Factors that affect learning difficulties include teachers' teaching methods, classroom atmosphere, parental support, social environment, interest in mathematics, and lazy learning. The same thing was also conveyed by Khoiri et al., (2024) that students' mathematical connection ability is still low because they make many technical, procedural, and conceptual mistakes. This is due to a lack of understanding of concepts, inaccuracy, and suboptimal learning. The solution is that teachers need to improve the quality of learning with a more interactive approach and focus on understanding basic concepts and practising various questions.

Some students still struggle to interpret math problems and convert them into accurate mathematical models, indicating weak mathematical connection skills. According to Jailani et al., (2020), students' difficulties in making mathematical connections can lead to difficulties in solving problems. Some students can understand the relationships between concepts in mathematics, but have difficulty relating them to other fields. In addition, there are still many students who are not able to apply the concept of Theorem Pythagoras in real life, such as in data analysis or decision-making based on numerical information Imani et al., (2023).

Taking into account this background, this study aims to analysed the mathematical connection ability of grade XI students of SMAN 4 Siak Huku on the Phytagoras Theorem material, identify various difficulties faced by students in solving related problems, and evaluate the extent of the relationship between the level of mathematical connection ability and the difficulties experienced by students in understanding and solving Pythagorean Theorem problems.

2. Methods

This study uses a qualitative method with a descriptive approach, which aims to understand the phenomenon in depth through direct observation. The data obtained were analysed to describe the situation being studied and formulate findings based on the results of observations (Bungin, 2007). This approach allows researchers to capture the meaning of subjects' behaviours, actions, and interactions in their natural context(Moleong, 2020) .

The determination of subjects in this study uses purposive sampling techniques, which are non-random sampling methods in which researchers select participants based on specific characteristics according to the research objectives. This technique is used so that the selected subject can provide relevant and in-depth information to answer research problems (Lenaini, 2021). This approach was also applied because it ensured that the subjects selected were truly "information rich cases," i.e., cases that provided deep insight into the phenomenon being studied, thereby increasing the credibility and accuracy of the research findings (Palinkas et al., 1968).The subjects in this study are grade XI students of SMAN 4 Siak Hulu for the 2024/2025 school year consisting of 22 students. The students are studying the material of the Pythagorean Theorem, which includes the collection, presentation, and analysis of simple data. The selection is based on the level of students' mathematical connection ability which is measured through a question test that is related to the student's mathematical connection ability. Based on the test results, students are grouped into four categories: low, medium, high, and very high. Each category is represented by one student who is selected by *purposive* to be analysed further.

Thus, four main subjects are the focus of the research, which are chosen to illustrate the variation in students' mathematical connection abilities in solving Pythagorean Theorem problems. This limited subject selection aims to describe in depth the characteristics of mathematical connection abilities at each level of ability categories. This approach also allows for case allocation with a variety of sampling strategies, such as maximum variation or extreme case sampling, so that information from each ability category can be explored in a representative and comprehensive manner (Nyimbili & Nyimbili, 2024)

The object of this study is a test question designed to measure students' mathematical connection ability in class XI Pythagorean Theorem material, as well as student answer sheets and interview results obtained from the direct interview process. This study focuses on one variable, namely students' mathematical connection ability which is analyzed based on three indicators from NCTM, namely: (1) the ability to connect between topics in mathematics, (2) the ability to connect mathematical concepts with other fields of study, and (3) the ability to connect mathematical concepts with daily life situations. Data from test results and interviews were analyzed to find out how students built these connections in understanding and solving Pythagorean Theorem problems.

In this study, researchers used data collection methods in the form of tests and interviews to determine students' mathematical connection abilities in the Pythagorean Theorem material, showing challenges in the aspects of abstraction and pattern recognition(Nurwita et al., 2022) The test was structured based on three indicators of mathematical connection according to NCTM, and interviews were conducted to reinforce the results of the test. This combination of tests and interviews has proven effective in identifying students' strategic patterns, conceptual errors, and deeper mathematical connections (Mila et al., 2023). The approach used is a case study, which allows researchers to describe students' mathematical connection abilities in depth. According to (Creswell, 2018), a case study is a research strategy used to examine a phenomenon comprehensively through various data collection techniques. This approach also aims to gain a deeper understanding and conduct intensive analysis of individuals, groups, or specific situations. In an effort to improve data validity, the researcher applied triangulation techniques. According to (Sugiyono, 2015), data triangulation is a data collection method that integrates various types of data and available sources of information, which is by comparing and reviewing data from test results, interviews, and documentation of student answer sheets at the same time. After analyzing the test results and interviews, the researcher identifies the types of connections that students demonstrate and presents them in the form of narrative descriptions. The following are the criteria for students' mathematical connection ability which is determined by looking at the percentage of mathematical connection ability (Romiyansah et al., 2020). The percentage formula used is presented in Table 1:

$$KK = \frac{R}{S} x\ 100\% \tag{1}$$

Information:
KK = Percentage of Mathematical Connection Ability
R = The total score of each student on an indicator
S = Maximum Total Score

Table 1 - Categories Mathematical Connection Capabilities

Category	Test Score Range
Low	$0 \leq KK < 50\%$
Keep	$50\% \leq KK < 70\%$
Tall	$70\% \leq KK < 90\%$
Very High	$90\% < KK < 100\%$

3. Results and Discussion

3.1 Results

After analysing the answers to the questions that the researcher gives to students, the researcher will find out facts about how students build mathematical connection skills in solving Pythagorean Theorem problems. This analysis includes three indicators of mathematical connection, namely: the ability to connect between topics in mathematics, the ability to connect mathematical concepts with other fields of study, and the ability to connect mathematical concepts with daily life situations. After the researcher analysed the mathematical connection ability of grade XI students at SMAN 4 Siak Hulu on the *Pythagorean Theorem material*, the level of students' mathematical connection ability in answering the questions that had been given could be obtained. The following is presented in Table 2:

Table 2 - Description of Mathematical Connection Capabilities Based on Indicators

NO	Mathematics with mathematics Questions 1&2	Mathematics with other fields of science Questions 3&4	Mathematics with everyday life Questions 4&5
Sum	146	147	78
%	82,95%	83,52%	44,32%

Based on Table 2, information was obtained that the mathematical connection ability for each indicator showed variations in student mastery levels. The lowest average was found in the indicator connecting mathematics with daily life, which was 44.32%. This shows that students still have difficulty in relating mathematical concepts to situations in daily life. On the other hand, the highest average of 83.95% is related to mathematics with other disciplines and at the second high level is found in the indicator of the relationship between mathematics and daily life. A high percentage of both indicators indicates that most students are able to understand the relationship of concepts in mathematics and are able to relate them to other fields of study. Furthermore, an overview of the percentage of students' mathematical connection ability in general is presented in Table 3 below.

Table 3 - Average Percentage of Mathematical Connection Ability

NO	Measured Aspects	Percentage Earned	Categories Mathematical Connection Ability
1	Ability to connect between topics in mathematics	82,95%	Tall
2	Ability to connect mathematical concepts with other fields of study	83,52%	Tall
3	Ability to relate mathematical concepts to everyday life situations	44,32%	Low
	Sum	210,79%	
	Average percentage (mean)	70,2633%	Tall

Based on Table 3, information was obtained that the average percentage of mathematical connection ability of Shiwa Kela XI SMAN 4 Siak Hulu was 70.2633% which was included in the High category. Furthermore, the researcher analyzed the results of the work of the 4 research subjects using the triangulation technique which can be seen in Table 5.

Table 4 - Participant Code

Categories Mathematical Connection Capabilities	Student Code
Low	SM
Keep	IR
Tall	JP
Very High	KA

Table 5 - Test and Interview Data Triangulation Results

Yes	Student Code	Indicator	Written test results	Interview Results
1	IR	Connecting Mathematics Concepts	• In question number 1, students answered the correct question; it's just that the student did not make a formula. • In question number 2, students answered the correct question, but the student did not make a formula.	• Because students think it's just the same when they answer directly. • I think it's okay if you don't do it.
		Integrating Mathematics	• In question number 3, students answered the questions correctly, but the	• Thinking that it doesn't matter if it's

Yes	Student Code	Indicator	Written test results	Interview Results
		with other fields	students did not make a formula • In question number 4, students answered the questions correctly, only in the known and asked part it was incomplete and did not make a formula.	not entered or created. • Forgetting to make a formula and be known.
		Relating the concept of mathematics to everyday life	• In question number 5, students answered the question incorrectly and students did not make it known, asked and answered. • In question number 6, students did not answer this question.	• Forgot to make it because he thought it had no effect • Forgetting the method and formula so that it is not solved.
2	KA	Connecting Mathematics Concepts	• In question no. 1, students answered the questions correctly, only the students did not make a formula. • In question no. 2, students answered the questions correctly and completely.	• Forgot to make the formula. • Because they understand and have been well studied.
		Integrating Mathematics with other fields	• In question no. 3, students answered the question correctly, it's just that the students did not make a formula. • In question no. 4, students answered the question correctly, it's just that the students did not make a formula.	• Because he thinks that if it is not made, it will be okay if it is not made. • Because they think that if they don't, they won't be able to do it. •
		Relating the concept of mathematics to everyday life	• In question number 5, students answered the questions correctly and completely. • In question no. 6 correctly and completely.	• Answering the question requires the concept of collaborating or connecting to the life of the other person, so students can answer smoothly. • Because I don't know at all.
3	JU	Connecting Mathematics Concepts	• In question no. 1, students answered correctly, but they didn't make a formula.	• Forget the formula, but you know how to do it.

Yes	Student Code	Indicator	Written test results	Interview Results
			• In question no. 2, students answered correctly, it's just they didn't make formulas.	• Forget the formula, but you know how to do it.
		Integrating Mathematics with other fields	• In question no. 3, students answered the questions correctly and completely. • In question no. 4, students answered the question correctly, but they did not make a formula.	• An easy question and considered the youngest. • Forget the formula, but not the way it works.
		Relating mathematical concepts to everyday life	• In question no. 5, students answered the questions correctly, it's just they did not make it known, asked and answered. • In question no. 6, students did not answer the questions.	• Forgot and thought it was just a direct answer. • Because I don't know at all.
4	BC	Connecting Mathematics Concepts	• Question No. 1 does not answer the question. • Answer question No. 2 well and perfectly.	• Didn't answer because he forgot. • Answer because students understand and remember how to do it.
		Integrating Mathematics with other fields	• Answer question No. 3 properly and correctly. • Not answering question No. 4.	• Answer because students understand and understand. • Forgetting how to do it.
		Relating mathematical concepts to everyday life	• Not answering question no. 5. • Not answering question no. 6.	• Forget the formula and how to do it. • Forget the formula and how to do it.

The results of this study show the ability of students to make mathematical connections in solving problems in the Pythagoras Theorem material. The instruments used were in the form of six questions. The assessment of students' mathematical connection ability refers to three main indicators that are discussed in detail, namely.

3.2 Discussion

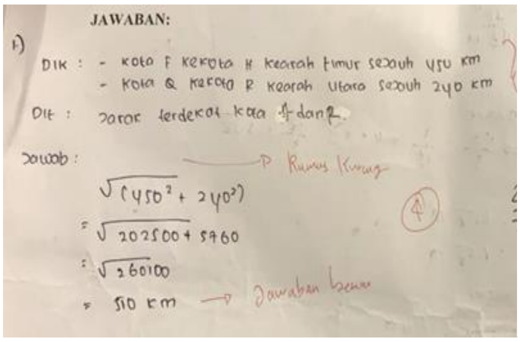
3.2.1 The ability to Connect between Topics in Mathematics

SOAL :

1. Sebuah kapal berlayar dari kota F ke kota H kea rah timur sejauh 450 km, kemudian dari kota Q dilanjutkan ke kota R kearah utara sejauh 240 km. jarak terdekat kota H dan R adalah…

1. A ship sails from city F to city H eastward for 450 km, then from city Q it continues to city R northward for 240 Km. The closest distance between cities H and R is...

Figure 1. Questions about Shipping Routes and Shortest Distances



1) Answer :

Given : city F city H towards the east as far as 450 km

city Q city R towards the east as far as 240 km

Asked :

The closest distance between cities F and R?

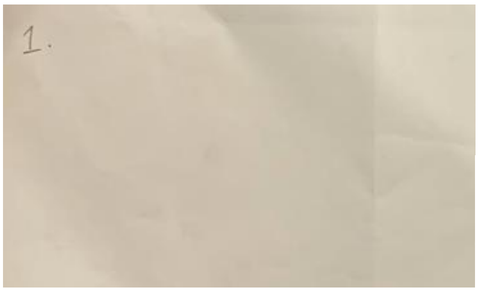
Solution : $= \sqrt{(450^2 + 240^2)}$

$= \sqrt{(202500 + 57600)}$

$= \sqrt{260100}$

$= 510$ km

Figure 2. Work Results of KA Students



1) EMPTY ANSWER

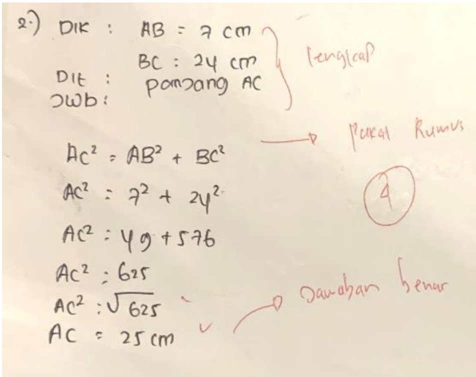
Figure 3. Results of SM Students

The results of the work of the KA students show a good understanding of question number 1, by including known information and questions asked clearly. The train successfully solved the problem to calculate the distance between the cities H and R, but did not write down the Theorem formula *Pythagoras* in the answer. Based on the results of the interview, KA revealed that he forgot to write down the formula because he felt that he had understood and had studied it well before. This phenomenon is in line with the findings Hart, (2022) which states that a strong understanding of mathematical concepts can help students solve problems, even if they do not always write down all the stages of completion completely. On the other hand, SM students are not able to answer question number 1 which is related to calculating the closest distance between two points, so the answer is blank and gets a score of zero. This condition shows that the lack of mastery of basic concepts can hinder students' ability to solve math problems. These findings are supported by research Latifah et al., (2024) which concludes that without adequate mastery of concepts and formulas, students will have difficulty in achieving computational thinking indicators, including in solving context-based problems. In general, the majority of students were able to answer question number 1 well and obtained a relatively high score, which indicates that most of them already understood the basic concepts of the Theorem *Pythagoras* and able to apply it appropriately in solving problems.

2. Pada bangun ABC adalah segitiga siku-siku di B. Diketahui $AB = 7\ cm$ dan $BC = 24\ cm$. Carilah Panjang AC.

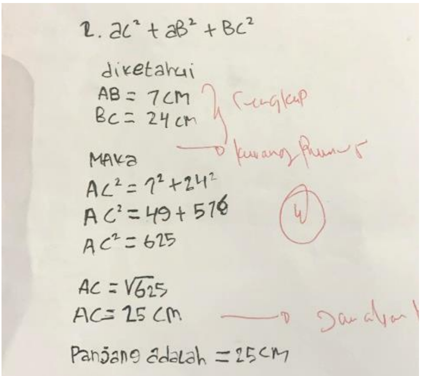
2. In figure ABC, triangle ABC is a right triangle at B. Given that AB = 7 Cm and BC = 24 Cm, find the length of AC.

Figure 4. ABC Elbow Triangle



2) Given : AB = 7 cm
BC = 24 cm
Asked : Long AC?
Solution :
$AC^2 = AB^2 + BC^2$
$AC^2 = 7^2 + 24^2$
$AC^2 = 49 + 576$
$AC^2 = 625$
$AC^2 = \sqrt{625}$
AC = 25 cm

Figure 5. Work Results of KA Students



2. $ac^2 + ab^2 + bc^2$
given :
ab = 7 cm
bc = 24 cm
so :
$AC^2 = 7^2 + 24^2$
$AC^2 = 49 + 576$
$AC^2 = 625$
$AC^2 = \sqrt{625}$
AC = 25 cm

Figure 6. Results of SM Students

The results of the work of KA and SM students showed that both were able to write down completely the information known and the questions asked in the questions. In addition, they also wrote down the formula used in solving the problem, namely the *Pythagorean* Theorem formula: This shows that KA and SM understand the basic concepts needed to solve the problem. Especially for KA students, the answers given have met the scoring criteria by writing down the steps of completion and correct answers, so that KA gets a score of 4.$AC^2 = AB^2 + BC^2$.

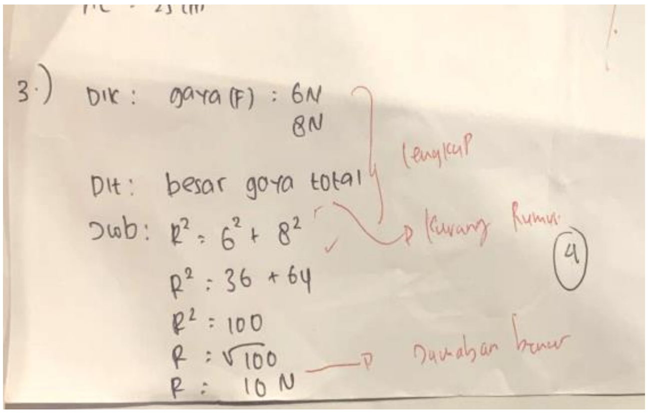
These findings are in line with research by Banne et al., (2024) which states that students who understand the concept of the Theorem *Pythagoras* tend to be able to solve problems correctly and completely. On the other hand, students who do not understand this concept often make mistakes in solving problems. Other research by Rahmawaty & Nurmeidina, (2023) and also found that a good understanding of concepts contributes significantly to students' success in solving math problems.

3.2.2 Ability to Connect Mathematical Concepts with other Fields of Study

3. Sebuah benda ditarik dengan gaya 6 N ke arah timur dan 8 N ke arah utara secara bersamaan. Berapakah besar gaya total (resultan) yang bekerja pada benda tersebut?

3. An object is pulled with a force of 6 N to the east and 8 N to the north simultaneously. What is the total force (resultant) acting on the object?

Figure 7. Calculation of the Force Magnitude



3) Given : Force (F) = 6 N

8 N

Asked : total force magnitude

Solution : $R^2 = 6^2 + 8^2$

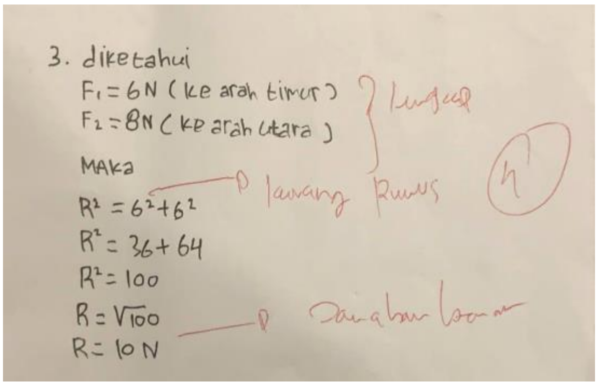
$R^2 = 36 + 64$

$R^2 = 100$

$R = \sqrt{100}$

$R = 10\ N$

Figure 8. Results of Student Work



3. given : $F_1 = 6$ N (eastward)

$F_2 = 8$ N (towards the north)

So

$R^2 = 6^2 + 8^2$

$R^2 = 36 + 64$

$R^2 = 100$

$R = \sqrt{100}$

$R = 10\ N$

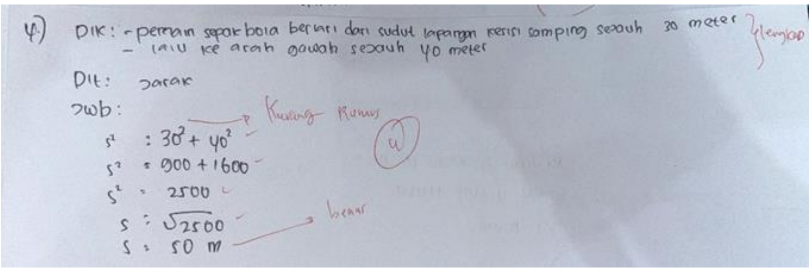
Figure 9. Results of SM Students

The results of the work of KA and SM students showed that both were able to identify the known information and questions asked in the questions well. However, both students have not written down the formula for calculating total force in their answers. Based on the results of the interview, KA stated that he forgot to write the formula because he felt that he had understood the concept well. Meanwhile, SM revealed that he understood and remembered how it worked, but did not write down the formula explicitly. Both obtained a score of 4, which indicates that although their understanding of concepts is quite good, the skills in writing down the completion steps still need to be improved. This phenomenon is in line with the findings (Asbar et al., 2024), which states that mistakes in solving math story problems are often caused by students' lack of verbal ability to study and solve math-related story problems. This phenomenon is also in line with the findings of (Luna et al., 2024), who stated that many students forget to write down formulas or concepts when answering questions, even though they understand the concepts mentally. Their research revealed that the causes include students not paying close attention to the question information, rushing, or feeling that it is unnecessary to explicitly include the formula. Based on the presentation by Aini & Saputro, (2023), he highlighted the importance of familiarizing students with the stages of problem solving, including writing formulas, so that they become accustomed to thinking sequentially and logically when solving problems.

4. Seorang pemain sepak bola berlari dari sudut lapangan ke sisi samping sejauh 30 meter, lalu ke arah gawang sejauh 40 meter. Berapa jarak langsung yang dia tempuh dari awal sampai ke posisi sekarang?

4. A soccer player runs from the corner of the field to the side 30 meters away, then toward the goal 40 meters away. What is the direct distance he has traveled from the start to his current position?

Figure 10. Shortest distance or trajectory question



4) Given : - Soccer players run from the corner of the field to the side
- Then towards the goal as far as 40 meters

Asked : distance

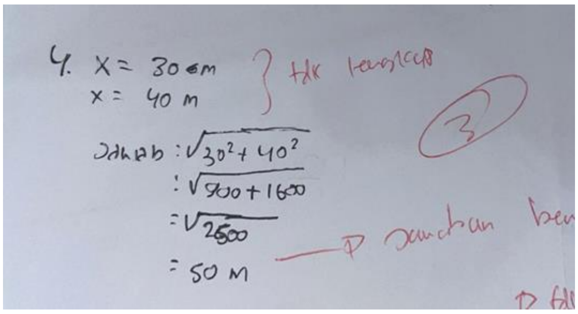
Solution : $s^2 = 30^2+40^2$

$s^2 = 900 + 1600$

$s^2 = \sqrt{2500}$

$s = 50\,m$

Figure 11. Work Results of KA Students



4) x = 30 m

x = 40 m

solution : $\sqrt{30^2 + 40^2}$

$\sqrt{900 + 1600}$

$\sqrt{2600}$

= 50 m

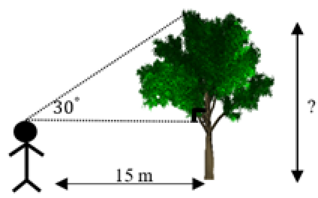
Figure 12. IR Work Results

Based on the results of the students' answers to question number 4, it can be seen that there is a difference in the level of mathematical connection ability between students with the initials KA and IR. KA students demonstrate the ability to connect between concepts (score 4) by associating theorem concepts *Pythagoras* in the context of the movement of football players on the field, as well as systematically formulating settlement steps even though the formula has not been explicitly listed. This reflects a deep understanding of the concept of geometry with real situations, according to the opinion Evy yosita Silvia, Zulkardi, (2009)that connections between concepts occur when students can integrate two or more mathematical concepts to solve contextual problems.

On the other hand, IR students only use symbolic representations without explaining the relationship with the context of the problem in full, so it is classified as representation connections (score 3), which is the ability to change a situation to a mathematical form without showing conceptual connection, that representation connections include the ability to translate problems into mathematical forms such as symbols and equations. This situation is in line with what (Khoiri et al., 2024) said, that conceptual errors often happen because students don't really get the concepts behind the problems, like not knowing how math ideas are connected, so they can't solve the problems logically. This finding is similar to the research by (Rustam et al., 2021), which shows that students often use symbolic representations but do not always include verbal or visual representations that connect symbols to broader mathematical concepts. As a result, mathematical connection skills are limited to symbols without concept integration.

3.2.3 *Ability to connect mathematical concepts to everyday life situations.*

5. Andi berdiri sejauh 15 m dari kaki sebuah pohon yang tumbuh tegak lurus, seperti pada gambar. Sudut yang terbentuk oleh garis pandang siswa ke puncak pohon dengan garis mendatar adalah 30°. Jika tinggi anak tersebut $\sqrt{3}$ m, berapakah tinggi pohon tersebut?



5. Andi stands 15 m away from the base of a tree that grows straight up, as shown in the picture. The angle formed by the line of sight from the student to the top of the tree and the horizontal line is 30°. If the child's height is $\sqrt{3}$ m, how tall is the tree?

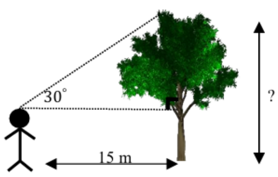
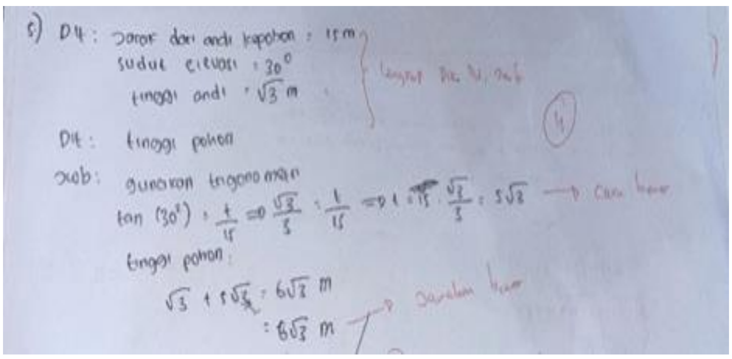


Figure 13. Angular Tangents in an Elbow Triangle.

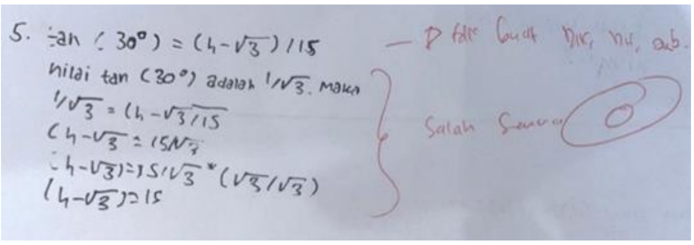


5) Given : distance from Andi to the tree = 15 m
Elevation angle = 30°
Andi's height = $\sqrt{3}$
Asked : height of the tree
Solution :
Use trigonometric ratio :

$$\tan(30^\circ) = \frac{t}{15} \rightarrow \frac{\sqrt{3}}{3} = \frac{t}{15} \rightarrow t = 15,\frac{\sqrt{3}}{3}$$

Height of the tree = $\sqrt{3} + 5\sqrt{3} = 6\sqrt{3}\ m$

Fig. 14. Work Results of KA Students



5) $\tan(30^{\circ}) = (h-\sqrt{3})\ 115$

the value of $\tan(30^{\circ})$ is $\frac{1}{3}$ then

$\frac{1}{\sqrt{3}} = (h-\sqrt{3115})$

$(h-\sqrt{3}) = \frac{15}{\sqrt{3}}$

$(h-\sqrt{3}) = \frac{15}{\sqrt{3}}(\frac{\sqrt{3}}{\sqrt{3}})$

$(h-\sqrt{3}) = 15$

Figure 15. IR Work Results

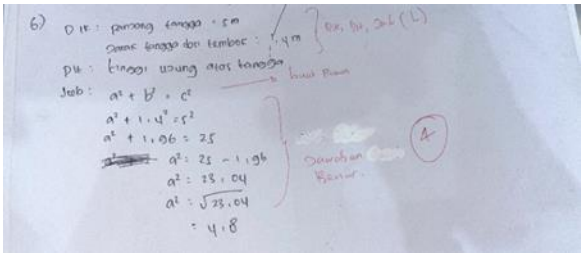
Based on the results of the students' answers to question number 5, there is a difference in the level of mathematical connection ability between KA and IR students. KA students show the ability to connect mathematical concepts with daily life situations. (score 4) because it successfully uses the concept of trigonometry, which is the 30° angular tangent function, and relates it to the context of the problem in the form of horizontal distance and observer height. The train also solves the problem systematically, although without explicitly writing the formula, but the calculation steps reflect a logical understanding of the relationship between the sides in a right triangle and the context of the height of the tree. This is in accordance with the opinion Istiqomah, (2022), that connections between concepts occur when students can integrate two or more mathematical ideas in the solution of contextual problems. This finding is also in line with the results of research by Tama & Setyadi, (2022) which shows that around 69% of students have fairly good mathematical connection skills, particularly in relating concepts such as tangents and the relationship between sides to everyday contexts.

On the other hand, IR students only write symbolic models and perform erroneous algebraic manipulations without understanding the structure of the relationship between the IR concepts do not distinguish between the height of the eyes and the total height of the tree so that it only shows a representation connection (score 2), i.e. the ability to convert a problem into a mathematical form but has not yet arrived at the correct conceptual understanding. This is in accordance with the indicator of the problem, namely the ability to use the concept of tangents correctly and logically in the context of daily life.

6. Pak didi adalah sorang tukang, ia meletakkan sebuah tangga dengan Panjang 5m. tangga tersebut disandarkan pada tembok. Jika jarak ujung bawah tangga dengan tembok 1,4 m, tinggi ujung atas tangga dari lantai adalah…

6. Mr. Didi is a carpenter. He placed a 5 meter-long ladder against a wall. If the distance between the bottom of the ladder and the wall is 1,4 meters, the height of the top of the ladder from the floor is...

Figure 16. The Context of Building a Flat Triangle Elbow



6) Given : length of ladder = 5 m

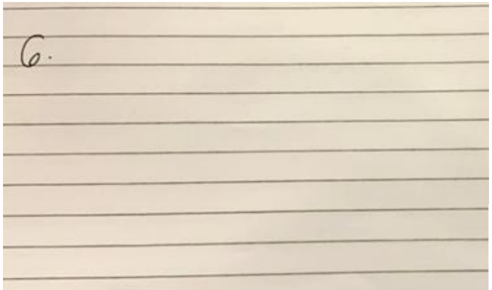
Distance of stairs from the wall = 1,4 m

Asked : height of the top of the stairs ?

Solution :

$$a^2 + b^2 = c^2$$
$$a^2 + 1\,4^2 = 5^2$$
$$a^2 + 1\,96 = 25$$
$$a^2 = 25 - 1\,96$$
$$a^2 = 23\,04$$
$$a^2 = \sqrt{23\,04} = 4{,}8$$

Figure 17. Work Results of KA Students



6) EMPTY ANSWER

Figure 18. IR Work Results

Based on the results of the students' work on question number 6, it can be seen that there is a difference in the ability of mathematical connections between KA and IR students. KA students showed the ability to relate mathematics to daily life (score 4) because they were able to relate contextual situations (stairs leaning against walls) into a right-right triangle mathematical model, using Theorem *Pythagoras* correctly, and complete the calculation with systematic steps. This is in accordance with the findings Hamdani & Nurdin, (2020)which states that high interest in learning correlates with the ability to relate mathematical concepts appropriately in contextual problem solving. In addition, the ability to connect good representations, namely transforming verbal information into visual and symbolic forms, is very important in solving mathematical problems systematically, which is in accordance with the abilities of KA students.

In contrast, IR students do not write down answers at all, so they do not show the ability to relate information from the problem to mathematical shapes or models. This condition reflects a low representation connection, i.e. the inability to transform verbal information into a visual or symbolic form, as explained by Mahendra & Mulyono, (2016) that mathematical connections include the ability to translate between mathematical representations in meaningful contexts. This is also in line with the results of the study Hutneriana et al., (2024) who found that students with low mathematical connections tend to have difficulty understanding and applying mathematical concepts in real-life situations.

Thus, the difference in mathematical connection ability between KA and IR students can be explained by differences in the ability to connect mathematical concepts logically and procedurally and transform mathematical representations appropriately in contextual contexts.

4. Conclusions

Based on the results of data analysis that have been described through the average percentage and triangulation of test results and interviews, it can be concluded that grade XI students of SMAN 4 Siak Hulu have a relatively high mathematical connection ability in solving problems in the *Pythagorean* Theorem material. Students are able to identify and relate mathematical concepts to other fields and between topics in mathematics. However, in the indicator of connecting mathematical concepts with daily life situations, some difficulties are still found, especially in converting contextual information into a proper mathematical model. Therefore, teachers need to continue to develop contextual learning strategies that encourage students to hone mathematical connection skills in everyday life.

Conflict of Interest

The authors declare no conflicts of interest.

References

Aini, J., & Saputro, M. (2023). Analisis Kesalahan Siswa Dalam Menyelesaikan Soal Cerita Materi Peluang Berdasarkan Tahapan Polya. *Sigma: Jurnal Pendidikan Matematika*, *15*(1), 71–80. https://doi.org/10.26618/sigma.v15i1.11417

Amilawati, D. (2025). *Peningkatan Kemampuan Koneksi dan Penalaran Matematis Siswa Sekolah Menengah Pertama melalui Pendekatan Pembelajaran STEM*. *09*, 151–159.

Asbar, V., Sains, U., & Nyak, C. (2024). *Matematika Kelas XI MA Muhammadiyah Boarding*. *8*(1).

Baiduri, Putri, O. R. U., & Alfani, I. (2020). Mathematical connection process of students with high mathematics ability in solving PISA problems. *European Journal of Educational Research*, *9*(4), 1527–1537. https://doi.org/10.12973/EU-JER.9.4.1527

Banne, R. S. R. R. L., Pulukadang, R. J., & Regar, V. E. (2024). *Analisis Kesalahan Siswa Dalam Menyelesaikan Soal Cerita Pada Materi Pythagoras Berdasarkan Teori Kastolan Di Smp Negeri 2 Langowan Analysis*. *7*(2).

Bungin, B. (2007). *Penelitian Kualitatif* (2nd ed.). Kencana.

Creswell. (2018). Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. In *Writing Center Talk over Time*. https://doi.org/10.4324/9780429469237-3

Duma, S. Y., Modjo, A. S., & Walid, A. (2024). *The role of Mathematics Education in Developing Critical Thingking Skill in the Industrial Era 5 . 0*. *1*(December), 1–11.

Evy yosita Silvia, Zulkardi, D. (2009). *Pengembangan Soal Matematika Model Pisa Pada Konten Uncertainty Untuk Mengukur Kemampuan Pemecahan Masalah Matematika Siswa Sekolah Menengah Pertama*.

Fahira, J., Arjudin, A., Amrullah, A., & Subarinah, S. (2023). Analasis Kemampuan Koneksi Matematis Ditinjau Dari Tipe Kepribadian MBTI (Myers Briggs Type Indicator) Siswa Kelas VII SMPN 6 Mataram pada Materi Perbandingan Tahun Ajaran 2022/2023. *Jurnal Ilmiah Profesi Pendidikan*, *8*(3), 1768–1774. https://doi.org/10.29303/jipp.v8i3.1581

Faridayanti, I., Nasrullah, A., Hidayat, A., & Kania, N. (2024). *The Impact of the Discovery Learning Model on Mathematical Communication Skills and Study Habits of Junior High School Students*. 16–29.

Fatunnisa, S. H., & Fitri, H. (2021). Kemampuan Koneksi Matematis Siswa Kelas VII.4 SMP N 1 2 X 11 Kayutanam. *CIRCLE : Jurnal Pendidikan Matematika*, *1*(02), 39–51. https://doi.org/10.28918/circle.v1i02.3930

Hartini, Z. (2022). Pengaruh Kemampuan Pemahaman Konsep Matematika dan Kemampuan Numerik Terhadap Kemampuan Menyelesaikan Soal Cerita. *Jurnal Riset Pendidikan Matematika Jakarta*, *4*(1), 12–22. https://doi.org/10.21009/jrpmj.v4i1.23022

Haryanti, Lastini, Setyaningsih, dan S. (2024). *Analisis Kesulitan Belajar Peserta Didik Sekolah Dasar Terhadap Kemampuan Koneksi Matematis Dalam Statistika*. *09*.

Hutneriana, R., Hidayah, I., Dwijanto, & Wardono. (2024). Meningkatkan Kemampuan Koneksi Matematis melalui Pembelajaran Matematika Realistik. *PRISMA, Prosiding Seminar Nasional Matematika*, *7*, 529–538.

Imani, R. A., Maimunah, M., & Roza, Y. (2023). Kemampuan Koneksi Matematis Siswa SMP pada Materi Statistika. *JIPM (Jurnal Ilmiah Pendidikan Matematika)*, *12*(1), 110. https://doi.org/10.25273/jipm.v12i1.12718

Istiqomah, F. (2022). Membangun Kemampuan Komunikasi Matematis Dalam Pembelajaran Matematika. *Jurnal Teknologi Dan Bisnis*, *4*(2), 135–142. https://doi.org/10.37087/jtb.v4i2.100

Jailani, Retnawati, H., Apino, E., & Santoso, A. (2020). High school students’ difficulties in making mathematical connections when solving problems. *International Journal of Learning, Teaching and Educational Research*, *19*(8), 255–277. https://doi.org/10.26803/ijlter.19.8.14

Khoiri, M., Lestari, A. S. B., & Rayungsari, M. (2024). Analisis Kemampuan Koneksi Matematis Berdasarkan Teori Kastolan Di MA At Taqwa Cabean. *Indonesian Journal of Teaching and Learning (INTEL)*, *3*(3), 157–168. https://doi.org/10.56855/intel.v3i3.1133

Lappan, G. (2002). *Getting to know connected mathematics: an implementation guide*.

Latifah, A. G., Quini, I. F., & Aripin, U. (2024). *Kemampuan Berpikir Komputasi Ditinjau dari Kecemasan Belajar Matematika*. *09*(September), 351–360.

Lenaini, I. (2021). Teknik Pengambilan Sampel Purposive Dan Snowball Sampling. *HISTORIS: Jurnal Kajian, Penelitian & Pengembangan Pendidikan Sejarah*, *6*(1), 33–39. http://journal.ummat.ac.id/index.php/historis

Luna, S., Liana, M., & Azmi, R. D. (2024). *Analisis Kesalahan Siswa Berdasarkan Teori Nolting dalam Menyelesaikan Soal Literasi Matematika Ditinjau dari Gaya Golb*. *16*, 269–283.

Mahendra, N. R., & Mulyono. (2016). Analisis Kemampuan Koneksi Matematis Siswa SMA Ditinjau dari Gaya Kognitif pada Model PBL. *Prosiding Seminar Nasional Matematika X Universitas Negeri Semarang*, *4*, 62–71.

Mila, S. N. J. A., Yayan, Y. E. S., Fara, S. S. F., Teeside, S. V. S., & Zoker, E. M. (2023). The Process of Students’ Mathematical Literacy in Solving System of Two Variables Linear Equation Based on Level of Ability. *Numerical: Jurnal Matematika Dan Pendidikan Matematika*, *7*(2), 333–344. https://doi.org/10.25217/numerical.v6i2.3859

Moleong. (2020). Kemampuan Koneksi Matematis berdasarkan Minat Belajar Siswa. *JURING (Journal for Research in Mathematics Learning)*, *3*(3), 275. https://doi.org/10.24014/juring.v3i3.10346

NCTM. (2000). Standards for school mathematics. *Reston, VA: National Council of*

Teachers of Mathematics.

Nurwita, F., Kusumah, Y. S., & Priatna, N. (2022). Exploring students' mathematical computational thinking ability in solving pythagorean theorem problems. *Al-Jabar : Jurnal Pendidikan Matematika*, *13*(2), 273–287. https://doi.org/10.24042/ajpm.v13i2.12496

Nyimbili, F., & Nyimbili, L. (2024). Types of Purposive Sampling Techniques with Their Examples and Application in Qualitative Research Studies. *British Journal of Multidisciplinary and Advanced Studies*, *5*(1), 90–99. https://doi.org/10.37745/bjmas.2022.0419

Palinkas, L. A., Horwitz, S. M., Green, C. A., Wisdom, J. P., Duan, N., Hoagwood, K., Angeles, L., & Northwest, K. P. (1968). Purposeful sampling for qualitative data collection and analysis in mixed method implementation research. *Dental Survey*, *44*(12), 73. https://doi.org/10.1007/s10488-013-0528-y.Purposeful

Rahmawaty, A., & Nurmeidina, R. (2023). Analisis Kesalahan Siswa Dalam Menyelesaikan Soal Ulangan Harian Matematika Pada Materi Teorema Phytagoras Di Masa New Normal. *EMTEKA: Jurnal Pendidikan Matematika*, *4*(1), 126–140.

Romiyansah, R., Karim, K., & Mawaddah, S. (2020). Analisis Kemampuan Koneksi Matematis Siswa Pada Pembelajaran Matematika Dengan Menggunakan Model Pembelajaran Inkuiri Terbimbing. *EDU-MAT: Jurnal Pendidikan Matematika*, *8*(1), 88–95. https://doi.org/10.20527/edumat.v8i1.8342

Rustam, R., Fitriawan, D., & Zubaidah, Z. (2021). Kemampuan Koneksi dan Representasi Matematis serta Cara Pembelajaran Matematika di SMA. *JURNAL E-DuMath*, *7*(2), 81–92. https://doi.org/10.52657/je.v7i2.1547

Sugiyono, S. (2015). Metode penelitian & pengembangan research and development. *Bandung: Alfabeta*.

Tama, D. A., & Setyadi, D. (2022). Kemampuan Koneksi Matematis Siswa dalam Memecahkan Masalah Matematika Materi Trigonometri. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *6*(2), 1536–1548. https://doi.org/10.31004/cendekia.v6i2.1303

Tinambunan, R. R., Pratiwi, S., Ulandari, N., & Ni'mah, N. T. A. (2023). Meningkatkan Kemampuan Berpikir Kritis Matematika Peserta Didik di Sekolah Dasar pada Era Digital. *Jurnal Pendidikan Guru Sekolah Dasar*, *1*(2), 1–10. https://doi.org/10.47134/pgsd.v1i2.149

Wardhana, I. R., & Fuady, A. (2024). Analisis kemampuan koneksi matematis peserta didik dalam menyelesaikan soal pythagoras ditinjau dari gaya kognitif. *JPMI (Jurnal Pembelajaran Matematika Inovatif)*, *7*(5), 863–874. https://doi.org/10.22460/jpmi.v7i5.21943

Yunita, D. Y., Utami, R. E., & Aini, A. N. (2024). Analisis Kemampuan Koneksi Matematika pada Materi Statistika Ditinjau dari Self Confidence. *Imajiner: Jurnal Matematika Dan Pendidikan Matematika*, *6*(3), 89–94. https://doi.org/10.26877/imajiner.v6i3.18966