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**Prof. Dr. Ratu Ilma Indra Putri, M.Si.** <ejournal@unsri.ac.id>

to me ▾

Ayu Faradillah:

Thank you for submitting the manuscript, "Mathematical Understanding Concepts Ability" to Jurnal Pendidikan Matematika. With the online journal management system that we are using, you will be able to track its progress through the editorial process by logging in to the journal web site:

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Prof. Dr. Ratu Ilma Indra Putri, M.Si.  
Department of Mathematics and Science Education,  
Faculty of Teacher Training and Education,  
Sriwijaya University,  
Indonesia

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## **Mathematical Understanding Concepts Ability in QR Code-Assisted Problem Solving by Gender**

### ***Abstract***

Student must be able to develop an accurate understand of mathematical concepts since this is essential for them to understand the concepts that are related to their studies. The purpose of this study is to analyse the ability of students' conceptual understanding assisted by QR codes in solving mathematical problems based on gender. This study is a qualitative research with a descriptive approach. The data collection techniques that were used in this study include tests, interviews, and documentation. The subjects of this research were one male and female students each in one of the public high schools in Jakarta. The research findings indicate that both males and females perform equally well in the indicators of restating concepts and providing examples and non-examples of the taught material. Subsequently, male are great in presenting concepts related to the learned material through mathematical representations. On the other hand, female are great in applying concepts logically. However, both males and females still exhibit deficiencies in their ability to classify objects based on the concepts that have been taught.

**Keywords:** Understanding Concepts, Gender, QR codes

### **Abstrak ← 10pt, bold, center**

Kemampuan pemahaman konsep matematis siswa menjadi hal penting yang harus dimiliki oleh siswa, karena dengan memahami konsep siswa akan dengan mudah untuk belajar dan menguasai konsep-konsep dalam matematika. Penelitian ini bertujuan untuk menganalisis kemampuan pemahaman konsep siswa berbantu QR dalam menyelesaikan masalah matematis berdasarkan gender. Penelitian ini merupakan penelitian kualitatif dengan pendekatan deksriptif. Teknik pengumpulan data dalam penelitian ini adalah tes, wawancara dan dokumentasi. Subjek dalam penelitian ini adalah masing-masing satu siswa laki-laki dan perempuan di salah satu Sekolah Menengah Atas negeri di Jakarta. Hasil penelitian menunjukkan bahwa laki-laki dan perempuan sama sama unggul dalam indikator menyatakan ulang konsep dan memberikan contoh dan bukan contoh dari materi yang telah diajarkan. Kemudian laki-laki unggul dalam menyajikan konsep pada materi yang dipelajari dalam representasi matematis. Sedangkan perempuan unggul dalam mengaplikasikan konsep secara logis. Namun, baik laki-laki maupun perempuan masih kurang dalam indikator mengklasifikasikan objek dari konsep yang sudah diajarkan.

**Kata kunci:** Kemampuan Pemahaman Konsep, Gender, QR code

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## **INTRODUCTION**

The understanding of concepts provide a crucial foundation for students to be able to understand functional mathematical ideas (Hartati, Abdullah & Haji, 2017). One elements of proficiency in learning mathematics in the independent curriculum is the understanding of mathematical concepts (Kepala Badan Penelitian dan Pengembangan dan Perbukuan, 2021).

Students who are able to understand mathematical concepts by involving mental processes so as to develop visual representations of the meaning of the concepts understood (Luritawaty, 2018).

However, students' understanding of mathematical concepts is still low. Due to an insufficient knowledge of crucial mathematical concepts, the students have difficulty solving mathematical problems (Ariyanto, Aditya, & Dwijayanti, 2019). Another factor is the limited learning time in the classroom, which causes students to have difficulty understanding the diverse concepts of mathematics. Additionally, the uninteresting teaching methods employed by teachers fail to develop students' interest in learning (Astuti et al., 2018; Lestari et al., 2019). The subject of mathematics is perceived as unenjoyable by some individuals due to its inherent difficulty and lack of engaging conditions. Therefore, implementing enjoyable play-based methods might improve the atmosphere of learning for mathematics. (Widyasari et al., 2019). While teachers try to make students understand the conceptual of mathematics, but their efforts does not succeed easily (Papadakis & Kalogiannakis, 2017).

Based on the previously stated explanation, the issue concerning students' mathematical concept understanding can be resolved by using exciting and interactive teaching media to capture their interest and motivation in the learning process, thus improving their ability to comprehend mathematical concepts. (Ariyanto et al., 2019). One way to increase students' enthusiasm and motivation in understanding mathematical concepts is smartphones. Smartphones as an effective tool to encourage student motivation to understand concepts through collaborative learning (Iqbal & Bhatti, 2020). It is difficult to write long characters in a site the internet address because typing errors might exist. The subject can be immediately accessed by using Quick Response codes or usually called by QR codes. Students can save time by avoiding typing with QR codes, and they will get it straight on the very first time (Widyasari et al., 2019). By using a QR code you can directly connect to a website without entering a web address (Park et al., 2019). This is done by scanning a QR code, which is a kind of two-dimensional barcode on smartphones.

The enthusiasm to learn inside students, their abilities, intelligence, the preparedness of teachers to teach in the classroom, the willingness of students to begin learning, the school curriculum, teaching methods, and gender differences are factors that require special attention in the learning process (Khasanah & Utami, 2020). In addition, there are several other internal and external factors, such as cognitive development of students which originates from within and is also influenced by gender. (Winata & Friantini, 2020). Gender is also an important factor in mathematics learning. In fact, there exist almost everywhere differences between females and males through any field. (Diandita et al., 2017). According to previous research, gender differences in maths learning depend on the type of task, the student's level of understanding and preparation, as well as the situation at the moment the task is being carried out. (Gross, 2014)

Gender stereotypes prevalent in society, such as the belief that men has higher mathematical

abilities than women, can pose a significant challenge to female students. However, According to Leder and Forgasz's findings, the potential for both genders to excel in various mathematical elements is contingent upon the specific domain of mathematics content being evaluated, as well as the assessment tool employed (Leder & Forgasz, 2018). The study indicated that gender differences didn't have any influence on the attitudes towards mathematics. However, it was observed that the attitudes towards mathematics varied among students attending schools that offered preparation for university education and those attending vocational schools (Guner, 2014). The 2018 PISA survey found that boys performed much better than girls in the ability to understand mathematical concepts (Marais et al., 2020).

Several study have been conducted regarding the mathematical understanding concepts, QR code and gender. First, In 2022, academic research examining the relationship between mathematics and gender indicates that female students exhibit more competence in this subject area than male students. The previous statements can be inferred from the indicators that demonstrate the instruction of concepts, the establishment of identity through exemplification or implementation of said concept, the explication of the concept through mathematical representation, the utilisation of specific operations, and the application of concepts to resolve problems (Syaifar & Roza, 2022). Second, The present study discusses the theme of mathematical concept comprehension among junior high school students, focusing on the material that reflects the final outcomes. The findings indicate that students who possess the ability to comprehend mathematical concepts are classified as low, with a percentage of 31.25%, when viewed from the implementation perspective (Handayani & Aini, 2019). Third, research (Widyasari et al., 2019) The utilisation of QR code technology in the learning process has been found to be beneficial for educators as it facilitates access to maths games, thereby enhancing children's motivation to learn mathematics. The utilization of the math game as an educational tool is advantageous for students as it provides them with the flexibility to access it at any time and from any location, thereby potentially enhancing their academic performance.

There are no previous relevant studies that have analyzed the ability to understand mathematical concepts in terms of gender and QR code-assisted technology. Therefore, in order to update this study, researchers conducted fresh studies to analyze how well male and female students of different gender understand mathematical ideas when using QR codes to solve issues. The researchers wanted to see how gender affected students' comprehension of mathematical ideas when using QR codes to solve problems.

## **METHODS**

The method used in this research is the descriptive qualitative approach. Qualitative research methods are carried out in natural conditions so this method is called the naturalistic research method (Sugiyono, 2018). This research was conducted in 10th Grade in one of Public Senior High School in Jakarta. The subjects were chosen through purposive sampling, where determining subjects is based on recommendations from teachers for subjects that have equivalent communication and mathematics

skills. So, one was chosen consisting of male students and another consisting of female students.

The research instrument was in the form of a description test with a total of 5 questions which contained indicators of the ability to understanding conceptual mathematic and were supported by interview results. The test in this study used mathematical understanding conceptual assisted by QR code, the validity and reliability of the previously mentioned has been validated through validation. The validation of the test was conducted through content validity by expert specialists in education, including a lecturer and a mathematics teacher. The result of this validation was changing the words used in the questions to make them easier to understand for upper secondary students.

In the content validation process, there were 4 classes of 10th grade students with a total of 140 students. Validity and reliability test using the Winstep software version 3.73. It is seen based on the MNSQ, ZTSD, and PT-MEASURE CORR values which displayed in the figure 1 below.

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	MEASURE	MODEL		INFIT		OUTFIT		PT-MEASURE		EXACT MATCH		Item
				S.E.	MNSQ	ZSTD	MNSQ	ZSTD	CORR.	EXP.	OBS%	EXP%		
1	246	86	-.07	.15	.78	-1.5	.82	-1.1	.76	.71	51.9	51.2	a1	
2	297	86	-1.38	.18	1.03	.2	.85	-.4	.59	.61	64.2	64.9	a2	
3	244	86	-.03	.15	.90	-.7	.84	-1.0	.76	.71	51.9	51.0	a3	
4	206	86	.78	.14	1.34	2.1	1.27	1.7	.68	.74	34.6	48.4	a4	
5	210	86	.70	.14	.99	.0	1.06	.5	.72	.74	48.1	46.9	a5	
MEAN	240.6	86.0	.00	.15	1.01	.0	.97	-.1			50.1	52.5		
S.D.	32.7	.0	.77	.01	.19	1.2	.18	1.0			9.5	6.4		

Figure 1. Validity of the Question Test

Figure 1 above shows that all items are declared valid because they have fulfilled the 2 suggested criteria, which is; Outfit Mean Square (MNSQ) is about  $0.5 < MNSQ < 1.5$ ; Outfit Z-Standard (ZSTD)  $-2.0 < ZSTD < +2.0$ ; Point Measure Correlation (Pt Measure Corr)  $0.4 < Pt Measure Corr < 0.85$  (Sakakibara et al., 2018). The test of mathematical understanding conceptual consists of five indicator which (1) restate the concepts in writing; (2) classify objects according to certain properties according to the concept; (3) apply the concepts logically; (4) give examples and not examples of a concepts they have learned; (5) able to present concept in the form of mathematical representation (Wibowo et al., 2021). The test assisted with Quick Response (QR) codes. The Cronbach alpha coefficient for the final scale derived from the test is 0.76, as illustrated in Figure 2..

	TOTAL SCORE	COUNT	MEASURE	MODEL ERROR	INFIT MNSQ	ZSTD	OUTFIT MNSQ	ZSTD
MEAN	14.0	5.0	1.62	.69				
S.D.	3.7	.0	1.46	.29				
MAX.	20.0	5.0	4.88	1.80				
MIN.	5.0	5.0	-1.73	.57	.07	-2.5	.08	-2.4
REAL RMSE	.79	TRUE SD	1.23	SEPARATION	1.55	Person RELIABILITY	.71	
MODEL RMSE	.75	TRUE SD	1.25	SEPARATION	1.66	Person RELIABILITY	.73	
S.E. OF Person MEAN = .16								
Person RAW SCORE-TO-MEASURE CORRELATION = .98								
CRONBACH ALPHA (KR-20) Person RAW SCORE "TEST" RELIABILITY = .76								

Figure 2. Reliability of the Question Test

Based on the figure 2, KR-20 value is 0.76, with high criteria according to Faradillah if the Cronbach's Alpha value is  $> 0.50$  the instrument is said to be reliable (Faradillah & Septiana, 2022). The selected participants went through a test to evaluate their ability to understand mathematical concepts. The instrument used for the study included of a set of 5 trigonometric questions that went through expert validation and was determined suitable for use. After taking the understanding concept ability test, the researcher interviewed the students. The purpose of the interview is to determine the students understanding concept ability, which is consisted 5 indicators. Researchers do not ask identical questions for each subject; rather, the questions depend on the quantity of information required.

## RESULTS AND DISCUSSION

Two students from the school were purposely selected according to their last results of students test score in X grade on mathematics and were interviewed by the researchers. The following shows the results by the gender, female student and male student.

Table 1. Subject Coding

No.	Gender	Subject Code
1.	Female	FS
2.	Male	MS

The researchers then analyze the students understanding conceptual ability assisted with QR codes. The QR codes requires a smartphone camera to scan a barcode which will show the image on the screen of the students smartphone. Question numbers three and five involve the application of QR code technology. The result are written based on each indicators.



Figure 3. QR code number 3



Figure 4. QR code number 5

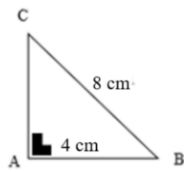


Figure 5. Question number 3

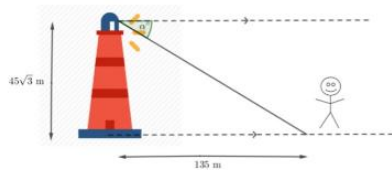


Figure 6. Question number 5

### Restate a concepts in writing

Students are supposed to show their understanding of the topic at issue by restating a significant concept. FS claimed to be familiar with the format of the test questions and able to paraphrase the concepts in her own words.

Answer :

$$\sin B = \frac{6}{10} // b : 10$$

$$\sin = \frac{\text{front side}}{\text{hypotenuse}}$$

∴ Adjacent (BC)

$$\sqrt{10^2 - 6^2} = \sqrt{100 - 36}$$

$$= \sqrt{64}$$

$$= 8$$

a.)  $\cot B = \frac{8}{10}$

b.)  $\tan B = \frac{6}{10}$

Figure 7. Results of FS's answer writing the concept of Trigonometry

*“So for question number 1 is a right triangle with sides  $AB = 6, BC = 10$ , and  $AC =$  unknown, then the question concerns the idea of comparing trigonometric functions. Here we shall search for  $\sin B$ , which is  $\frac{6}{10} = 6 : 10$ . A frontal of oblique  $\sin b$ . therefore, the answer is 8 when the Pythagoras theorem applied to the other side using the root formula  $\sqrt{10^2 - 6^2}$  is  $\sqrt{64} = 8$ . Simply substitute the  $\frac{8}{10} \cos B$  value with the  $\frac{6}{10} \tan B$  value.”.*

based on the findings of the FS answer sheets and supported by the outcomes of the interviews, it can be posited that FS has not satisfactorily fulfilled the criteria for restating concept in their own language, as they have failed to explicate the concept of the Pythagorean triangle that was assessed in the questions, instead solely concentrating on rote memorization of formulas. Then there are similarities in answers between male students who also excel in expressing concepts

MS claimed to have a complete understanding of the problem's structure and was able to articulate the central idea in his own words.

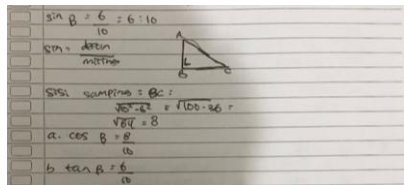


Figure 8. Results of MS's answer writing the concept of Trigonometry

*“In order to avoid getting lost when determining the trigonometry location I first write down what I already know. Specifically, the sin b value is  $\frac{6}{10}$ . Then I may apply the standard sin formula  $\frac{\text{forward}}{\text{stated}}$ . I can calculate cos from the BC length, but I didn't remember to look up tan”*

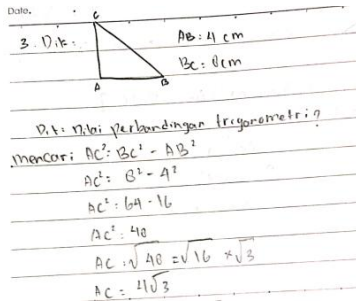
According to the findings based on answers and interviews, female students exhibit greater abilities in restating a concept and providing clear explanations of answers as compared to their male counterparts. The indicator pertaining to the restatement of a concept can be deemed as being fulfilled by FS. Consistent with prior research findings, it was observed that female students exhibited higher ability in the sequential and systematic application of the Steps, resulting in clear and neat writing with minimal errors attributable to aesthetic considerations. (Putra et al., 2016).

### Classify Objects According To Certain Properties According To The Concept

In this indicator, researchers deploy technology assisted by QR codes to solve questions. According to the interview findings, FS expressed a high level of confidence in comprehending the structure of the questions that were being evaluated.

*“The formula instructed in school had been used to determine the values of sine, cosine, and tangent for the improvement of the village in question. First, the length of  $AC^2$  was determined by employing the Pythagorean theorem, and a right triangle ABC was also depicted for this purpose.”*

However, FS also added that he did not fully understand the form of the questions because there was a question regarding the csc value for which he did not know the formula,



(a)

$$\sin \frac{de}{mi} = \frac{4\sqrt{3}}{8} = \frac{1}{2}\sqrt{3}$$

$$\cos \frac{ga}{mi} = \frac{4}{8} = \frac{1}{2}$$

$$\tan \frac{de}{sa} = \frac{4\sqrt{3}}{4} = \sqrt{3}$$

$$\csc \frac{mi}{de} = \frac{8}{4\sqrt{3}} = 2\sqrt{3}$$

(b)

Figure 9. (a) & (b) Results of FS's answer classify objects according to the Trigonometry

*"In school, we often only go as far as sin cos tan, thus I'm still looking for the solution to the cosecan value."*

The results of student answers are not optimal since there are still students who are not independent in working on the questions; many of these students rely on internet searches to find the answers. (Gebeyehu et al., 2021).

MS said he did not fully get the format of the questions on this indication, but he did his best to answer them using formula in number 1.

<input type="checkbox"/>	$AC^2 = BC^2 - AB^2$	$\sin = \frac{de}{mi} = \frac{4\sqrt{3}}{8} = \frac{1}{2}\sqrt{3}$
<input type="checkbox"/>	$AC^2 = 8^2 - 4^2$	$\cos = \frac{sa}{mi} = \frac{4}{8} = \frac{1}{2}$
<input type="checkbox"/>	$AC^2 = 64 - 16$	$\tan = \frac{de}{sa} = \frac{4\sqrt{3}}{4} = \sqrt{3}$
<input type="checkbox"/>	$AC^2 = 48$	$\csc = \frac{mi}{de} = \frac{8}{4\sqrt{3}} = 2\sqrt{3}$
<input type="checkbox"/>	$AC = \sqrt{48} = \sqrt{16 \times 3}$	
<input type="checkbox"/>	$AC = 4\sqrt{3}$	

Figure 10. Results of MS's answer classify objects according to the Trigonometry

*"Actually, I was confused by this problem, but after giving it some more thought, I realized that its structure was very similar to that of problem 1. To solve this problem, I first applied the Pythagorean theorem to determine the unknown length, and then I used the sin cos tan formula that I had learned in school."*

Just like FS, MS also said that he did not understand the cosecant concept and only memorized the formula taught at school.

*“Looking back at the notes, I realized that we had briefly covered cosecant in class; yet, I still didn't really get the concept.”*

Consistent with prior research, it was observed that a significant number of students were unable to respond to the teacher's inquiry regarding the previously taught material during the preceding session. (Nurhayati & Hartono, 2017)

### Apply the concept logically

FS said that in this problem it is necessary to illustrate the picture first to be able to understand the form of the question properly.

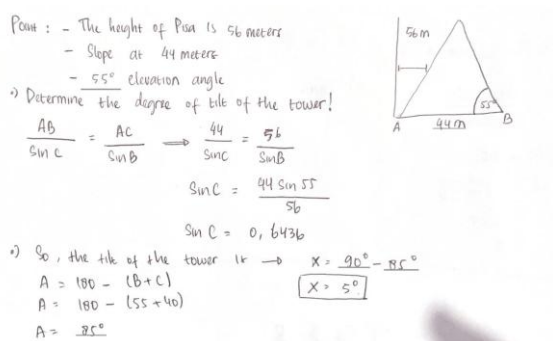


Figure 11. Results of FS's answer apply the concepts logically

*“It is stated in the question that 44 meters up from the ground, the Tower of Pisa begins to slope. The value of angle C was then calculated using the sine rule. After determining the value of sin C, you can next get the value at angle A by subtracting 180 from the sum of B and C (the alignment angle) resulting at  $85^\circ$ . Then, since  $90^\circ - 85^\circ = 5^\circ$ , the Leaning Tower of Pisa leans at an angle of  $5^\circ$ ”*

FS satisfies the indicators of being able to apply concepts rationally based on the responses written and the results of the interviews. FS uses visual aids to demonstrate its findings and offers advice on how to approach problems with assurance and order. This lends credence to the findings of prior studies, which found that female students, in comparison to their male counterparts, tend to generate a larger association between grades and achievement. (Lim & Chapman, 2013)

MS explained in the interview that he could not explain how to answer this question.

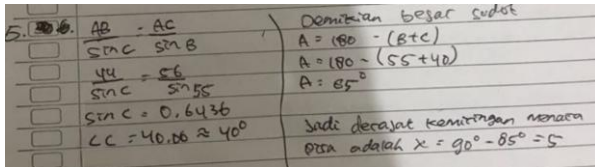


Figure 12. Results of MS’s answer apply the concepts logically

*“I understand quite a bit about this number, but I’m still not sure”*

MS continued by saying that he had learned certain things at school, but that he had to consult with his buddies in order to fully comprehend the questions. The answers show that students have a limited capacity to make connections between mathematical concepts and real-world situations. (Legesse et al., 2020).

*“I still don’t get what an elevation angle is supposed to signify, so perhaps if my teacher explains it again I’ll get it.”*

The MS worksheet exhibits an interesting characteristic of utilizing non-sequential steps and putting first the final answer over intermediate calculations. This approach results in extraneous markings and a lack of emphasis on aesthetic presentation and problem-solving sequence. The aforementioned observation aligns with Gallagher's findings that male students possess the capability to accurately solve non-traditional problems by utilizing their logical reasoning and comprehension skills (Gallagher et al., 2000). The findings of this investigation provide evidence that the inclination of MS to fulfill the criteria of employing concepts in a logical manner has an impact on the capacity to comprehend concepts.

### Give examples and not examples of a concept they have learned

The student taking the FS exam demonstrates a clear and organized approach to answering questions, beginning with responses labeled as a, b, and c.

*“I understand the methodology behind this proof, wherein I manipulate the formula by transposing the left and right sides. This trigonometry identity has been taught to us in school and it appears to have no alternative solution..”*

FS employs the formula for the three trigonometric identities called for in the issue, which is  $\sin^2 a + \cos^2 a = 1$ . Answers and findings from interview with researchers show that FS completes the indicator of providing examples that are concrete rather than only theoretical ones.

7. Buktikan yg termasuk identitas trigonometri:

a.  $\frac{1}{3} \sin^2 a + \frac{1}{3} \cos^2 a = \frac{1}{3}$

b.  $3 \cos^2 a - 2 = 1 - 3 \sin^2 a$

c.  $3 + 5 \sin^2 a = 3 - 5 \cos^2 a$

Jawab:

a.  $\frac{1}{3} \sin^2 a + \frac{1}{3} \cos^2 a = \frac{1}{3}$

$\frac{1}{3} (\sin^2 a + \cos^2 a) = \frac{1}{3}$

$\frac{1}{3} (1) = \frac{1}{3}$

$\frac{1}{3} = \frac{1}{3}$  (terbukti)

b.  $3 \cos^2 a - 2 = 1 - 3 \sin^2 a$

(ingat bahwa  $\sin^2 a + \cos^2 a = 1$ )

$3 \sin^2 a + 3 \cos^2 a = 3$

$3 \cos^2 a = 3 - 3 \sin^2 a$

Jadi,  $3 - 3 \sin^2 a - 2 = 1 - 3 \sin^2 a$

$1 - 3 \sin^2 a = 1 - 3 \sin^2 a$  (terbukti)

(a)

(b)

c.  $3 + 5 \sin^2 a = 3 - 5 \cos^2 a$

$(\sin^2 a + \cos^2 a = 1)$

$5 \sin^2 a + 5 \cos^2 a = 5$

$5 \sin^2 a = 5 - 5 \cos^2 a$

Jadi  $3 + 5 \sin^2 a = 3 - 5 \cos^2 a$

$3 + 5 - 5 \cos^2 a = 3 - 5 \cos^2 a$

$8 - 5 \cos^2 a = 3 - 5 \cos^2 a$

(tidak terbukti)

(c)

Figure 13. (a) (b) & (c) Results of FS's answer give examples and not examples

MS only fills in points a and b, while point c is empty.

Pembuktian

a)  $\frac{1}{3} \sin^2 a + \frac{1}{3} \cos^2 a = \frac{1}{3}$

$\frac{1}{3} (\sin^2 a + \cos^2 a) = \frac{1}{3}$

$\frac{1}{3} (1) = \frac{1}{3}$  (terbukti)

b)  $3 \cos^2 a - 2 = 1 - 3 \sin^2 a$

$3 \cos^2 a - 2 = 1 - 3(1 - \cos^2 a)$

$= 1 - (3 + 3 \cos^2 a)$

$= -2 + 3 \cos^2 a$

$3 \cos^2 a - 2 = 3 \cos^2 a - 2$  (terbukti)

Figure 14. Results of MS's answer give examples and not examples

*“...I didn't prove that since I don't think it can be demonstrated that point C is a trigonometric identity. Although I learnt trigonometry outside of school (via tutoring), I remembered point c in my memory.*

According to prior studies' findings that students did not fully understanding the idea, the latest findings suggested that students only memorized the formulas and lacked exposure to non-standard examples of trigonometric identity questions. (Nuraeni & Afriansyah, 2016)

### Present concepts in the form of mathematical representation

As a result of not completing the interview's answer sheet, FS was unable to demonstrate the indicators of being able to present concepts through mathematical representation. The context in which a student learns plays a crucial role in the student's ability to understanding new concepts. (Nova, Retta, & Nopriyanti, 2022). The students' understanding of the concept was closely associated with the context that was involved in the process of learning.

*“The depression angle is something I just don't get. I was taught this in school, but I can't put my finger on why I'm having trouble describing the problem mathematically. I still don't understand exactly this person's position is.”*

Female students who hold stronger gender roles and beliefs may perceive themselves as having lower abilities in learning mathematics compared to their male classmates. This perception can lead to increased anxiety when engaging in mathematical tasks, ultimately resulting in lower mathematics achievement. (Wen & Dubé, 2022). In contrast to MS, who carefully followed the instructions and filled out all of the answer sheets before conducting interviews to back up her finding.

*“There's a QR code, thus I'm curious about the answer to this question. Naturally, I started by scanning the QR barcode, then looked at the image, and finally I re-drew it on the answer sheet. I begin by calculating the depressive angle using the tan value. This ends up resulting in a depression angle of  $30^\circ$  as  $\tan = \frac{1}{3}\sqrt{3}$ .”*

From the results of the answer sheets and interviews, it can be said that MS meets the indicators of could present concepts in the form of mathematical representation.

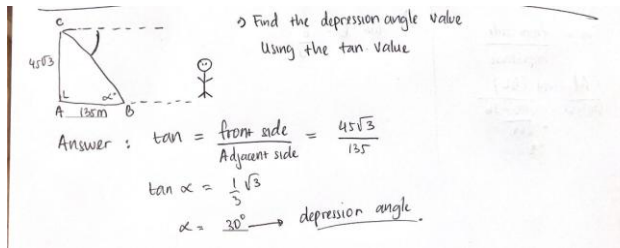


Figure 15. Results of FS's answer give examples and not examples

According to (Goos et al., 2016) the differences of students mathematical learning result influenced by gender differences has not been consistent, some studies have shown differences (male are better than female or vice versa) and some not show differences both. In general, gender differences in mathematical learning achievement depends the contents of the task, the nature of the assigned knowledge and skills, and the condition when working the task (Kamid et al., 2020).

**CONCLUSION**

Based on the results of data analysis of the research, it can be drawn that students understanding mathematical concepts ability in QR code assisted problem solving by gender were : female students exhibit greater levels of ability in restating a concept compared to their male classmates. Both male and female students show deficiencies in their ability to classify objects according to certain properties according to the concepts. In terms of the application of concepts in a logical manner, female students exhibit a higher level of ability compared to their male classmates. There are uncertainties regarding the ability of male students to successfully complete their education. Both female and male students demonstrate ability in providing examples and non-examples based on the concepts they have learned. They exhibit accuracy in solving questions and can be proven by the results of interviews. Male students outperform female students on the final indicators, which is Able to present concepts in the form of mathematical representation. This is due to the fact that female students do not complete out the answer sheet, preventing this indicator from being reached.

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## REFERENCES

- Ariyanto, L., Aditya, D., & Dwijayanti, I. (2019). Pengembangan Android Apps Berbasis Discovery Learning Untuk Meningkatkan Pemahaman Konsep Matematis Siswa Kelas VII. *Edumatika: Jurnal Riset Pendidikan Matematika*, 2(1), 40. <https://doi.org/10.32939/ejrpm.v2i1.355>
- Astuti, I. A. D., Dasmo, D., & Sumarni, R. A. (2018). Pengembangan Media Pembelajaran Berbasis Android Dengan Menggunakan Aplikasi Appypie Di Smk Bina Mandiri Depok. *Jurnal Pengabdian Kepada Masyarakat*, 24(2), 695. <https://doi.org/10.24114/jpkm.v24i2.10525>
- Chang, M., & Law, S. (2008). Factor structure for Young's Internet Addiction Test: A confirmatory study. *Computers in Human Behavior*, 24, 2597–2619. <https://doi.org/10.1016/j.chb.2008.03.001>
- Diandita, E. R., Johar, R., & Abidin, T. F. (2017). Kemampuan Komunikasi Matematis Dan Metakognitif Siswa Smp Pada Materi Lingkaran Berdasarkan Gender. *Jurnal Pendidikan Matematika*, 11(2), 79–97. <https://doi.org/10.22342/jpm.11.2.2533>.
- Estapa, A., & Nadolny, L. (2015). The Effect of Augmented Reality Applications in Biology Lesson on Academic Achievement and Motivation. *Journal of Education in Science, Environment and Health*, 16(3), 40–48. <https://doi.org/10.21891/jeseh.1059283>
- Estes, Z., & Felker, S. (2012). Confidence mediates the sex difference in mental rotation performance. *Archives of Sexual Behavior*, 41(3), 557–570. <https://doi.org/10.1007/s10508-011-9875-5>
- Faradillah, A., & Septiana, C. (2022). Mathematical Resilience: Validity And Reliability With Rasch Model And SPSS In Senior High School. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, 11(4), 3545–3555. <https://doi.org/https://doi.org/10.24127/ajpm.v11i4.5204>
- Gallagher, A. M., De Lisi, R., Holst, P. C., McGillicuddy-De Lisi, A. V., Morely, M., & Chalan, C. (2000). Gender Differences in Advanced Mathematical Problem Solving.

*Journal of Experimental Child Psychology*, 75(3), 165–190.  
<https://doi.org/10.1006/jecp.1999.2532>

Gebeyehu, M., Atnafu, M., & Ejigu, T. (2021). Heliyon Implementing GeoGebra integrated with multi-teaching approaches guided by the APOS theory to enhance students' conceptual understanding of limit in Ethiopian Universities. *Heliyon*, 7(October 2020), e07012. <https://doi.org/10.1016/j.heliyon.2021.e07012>

Goos, M., Stillman, G., Herbert, S., & Geiger, V. (2016). *Teaching Secondary School Mathematics* (2nd Edition). <https://doi.org/10.4324/9781003117810>

Gross, J. J. (2014). Conceptual and Empirical Foundations. *Handbook of Regulation Emotion Second Edition*, 3–20.

Guner, N. (2014). Using Metaphor Analysis To Explore High School Students' Attitudes Towards Learning Mathematics. *Education*, 133(1), 39–48.

Handayani, Y., & Aini, I. N. (2019). Analisis Kemampuan Pemahaman Konsep Matematis Siswa Pada Materi Peluang. *Prosiding Seminar Nasional Matematika Dan Pendidikan Matematika Sesiomadika 2019*, 4(1), 575–581. <https://doi.org/10.31949/dm.v4i1.2010>

Hartati, S., Abdullah, I., & Haji, S. (2017). Pengaruh Kemampuan Pemahaman Konsep, Kemampuan Komunikasi Dan Koneksi Terhadap Kemampuan Pemecahan Masalah. *Jurnal Pendidikan Matematika*, 11(3), 41–59.

Kamid, Rusdi, M., Fitaloka, O., Basuki, F. R., & Anwar, K. (2020). Mathematical communication skills based on cognitive styles and gender. *International Journal of Evaluation and Research in Education*, 9(4), 847–856. <https://doi.org/10.11591/ijere.v9i4.20497>

Khasanah, M., & Utami, R. E. (2020). Analisis Kemampuan Pemahaman Konsep Matematis Siswa SMA Berdasarkan Gender. 2(5), 347–354.

Leder, G., & Forgasz, H. (2018). Measuring Who Counts: Gender and Mathematics Assessment. *ZDM: The International Journal on Mathematics Education*, 50. <https://doi.org/10.1007/s11858-018-0939-z>

Legesse, M., Luneta, K., & Ejigu, T. (2020). Analyzing the effects of mathematical discourse-

based instruction on eleventh-grade students' procedural and conceptual understanding of probability and statistics. *Studies in Educational Evaluation*, 67(July), 100918. <https://doi.org/10.1016/j.stueduc.2020.100918>

Lestari, A. I., Senjaya, A. J., & Ismunandar, D. (2019). Pengembangan Media Pembelajaran Berbasis Android Menggunakan Appy Pie Untuk Melatih Pemahaman Konsep Turunan Fungsi Aljabar. *Pedagogy: Jurnal Pendidikan Matematika*, 4(2), 1–9. <https://doi.org/10.30605/pedagogy.v4i2.1437>

Lim, S. Y., & Chapman, E. (2013). Development of a short form of the attitudes toward mathematics inventory Author (s): Siew Yee Lim and Elaine Chapman Source : Educational Studies in Mathematics , Vol . 82 , No . 1 ( January 2013 ), pp . 145-164 Published by : Springer Stable URL : [http://www.springer.com/10.1007/978-1-4419-9999-9\\_14](http://www.springer.com/10.1007/978-1-4419-9999-9_14) *Educational Studies in Mathematics*, 82(1), 145–164.

Luritawaty, I. P. (2018). Pembelajaran Take And Give Dalam Upaya Mengembangkan Kemampuan Pemahaman Konsep Matematis. *Mosharafa: Jurnal Pendidikan Matematika*, 7, 179–188.

National Foundation for Educational Research (NFER). (2010). *Programme for International Student Assessment 2009 achievement of 15-year-olds in England*.

Nova, E., Retta, A. M., & Nopriyanti, T. D. (2022). Student Worksheet Development Using the PMRI Approach in the Classroom Context with an Orientation toward Students' Conceptual Understanding. *Jurnal Pendidikan Matematika*, 16(2), 203–214.

Nuraeni, Y., & Afriansyah, E. A. (2016). Peningkatan Kemampuan Pemahaman Matematis Siswa Melalui Pembelajaran Kooperatif Tipe Rotating Trio Exchange. *Jurnal Inovasi Pendidikan Dasar*, 1(2), 85–94. <http://jipd.uhamka.ac.id/index.php/jipd/article/view/24/12>

Nurhayati, D. M., & Hartono. (2017). Implementation of cooperative learning model type STAD with RME approach to understanding of mathematical concept student state junior high school in Pekanbaru. *AIP Conference Proceedings*, 1848(2017), 1–6. <https://doi.org/10.1063/1.4983940>

Papadakis, S., & Kalogiannakis, M. (2017). Mobile educational applications for children. What

educators and parents need to know. *International Journal of Mobile Learning and Organisation*, 11(2), 1. <https://doi.org/10.1504/ijmlo.2017.10003925>

Putra, H., Wijaya, I., & Sujadi, I. (2016). Kemampuan Komunikasi Matematis Siswa Sesuai Dengan Gender Dalam Pemecahan Masalah Pada Materi Balok Dan Kubus (Studi Kasus Pada Siswa Smp Kelas Viii Smp Islam Al-Azhar 29 Semarang). *Jurnal Elektronik Pembelajaran Matematika*, 4(9), 778–788. <http://jurnal.fkip.uns.ac.id>

Sakakibara, B. M., Miller, W. C., Rushton, P. W., & Polgar, J. M. (2018). Rasch Analyses of the Wheelchair Use Confidence Scale for Power Wheelchair Users. *Archives of Physical Medicine and Rehabilitation*, 99(1), 17–25. <https://doi.org/10.1016/j.apmr.2017.09.004>

Peraturan Menteri Pendidikan Nasional Republik Indonesia, Pub. L. No. 22, 13 1 (2016). <https://akhmadsudrajat.files.wordpress.com/2009/04/permendiknas-no-22-tahun-2006.pdf>

Sugiyono. (2018). *Metode Penelitian Kuantitatif, Kualitatif, dan Kombinasi (mixed methods)* (Cetakan ke). Bandung; Alfabeta, 2011.

Thulasidharan, P. P., & Nair, M. S. (2015). QR code based blind digital image watermarking with attack detection code. *AEU - International Journal of Electronics and Communications*, 69(7), 1074–1084. <https://doi.org/10.1016/j.aeue.2015.03.007>

Wen, R., & Dubé, A. K. (2022). A Systematic Review of Secondary Students' Attitudes Towards Mathematics and its Relations With Mathematics Achievement. *Journal of Numerical Cognition*, 8(2), 295–325. <https://doi.org/10.5964/jnc.7937>

Wibowo, T., Darmono, P. B., & Azieta, H. N. (2021). An Analysis of the Ability to Understand Mathematical Concepts of Middle School Students in Completing Integer Operations. *Jurnal Pendidikan Matematika*, 16(1), 29–44. <https://doi.org/10.22342/jpm.16.1.15324.29-44>

Widyasari, W., Sutopo, H., & Agustian, M. (2019). QR code-based learning development: Accessing math game for children learning enhancement. *International Journal of Interactive Mobile Technologies*, 13(11), 111–124. <https://doi.org/10.3991/ijim.v13i11.10976>

## 2. BUKTI KONFIRMASI REVIEW DAN HASIL REVIEW PERTAMA (24 SEPTEMBER 2023)

[JPM] Editor Decision External Inbox x



Prof. Ratu Ilma Indra Putri <ejournal@unsri.ac.id>

to me ▾

Ayu Faradillah:

We have reached a decision regarding your submission to Jurnal Pendidikan Matematika, "Mathematical Understanding Concepts Ability in QR Code-Assisted Problem Solving by Gender".

Our decision is to: MINOR REVISION

Prof. Ratu Ilma Indra Putri  
(SCOPUS ID: 55874038900), Universitas Sriwijaya, Palembang  
[ratu.ilma@yahoo.com](mailto:ratu.ilma@yahoo.com)

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Jurnal Pendidikan Matematika <jpm@unsri.ac.id>  
to putri.awaliarizkia, me ▾

Sat, Oct 14, 2023, 8:00 PM ☆ ↶ ⋮

Dear Putri Awalia Rizkia, Ayu Faradillah:

Just a gentle reminder of our request on the previous email for your revision of the manuscript, "Mathematical Understanding Concepts Ability in QR Code-Assisted Problem Solving by Gender" for Jurnal Pendidikan Matematika. We were hoping to have this revised by 18-10-2023, and would be pleased to receive it as soon as you are able to prepare it. We also remind you to attach proofreading certificate and plagiarism check results of your revision manuscript.

Please confirm your manuscript to complete this vital contribution to the work of the journal. I look forward to hearing from you. Should you have any questions, please do not hesitate to contact us with WA Number +6289627002026 (Duano)

Kind regards

Prof. Dr. Ratu Ilma Indra Putri, M.Si.

Editor in Chief

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Department of Master Program on Mathematics Education

Faculty of Teacher Training and Education

Sriwijaya University, Palembang, Indonesia

Jl. Srijaya Negara, Bukit Besar Palembang - 30139

## **Mathematical Understanding Concepts Ability in QR Code-Assisted Problem Solving by Gender**

### ***Abstract***

Student must be able to develop an accurate understand of mathematical concepts since this is essential for them to understand the concepts that are related to their studies. The purpose of this study is to analyse the ability of students' conceptual understanding assisted by QR codes in solving mathematical problems based on gender. This study is a qualitative research with a descriptive approach. The data collection techniques that were used in this study include tests, interviews, and documentation. The subjects of this research were one male and female students each in one of the public high schools in Jakarta. The research findings indicate that both males and females perform equally well in the indicators of restating concepts and providing examples and non-examples of the taught material. Subsequently, male are great in presenting concepts related to the learned material through mathematical representations. On the other hand, female are great in applying concepts logically. However, both males and females still exhibit deficiencies in their ability to classify objects based on the concepts that have been taught.

**Keywords:** Understanding Concepts, Gender, QR codes

### **Abstrak ← 10pt, bold, center**

Kemampuan pemahaman konsep matematis siswa menjadi hal penting yang harus dimiliki oleh siswa, karena dengan memahami konsep siswa akan dengan mudah untuk belajar dan menguasai konsep-konsep dalam matematika. Penelitian ini bertujuan untuk menganalisis kemampuan pemahaman konsep siswa berbantu QR dalam menyelesaikan masalah matematis berdasarkan gender. Penelitian ini merupakan penelitian kualitatif dengan pendekatan deksriptif. Teknik pengumpulan data dalam penelitian ini adalah tes, wawancara dan dokumentasi. Subjek dalam penelitian ini adalah masing-masing satu siswa laki-laki dan perempuan di salah satu Sekolah Menengah Atas negeri di Jakarta. Hasil penelitian menunjukkan bahwa laki-laki dan perempuan sama sama unggul dalam indikator menyatakan ulang konsep dan memberikan contoh dan bukan contoh dari materi yang telah diajarkan. Kemudian laki-laki unggul dalam menyajikan konsep pada materi yang dipelajari dalam representasi matematis. Sedangkan perempuan unggul dalam mengaplikasikan konsep secara logis. Namun, baik laki-laki maupun perempuan masih kurang dalam indikator mengklasifikasikan objek dari konsep yang sudah diajarkan.

**Kata kunci:** Kemampuan Pemahaman Konsep, Gender, QR code

**How to Cite:** (2023). Analisis Kemampuan Pemahaman Konsep Matematis Siswa Berbantu QR Code dalam Menyelesaikan Masalah Berdasarkan Gender. *Jurnal Pendidikan Matematika*

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## **INTRODUCTION**

The understanding of concepts provide a crucial foundation for students to be able to understand functional mathematical ideas (Hartati, Abdullah & Haji, 2017). One elements of proficiency in learning mathematics in the independent curriculum is the understanding of mathematical concepts (Kepala Badan Penelitian dan Pengembangan dan Perbukuan, 2021).

Students who are able to understand mathematical concepts by involving mental processes so as to develop visual representations of the meaning of the concepts understood (Luritawaty, 2018).

However, students' understanding of mathematical concepts is still low. Due to an insufficient knowledge of crucial mathematical concepts, the students have difficulty solving mathematical problems (Ariyanto, Aditya, & Dwijayanti, 2019). Another factor is the limited learning time in the classroom, which causes students to have difficulty understanding the diverse concepts of mathematics. Additionally, the uninteresting teaching methods employed by teachers fail to develop students' interest in learning (Astuti et al., 2018; Lestari et al., 2019). The subject of mathematics is perceived as unenjoyable by some individuals due to its inherent difficulty and lack of engaging conditions. Therefore, implementing enjoyable play-based methods might improve the atmosphere of learning for mathematics. (Widyasari et al., 2019). While teachers try to make students understand the conceptual of mathematics, but their efforts does not succeed easily (Papadakis & Kalogiannakis, 2017).

Based on the previously stated explanation, the issue concerning students' mathematical concept understanding can be resolved by using exciting and interactive teaching media to capture their interest and motivation in the learning process, thus improving their ability to comprehend mathematical concepts. (Ariyanto et al., 2019). One way to increase students' enthusiasm and motivation in understanding mathematical concepts is smartphones. Smartphones as an effective tool to encourage student motivation to understand concepts through collaborative learning (Iqbal & Bhatti, 2020). It is difficult to write long characters in a site the internet address because typing errors might exist. The subject can be immediately accessed by using Quick Response codes or usually called by QR codes. Students can save time by avoiding typing with QR codes, and they will get it straight on the very first time (Widyasari et al., 2019). By using a QR code you can directly connect to a website without entering a web address (Park et al., 2019). This is done by scanning a QR code, which is a kind of two-dimensional barcode on smartphones.

The enthusiasm to learn inside students, their abilities, intelligence, the preparedness of teachers to teach in the classroom, the willingness of students to begin learning, the school curriculum, teaching methods, and gender differences are factors that require special attention in the learning process (Khasanah & Utami, 2020). In addition, there are several other internal and external factors, such as cognitive development of students which originates from within and is also influenced by gender. (Winata & Friantini, 2020). Gender is also an important factor in mathematics learning. In fact, there exist almost everywhere differences between females and males through any field. (Diandita et al., 2017). According to previous research, gender differences in maths learning depend on the type of task, the student's level of understanding and preparation, as well as the situation at the moment the task is being carried out. (Gross, 2014)

Gender stereotypes prevalent in society, such as the belief that men has higher mathematical

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Each paragraph contains only 1 main idea

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abilities than women, can pose a significant challenge to female students. However, According to Leder and Forgasz's findings, the potential for both genders to excel in various mathematical elements is contingent upon the specific domain of mathematics content being evaluated, as well as the assessment tool employed (Leder & Forgasz, 2018). The study indicated that gender differences didn't have any influence on the attitudes towards mathematics. However, it was observed that the attitudes towards mathematics varied among students attending schools that offered preparation for university education and those attending vocational schools (Guner, 2014). The 2018 PISA survey found that boys performed much better than girls in the ability to understand mathematical concepts (Marais et al., 2020).

Several study have been conducted regarding the mathematical understanding concepts, QR code and gender. First, In 2022, academic research examining the relationship between mathematics and gender indicates that female students exhibit more competence in this subject area than male students. The previous statements can be inferred from the indicators that demonstrate the instruction of concepts, the establishment of identity through exemplification or implementation of said concept, the explication of the concept through mathematical representation, the utilisation of specific operations, and the application of concepts to resolve problems (Syaifar & Roza, 2022). Second, The present study discusses the theme of mathematical concept comprehension among junior high school students, focusing on the material that reflects the final outcomes. The findings indicate that students who possess the ability to comprehend mathematical concepts are classified as low, with a percentage of 31.25%, when viewed from the implementation perspective (Handayani & Aini, 2019). Third, research (Widyasari et al., 2019) The utilisation of QR code technology in the learning process has been found to be beneficial for educators as it facilitates access to maths games, thereby enhancing children's motivation to learn mathematics. The utilization of the math game as an educational tool is advantageous for students as it provides them with the flexibility to access it at any time and from any location, thereby potentially enhancing their academic performance.

There are no previous relevant studies that have analyzed the ability to understand mathematical concepts in terms of gender and QR code-assisted technology. Therefore, in order to update this study, researchers conducted fresh studies to analyze how well male and female students of different gender understand mathematical ideas when using QR codes to solve issues. The researchers wanted to see how gender affected students' comprehension of mathematical ideas when using QR codes to solve problems.

## METHODS

The method used in this research is the descriptive qualitative approach. Qualitative research methods are carried out in natural conditions so this method is called the naturalistic research method (Sugiyono, 2018). This research was conducted in 10th Grade in one of Public Senior High School in Jakarta. The subjects were chosen through purposive sampling, where determining subjects is based on recommendations from teachers for subjects that have equivalent communication and mathematics

**Commented [NA4]:** In this paragraph there are two different opinions?  
Actually there is or not an effect of gender differences on math ability?

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skills. So, one was chosen consisting of male students and another consisting of female students.

The research instrument was in the form of a description test with a total of 5 questions which contained indicators of the ability to understanding conceptual mathematic and were supported by interview results. The test in this study used mathematical understanding conceptual assisted by QR code, the validity and reliability of the previously mentioned has been validated through validation. The validation of the test was conducted through content validity by expert specialists in education, including a lecturer and a mathematics teacher. The result of this validation was changing the words used in the questions to make them easier to understand for upper secondary students.

In the content validation process, there were 4 classes of 10th grade students with a total of 140 students. Validity and reliability test using the Winstep software version 3.73. It is seen based on the MNSQ, ZTSD, and PT-MEASURE CORR values which displayed in the figure 1 below.

**Commented [NA6]:** This research was done in 10th or 11th grade?  
 In the previous paragraph it was written 10th grade  
 Are 10th or 11th grade abilities equal?

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	MEASURE	MODEL S.E.		INFIT		OUTFIT		PT-MEASURE		EXACT MATCH		Item
				MNSQ	ZSTD	MNSQ	ZSTD	MNSQ	ZSTD	CORR.	EXP.	OBS%	EXP%	
1	246	86	-.07	.15	.78	-1.5	.82	-1.1	.76	.71	51.9	51.2	a1	
2	297	86	-1.38	.18	1.03	.2	.85	-.4	.59	.61	64.2	64.9	a2	
3	244	86	-.03	.15	.90	-.7	.84	-1.0	.76	.71	51.9	51.0	a3	
4	206	86	.78	.14	1.34	2.1	1.27	1.7	.68	.74	34.6	48.4	a4	
5	210	86	.70	.14	.99	.0	1.06	.5	.72	.74	48.1	46.9	a5	
MEAN	240.6	86.0	.00	.15	1.01	.0	.97	-.1			50.1	52.5		
S.D.	32.7	.0	.77	.01	.19	1.2	.18	1.0			9.5	6.4		

Figure 16. Validity of the Question Test

Figure 1 above shows that all items are declared valid because they have fulfilled the 2 suggested criteria, which is; Outfit Mean Square (MNSQ) is about  $0.5 < MNSQ < 1.5$  ; Outfit Z-Standard (ZSTD)  $-2.0 < ZSTD < +2.0$  ; Point Measure Correlation (Pt Measure Corr)  $0.4 < Pt Measure Corr < 0.85$  (Sakakibara et al., 2018). The test of mathematical understanding conceptual consists of five indicator which (1) restate the concepts in writing; (2) classify objects according to certain properties according to the concept; (3) apply the concepts logically; (4) give examples and not examples of a concepts they have learned; (5) able to present concept in the form of mathematical representation (Wibowo et al., 2021). The test assisted with Quick Response (QR) codes. The Cronbach alpha coefficient for the final scale derived from the test is 0.76, as illustrated in Figure 2..

	TOTAL SCORE	COUNT	MEASURE	MODEL ERROR	INFIT MNSQ	ZSTD	OUTFIT MNSQ	ZSTD
MEAN	14.0	5.0	1.62	.69				
S.D.	3.7	.0	1.46	.29				
MAX.	20.0	5.0	4.88	1.80				
MIN.	5.0	5.0	-1.73	.57	.07	-2.5	.08	-2.4
REAL RMSE	.79	TRUE SD	1.23	SEPARATION	1.55	Person RELIABILITY	.71	
MODEL RMSE	.75	TRUE SD	1.25	SEPARATION	1.66	Person RELIABILITY	.73	
S.E. OF Person MEAN = .16								
Person RAW SCORE-TO-MEASURE CORRELATION = .98								
CRONBACH ALPHA (KR-20) Person RAW SCORE "TEST" RELIABILITY = .76								

Figure 17. Reliability of the Question Test

Based on the figure 2, KR-20 value is 0.76, with high criteria according to Faradillah if the Cronbach's Alpha value is  $> 0.50$  the instrument is said to be reliable (Faradillah & Septiana, 2022). The selected participants went through a test to evaluate their ability to understand mathematical concepts. The instrument used for the study included of a set of 5 trigonometric questions that went through expert validation and was determined suitable for use. After taking the understanding concept ability test, the researcher interviewed the students. The purpose of the interview is to determine the students understanding concept ability, which is consisted 5 indicators. Researchers do not ask identical questions for each subject; rather, the questions depend on the quantity of information required.

## RESULTS AND DISCUSSION

Two students from the school were purposely selected according to their last results of students test score in X grade on mathematics and were interviewed by the researchers. The following shows the results by the gender, female student and male student.

Table 2. Subject Coding

No.	Gender	Subject Code
1.	Female	FS
2.	Male	MS

The researchers then analyze the students understanding conceptual ability assisted with QR codes. The QR codes requires a smartphone camera to scan a barcode which will show the image on the screen of the students smartphone. Question numbers three and five involve the application of QR code technology. The result are written based on each indicators.



Figure 18. QR code number 3



Figure 19. QR code number 5

**Commented [NA7]:** There are no questions on the QR  
Just a picture

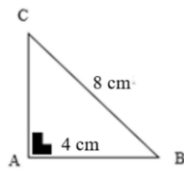


Figure 20. Question number 3

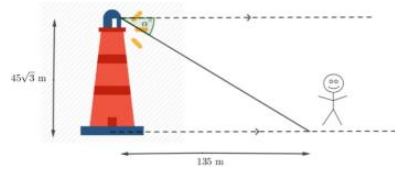


Figure 21. Question number 5

### Restate a concepts in writing

Students are supposed to show their understanding of the topic at issue by restating a significant concept. FS claimed to be familiar with the format of the test questions and able to paraphrase the concepts in her own words.

Figure 22. Results of FS's answer writing the concept of Trigonometry

*“So for question number 1 is a right triangle with sides  $AB = 6, BC = 10$ , and  $AC =$  unknown, then the question concerns the idea of comparing trigonometric functions. Here we shall search for  $\sin B$ , which is  $\frac{6}{10} = 6:10$ . A frontal of oblique  $\sin b$ . therefore, the answer is 8 when the Pythagoras theorem applied to the other side using the root formula  $\sqrt{10^2 - 6^2}$  is  $\sqrt{64} = 8$ . Simply substitute the  $\frac{8}{10} \cos B$  value with the  $\frac{6}{10} \tan B$  value.”.*

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based on the findings of the FS answer sheets and supported by the outcomes of the interviews, it can be posited that FS has not satisfactorily fulfilled the criteria for restating concept in their own language, as they have failed to explicate the concept of the Pythagorean triangle that was assessed in the questions, instead solely concentrating on rote memorization of formulas. Then there are similarities in answers between male students who also excel in expressing concepts MS claimed to have a complete understanding of the problem's structure and was able to articulate the central idea in his own words.

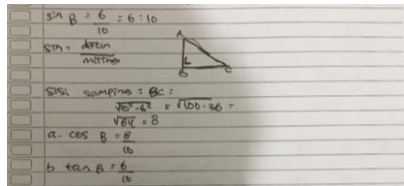


Figure 23. Results of MS's answer writing the concept of Trigonometry

*"In order to avoid getting lost when determining the trigonometry location, I first write down what I already know. Specifically, the sin b value is  $\frac{6}{10}$ . Then I may apply the standard sin formula  $\frac{\text{forward}}{\text{stanted}}$ . I can calculate cos from the BC length, but I didn't remember to look up tan"*

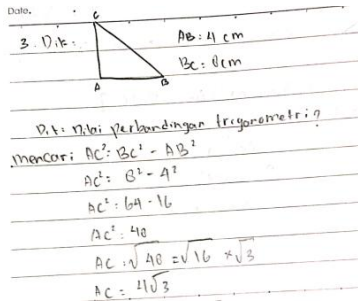
According to the findings based on answers and interviews, female students exhibit greater abilities in restating a concept and providing clear explanations of answers as compared to their male counterparts. The indicator pertaining to the restatement of a concept can be deemed as being fulfilled by FS. Consistent with prior research findings, it was observed that female students exhibited higher ability in the sequential and systematic application of the Steps, resulting in clear and neat writing with minimal errors attributable to aesthetic considerations. (Putra et al., 2016).

### Classify Objects According To Certain Properties According To The Concept

In this indicator, researchers deploy technology assisted by QR codes to solve questions. According to the interview findings, FS expressed a high level of confidence in comprehending the structure of the questions that were being evaluated.

*"The formula instructed in school had been used to determine the values of sine, cosine, and tangent for the improvement of the village in question. First, the length of  $AC^2$  was determined by employing the Pythagorean theorem, and a right triangle ABC was also depicted for this purpose."*

However, FS also added that he did not fully understand the form of the questions because there was a question regarding the csc value for which he did not know the formula,



(a)

$$\sin \frac{de}{mi} = \frac{4\sqrt{3}}{8} = \frac{1}{2}\sqrt{3}$$

$$\cos \frac{sa}{mi} = \frac{4}{8} = \frac{1}{2}$$

$$\tan \frac{de}{sa} = \frac{4\sqrt{3}}{4} = \sqrt{3}$$

$$\csc \frac{mi}{de} = \frac{8}{4\sqrt{3}} = 2\sqrt{3}$$

(b)

Figure 24. (a) & (b) Results of FS's answer classify objects according to the Trigonometry

*"In school, we often only go as far as sin cos tan, thus I'm still looking for the solution to the cosecan value."*

The results of student answers are not optimal since there are still students who are not independent in working on the questions; many of these students rely on internet searches to find the answers. (Gebeyehu et al., 2021).

MS said he did not fully get the format of the questions on this indication, but he did his best to answer them using formula in number 1.

<input checked="" type="checkbox"/>	$AC^2 = BC^2 - AB^2$	$\sin = \frac{de}{mi} = \frac{4\sqrt{3}}{8} = \frac{1}{2}\sqrt{3}$ $\cos = \frac{sa}{mi} = \frac{4}{8} = \frac{1}{2}$ $\tan = \frac{de}{sa} = \frac{4\sqrt{3}}{4} = \sqrt{3}$ $\csc = \frac{mi}{de} = \frac{8}{4\sqrt{3}} = 2\sqrt{3}$
<input type="checkbox"/>	$AC^2 = 8^2 - 4^2$	
<input type="checkbox"/>	$AC^2 = 64 - 16$	
<input type="checkbox"/>	$AC^2 = 48$	
<input type="checkbox"/>	$AC = \sqrt{48} = \sqrt{16 \times 3}$	
<input type="checkbox"/>	$AC = 4\sqrt{3}$	
<input type="checkbox"/>		

Figure 25. Results of MS's answer classify objects according to the Trigonometry

*"Actually, I was confused by this problem, but after giving it some more thought, I realized that its structure was very similar to that of problem 1. To solve this problem, I first applied the Pythagorean theorem to determine the unknown length, and then I used the sin cos tan formula that I had learned in school."*

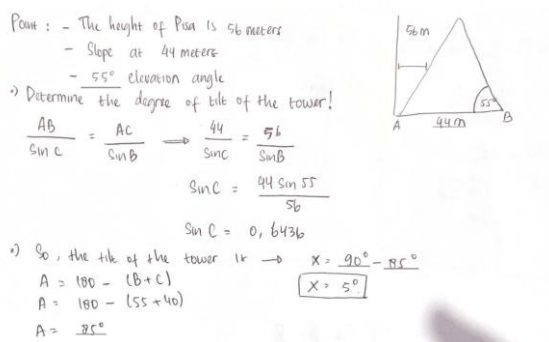
Just like FS, MS also said that he did not understand the cosecant concept and only memorized the formula taught at school.

*“Looking back at the notes, I realized that we had briefly covered cosecant in class; yet, I still didn't really get the concept.”*

Consistent with prior research, it was observed that a significant number of students were unable to respond to the teacher's inquiry regarding the previously taught material during the preceding session. (Nurhayati & Hartono, 2017)

### Apply the concept logically

FS said that in this problem it is necessary to illustrate the picture first to be able to understand the form of the question properly.



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Figure 26. Results of FS's answer apply the concepts logically

*“It is stated in the question that 44 meters up from the ground, the Tower of Pisa begins to slope. The value of angle C was then calculated using the sine rule. After determining the value of sin C, you can next get the value at angle A by subtracting 180 from the sum of B and C (the alignment angle) resulting at 85°. Then, since 90° – 85° = 5°, the Leaning Tower of Pisa leans at an angle of 5°”*

FS satisfies the indicators of being able to apply concepts rationally based on the responses written and the results of the interviews. FS uses visual aids to demonstrate its findings and offers advice on how to approach problems with assurance and order. This lends credence to the findings of prior studies, which found that female students, in comparison to their male counterparts, tend to generate a larger association between grades and achievement. (Lim & Chapman, 2013)

MS explained in the interview that he could not explain how to answer this question.

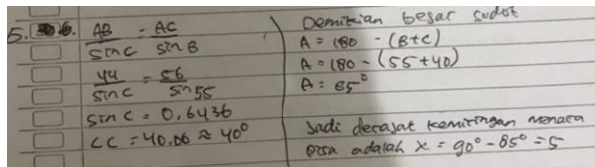


Figure 27. Results of MS’s answer apply the concepts logically

*“I understand quite a bit about this number, but I’m still not sure”*

MS continued by saying that he had learned certain things at school, but that he had to consult with his buddies in order to fully comprehend the questions. The answers show that students have a limited capacity to make connections between mathematical concepts and real-world situations. (Legesse et al., 2020).

*“I still don’t get what an elevation angle is supposed to signify, so perhaps if my teacher explains it again I’ll get it.”*

The MS worksheet exhibits an interesting characteristic of utilizing non-sequential steps and putting first the final answer over intermediate calculations. This approach results in extraneous markings and a lack of emphasis on aesthetic presentation and problem-solving sequence. The aforementioned observation aligns with Gallagher's findings that male students possess the capability to accurately solve non-traditional problems by utilizing their logical reasoning and comprehension skills (Gallagher et al., 2000). The findings of this investigation provide evidence that the inclination of MS to fulfill the criteria of employing concepts in a logical manner has an impact on the capacity to comprehend concepts.

### Give examples and not examples of a concept they have learned

The student taking the FS exam demonstrates a clear and organized approach to answering questions, beginning with responses labeled as a, b, and c.

*“I understand the methodology behind this proof, wherein I manipulate the formula by transposing the left and right sides. This trigonometry identity has been taught to us in school and it appears to have no alternative solution..”*

FS employs the formula for the three trigonometric identities called for in the issue, which is  $\sin^2 a + \cos^2 a = 1$ . Answers and findings from interview with researchers show that FS completes the indicator of providing examples that are concrete rather than only theoretical ones.

7. Buktikan yg termasuk identitas trigonometri:

a.  $\frac{1}{3} \sin^2 a + \frac{1}{3} \cos^2 a = \frac{1}{3}$

b.  $3 \cos^2 a - 2 = 1 - 3 \sin^2 a$

c.  $3 + 5 \sin^2 a = 3 - 5 \cos^2 a$

Jawab:

a.  $\frac{1}{3} \sin^2 a + \frac{1}{3} \cos^2 a = \frac{1}{3}$

$\frac{1}{3} (\sin^2 a + \cos^2 a) = \frac{1}{3}$

$\frac{1}{3} (1) = \frac{1}{3}$

$\frac{1}{3} = \frac{1}{3}$  (terbukti)

b.  $3 \cos^2 a - 2 = 1 - 3 \sin^2 a$

(ingat bahwa  $\sin^2 a + \cos^2 a = 1$ )

$3 \sin^2 a + 3 \cos^2 a = 3$

$3 \cos^2 a = 3 - 3 \sin^2 a$

Jadi,  $3 - 3 \sin^2 a - 2 = 1 - 3 \sin^2 a$

$1 - 3 \sin^2 a = 1 - 3 \sin^2 a$  (terbukti)

(a)
(b)

c.  $3 + 5 \sin^2 a = 3 - 5 \cos^2 a$

$(\sin^2 a + \cos^2 a = 1)$

$-5 \sin^2 a + 5 \cos^2 a = 5$

$5 \sin^2 a = 5 - 5 \cos^2 a$

Jadi,  $3 + 5 \sin^2 a = 3 - 5 \cos^2 a$

$3 + 5 - 5 \cos^2 a = 3 - 5 \cos^2 a$

$8 - 5 \cos^2 a = 3 - 5 \cos^2 a$

(tidak terbukti)

(c)

Figure 28. (a) (b) & (c) Results of FS's answer give examples and not examples

MS only fills in points a and b, while point c is empty.

Pembuktian

a)  $\frac{1}{3} \sin^2 a + \frac{1}{3} \cos^2 a = \frac{1}{3}$

$\frac{1}{3} (\sin^2 a + \cos^2 a) = \frac{1}{3}$

$\frac{1}{3} (1) = \frac{1}{3}$  (terbukti)

b)  $3 \cos^2 a - 2 = 1 - 3 \sin^2 a$

$3 \cos^2 a - 2 = 1 - 3(1 - \cos^2 a)$

$= 1 - (3 + 3 \cos^2 a)$

$= -2 + 3 \cos^2 a$

$3 \cos^2 a - 2 = 3 \cos^2 a - 2$  (terbukti)

Figure 29. Results of MS's answer give examples and not examples

*“...I didn't prove that since I don't think it can be demonstrated that point C is a trigonometric identity. Although I learnt trigonometry outside of school (via tutoring), I remembered point c in my memory.*

According to prior studies' findings that students did not fully understanding the idea, the latest findings suggested that students only memorized the formulas and lacked exposure to non-standard examples of trigonometric identity questions. (Nuraeni & Afriansyah, 2016)

### Present concepts in the form of mathematical representation

As a result of not completing the interview's answer sheet, FS was unable to demonstrate the indicators of being able to present concepts through mathematical representation. The context in which a student learns plays a crucial role in the student's ability to understanding new concepts. (Nova, Retta, & Nopriyanti, 2022). The students' understanding of the concept was closely associated with the context that was involved in the process of learning.

*“The depression angle is something I just don't get. I was taught this in school, but I can't put my finger on why I'm having trouble describing the problem mathematically. I still don't understand exactly this person's position is.”*

Female students who hold stronger gender roles and beliefs may perceive themselves as having lower abilities in learning mathematics compared to their male classmates. This perception can lead to increased anxiety when engaging in mathematical tasks, ultimately resulting in lower mathematics achievement. (Wen & Dubé, 2022). In contrast to MS, who carefully followed the instructions and filled out all of the answer sheets before conducting interviews to back up her finding.

*“There's a QR code, thus I'm curious about the answer to this question. Naturally, I started by scanning the QR barcode, then looked at the image, and finally I re-drew it on the answer sheet. I begin by calculating the depressive angle using the tan value. This ends up resulting in a depression angle of  $30^\circ$  as  $\tan = \frac{1}{3}\sqrt{3}$ .”*

From the results of the answer sheets and interviews, it can be said that MS meets the indicators of could present concepts in the form of mathematical representation.

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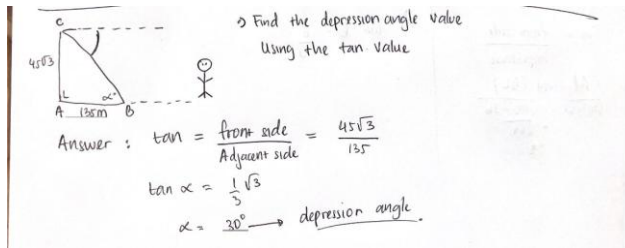


Figure 30. Results of FS's answer give examples and not examples

According to (Goos et al., 2016) the differences of students mathematical learning result influenced by gender differences has not been consistent, some studies have shown differences (male are better than female or vice versa) and some not show differences both. In general, gender differences in mathematical learning achievement depends the contents of the task, the nature of the assigned knowledge and skills, and the condition when working the task (Kamid et al., 2020).

## CONCLUSION

Based on the results of data analysis of the research, it can be drawn that students understanding mathematical concepts ability in QR code assisted problem solving by gender were : female students exhibit greater levels of ability in restating a concept compared to their male classmates. Both male and female students show deficiencies in their ability to classify objects according to certain properties according to the concepts. In terms of the application of concepts in a logical manner, female students exhibit a higher level of ability compared to their male classmates. There are uncertainties regarding the ability of male students to successfully complete their education. Both female and male students demonstrate ability in providing examples and non-examples based on the concepts they have learned. They exhibit accuracy in solving questions and can be proven by the results of interviews. Male students outperform female students on the final indicators, which is Able to present concepts in the form of mathematical representation. This is due to the fact that female students do not complete out the answer sheet, preventing this indicator from being reached.

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**Commented [NA12]:** What is the comparison result? Are the results significant?

**Commented [NA13]:** The results of this study are inversely proportional to the results of PISA in paragraph 6 which says male are better than female? What is the reason for this difference?

providing opportunities and participating in this study.

## REFERENCES

- Ariyanto, L., Aditya, D., & Dwijayanti, I. (2019). Pengembangan Android Apps Berbasis Discovery Learning Untuk Meningkatkan Pemahaman Konsep Matematis Siswa Kelas VII. *Edumatika: Jurnal Riset Pendidikan Matematika*, 2(1), 40. <https://doi.org/10.32939/ejrpm.v2i1.355>
- Astuti, I. A. D., Dasmo, D., & Sumarni, R. A. (2018). Pengembangan Media Pembelajaran Berbasis Android Dengan Menggunakan Aplikasi Appypie Di Smk Bina Mandiri Depok. *Jurnal Pengabdian Kepada Masyarakat*, 24(2), 695. <https://doi.org/10.24114/jpkm.v24i2.10525>
- Chang, M., & Law, S. (2008). Factor structure for Young's Internet Addiction Test: A confirmatory study. *Computers in Human Behavior*, 24, 2597–2619. <https://doi.org/10.1016/j.chb.2008.03.001>
- Diandita, E. R., Johar, R., & Abidin, T. F. (2017). Kemampuan Komunikasi Matematis Dan Metakognitif Siswa Smp Pada Materi Lingkaran Berdasarkan Gender. *Jurnal Pendidikan Matematika*, 11(2), 79–97. <https://doi.org/10.22342/jpm.11.2.2533>.
- Estapa, A., & Nadolny, L. (2015). The Effect of Augmented Reality Applications in Biology Lesson on Academic Achievement and Motivation. *Journal of Education in Science, Environment and Health*, 16(3), 40–48. <https://doi.org/10.21891/jeseh.1059283>
- Estes, Z., & Felker, S. (2012). Confidence mediates the sex difference in mental rotation performance. *Archives of Sexual Behavior*, 41(3), 557–570. <https://doi.org/10.1007/s10508-011-9875-5>
- Faradillah, A., & Septiana, C. (2022). MATHEMATICAL RESILIENCE: VALIDITY AND RELIABILITY WITH RASCH MODEL AND SPSS IN SENIOR HIGH SCHOOL. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, 11(4), 3545–3555. <https://doi.org/https://doi.org/10.24127/ajpm.v11i4.5204>
- Gallagher, A. M., De Lisi, R., Holst, P. C., McGillicuddy-De Lisi, A. V., Morely, M., & Chalan, C. (2000). Gender Differences in Advanced Mathematical Problem Solving.

*Journal of Experimental Child Psychology*, 75(3), 165–190.  
<https://doi.org/10.1006/jecp.1999.2532>

Gebeyehu, M., Atnafu, M., & Ejigu, T. (2021). Heliyon Implementing GeoGebra integrated with multi-teaching approaches guided by the APOS theory to enhance students' conceptual understanding of limit in Ethiopian Universities. *Heliyon*, 7(October 2020), e07012. <https://doi.org/10.1016/j.heliyon.2021.e07012>

Goos, M., Stillman, G., Herbert, S., & Geiger, V. (2016). *Teaching Secondary School Mathematics* (2nd Edition). <https://doi.org/10.4324/9781003117810>

Gross, J. J. (2014). Conceptual and Empirical Foundations. *Handbook of Regulation Emotion Second Edition*, 3–20.

Guner, N. (2014). Using Metaphor Analysis To Explore High School Students' Attitudes Towards Learning Mathematics. *Education*, 133(1), 39–48.

Handayani, Y., & Aini, I. N. (2019). Analisis Kemampuan Pemahaman Konsep Matematis Siswa Pada Materi Peluang. *Prosiding Seminar Nasional Matematika Dan Pendidikan Matematika Sesiomadika 2019*, 4(1), 575–581. <https://doi.org/10.31949/dm.v4i1.2010>

Hartati, S., Abdullah, I., & Haji, S. (2017). PENGARUH KEMAMPUAN PEMAHAMAN KONSEP, KEMAMPUAN KOMUNIKASI DAN KONEKSI TERHADAP KEMAMPUAN PEMECAHAN MASALAH. *JURNAL PENDIDIKAN MATEMATIKA*, 11(3), 41–59.

Kamid, Rusdi, M., Fitaloka, O., Basuki, F. R., & Anwar, K. (2020). Mathematical communication skills based on cognitive styles and gender. *International Journal of Evaluation and Research in Education*, 9(4), 847–856. <https://doi.org/10.11591/ijere.v9i4.20497>

Khasanah, M., & Utami, R. E. (2020). Analisis Kemampuan Pemahaman Konsep Matematis Siswa SMA Berdasarkan Gender. 2(5), 347–354.

Leder, G., & Forgasz, H. (2018). Measuring Who Counts: Gender and Mathematics Assessment. *ZDM: The International Journal on Mathematics Education*, 50. <https://doi.org/10.1007/s11858-018-0939-z>

- Legesse, M., Luneta, K., & Ejigu, T. (2020). Analyzing the effects of mathematical discourse-based instruction on eleventh-grade students' procedural and conceptual understanding of probability and statistics. *Studies in Educational Evaluation*, 67(July), 100918. <https://doi.org/10.1016/j.stueduc.2020.100918>
- Lestari, A. I., Senjaya, A. J., & Ismunandar, D. (2019). Pengembangan Media Pembelajaran Berbasis Android Menggunakan Appy Pie Untuk Melatih Pemahaman Konsep Turunan Fungsi Aljabar. *Pedagogy: Jurnal Pendidikan Matematika*, 4(2), 1–9. <https://doi.org/10.30605/pedagogy.v4i2.1437>
- Lim, S. Y., & Chapman, E. (2013). Development of a short form of the attitudes toward mathematics inventory Author ( s ): Siew Yee Lim and Elaine Chapman Source : Educational Studies in Mathematics , Vol . 82 , No . 1 ( January 2013 ), pp . 145-164 Published by : Springer Stable URL : [htt](http://www.springer.com/9781441978111). *Educational Studies in Mathematics*, 82(1), 145–164.
- Luritawaty, I. P. (2018). PEMBELAJARAN TAKE AND GIVE DALAM UPAYA MENGEMBANGKAN KEMAMPUAN PEMAHAMAN KONSEP MATEMATIS. *Mosharafa: Jurnal Pendidikan Matematika*, 7, 179–188.
- National Foundation for Educational Research (NFER). (2010). *Programme for International Student Assessment 2009 achievement of 15-year-olds in England*.
- Nova, E., Retta, A. M., & Nopriyanti, T. D. (2022). Student Worksheet Development Using the PMRI Approach in the Classroom Context with an Orientation toward Students' Conceptual Understanding. *Jurnal Pendidikan Matematika*, 16(2), 203–214.
- Nuraeni, Y., & Afriansyah, E. A. (2016). Peningkatan Kemampuan Pemahaman Matematis Siswa Melalui Pembelajaran Kooperatif Tipe Rotating Trio Exchange. *Jurnal Inovasi Pendidikan Dasar*, 1(2), 85–94. <http://jipd.uhamka.ac.id/index.php/jipd/article/view/24/12>
- Nurhayati, D. M., & Hartono. (2017). Implementation of cooperative learning model type STAD with RME approach to understanding of mathematical concept student state junior high school in Pekanbaru. *AIP Conference Proceedings*, 1848(2017), 1–6. <https://doi.org/10.1063/1.4983940>

- Papadakis, S., & Kalogiannakis, M. (2017). Mobile educational applications for children. What educators and parents need to know. *International Journal of Mobile Learning and Organisation*, 11(2), 1. <https://doi.org/10.1504/ijmlo.2017.10003925>
- Putra, H., Wijaya, I., & Sujadi, I. (2016). Kemampuan Komunikasi Matematis Siswa Sesuai Dengan Gender Dalam Pemecahan Masalah Pada Materi Balok Dan Kubus (Studi Kasus Pada Siswa Smp Kelas Viii Smp Islam Al-Azhar 29 Semarang). *Jurnal Elektronik Pembelajaran Matematika*, 4(9), 778–788. <http://jurnal.fkip.uns.ac.id>
- Sakakibara, B. M., Miller, W. C., Rushton, P. W., & Polgar, J. M. (2018). Rasch Analyses of the Wheelchair Use Confidence Scale for Power Wheelchair Users. *Archives of Physical Medicine and Rehabilitation*, 99(1), 17–25. <https://doi.org/10.1016/j.apmr.2017.09.004>
- Peraturan Menteri Pendidikan Nasional Republik Indonesia, Pub. L. No. 22, 13 1 (2016). <https://akhmadsudrajat.files.wordpress.com/2009/04/permendiknas-no-22-tahun-2006.pdf>
- Sugiyono. (2018). *Metode Penelitian Kuantitatif, Kualitatif, dan Kombinasi (mixed methods)* (Cetakan ke). Bandung; Alfabeta,2011.
- Thulasidharan, P. P., & Nair, M. S. (2015). QR code based blind digital image watermarking with attack detection code. *AEU - International Journal of Electronics and Communications*, 69(7), 1074–1084. <https://doi.org/10.1016/j.aeue.2015.03.007>
- Wen, R., & Dubé, A. K. (2022). A Systematic Review of Secondary Students' Attitudes Towards Mathematics and its Relations With Mathematics Achievement. *Journal of Numerical Cognition*, 8(2), 295–325. <https://doi.org/10.5964/jnc.7937>
- Wibowo, T., Darmono, P. B., & Azieta, H. N. (2021). An Analysis of the Ability to Understand Mathematical Concepts of Middle School Students in Completing Integer Operations. *Jurnal Pendidikan Matematika*, 16(1), 29–44. <https://doi.org/10.22342/jpm.16.1.15324.29-44>
- Widyasari, W., Sutopo, H., & Agustian, M. (2019). QR code-based learning development: Accessing math game for children learning enhancement. *International Journal of Interactive Mobile Technologies*, 13(11), 111–124. <https://doi.org/10.3991/ijim.v13i11.10976>

### 3. BUKTI KONFIRMASI REVIEW DAN HASIL REVIEW KEDUA (1 FEBRUARI 2024)

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Thu, Feb 1, 2024, 11:54 AM

Dear Putri Awalia Rizkia & Ayu Faradillah:

Just a gentle reminder of our request on the previous email for your revision of the manuscript, "Mathematical Understanding Concepts Ability in QR Code-Assisted Problem Solving by Gender" for Jurnal Pendidikan Matematika.

Our decision is to **REVISION REQUIRED FOR 2ND ROUND**

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Department of Master Program on Mathematics Education

Faculty of Teacher Training and Education

Sriwijaya University, Palembang, Indonesia

Jl. Sriwijaya Negara, Bukit Besar Palembang - 30139

## Recapitulation the contents of the revised article

No	Reviewer	Content	Page	Problem	Revised	Page
1	1	Abstrak	1	Please indicate the contribution of the findings.	The results of this research contribute to mathematics learning so that the ability to understand concepts according to gender can be further facilitated because each gender has different problems.	
		How to cite	1	Please kindly translate it into English	Mathematical Understanding Concepts Ability in QR Code-Assisted Problem Solving by Gender	
		Introduction	3	Out of the date. You may use the new PISA results published 5 december 2023	The 2022 PISA survey found that girls performed much better than boys in the ability to understand mathematical concepts(OECD, 2023).	
				You may resume it and make it shorter, whats the main finding in each citation. Please kindly add more regarding the previous findings	Several studies have been conducted regarding the mathematical understanding concepts, QR code and gender. First, In 2022, academic research examining the relationship between mathematics and gender indicates that female students exhibit more competence in this subject area than male students. The previous statements can be inferred from the indicators that demonstrate the instruction of concepts, the establishment of identity through exemplification or implementation of said concept, the explication of the concept through mathematical representation, the utilization of specific operations, and the application of concepts to resolve problems (Syaifar & Roza, 2022). Second, The present study discusses the theme of mathematical concept comprehension among junior high school students, focusing on the material that reflects the final outcomes. The findings indicate that students who possess the ability to comprehend mathematical concepts are classified as low, with a percentage of 31.25%, when viewed from the implementation	

					perspective (Handayani & Aini, 2019). Third, research (Widyasari et al., 2019) The utilization of QR code technology in the learning process has been found to be beneficial for educators as it facilitates access to math games, thereby enhancing children's motivation to learn mathematics. The utilization of the math game as an educational tool is advantageous for students as it provides them with the flexibility to access it at any time and from any location, thereby potentially enhancing their academic performance.	
				In this paragraph you may mention, the previous findings, the gap analysis, the novelty, and the aim of this study	The gap with the previous research is the previous relevant studies that have not analyzed the ability to understand mathematical concepts in terms of gender and QR code-assisted technology. Therefore, the novelty is researchers conducted fresh studies to analyze how well male and female students of different gender understand mathematical ideas when using QR codes to solve issues. The purpose of this research is researchers wanted to analyze how gender affected students' comprehension of mathematical ideas when using QR codes to solve problems.	
		Method	3	In this METHOD SECTION, please re-write it. Kindly make it into sub section. For instance  Research type  Research procedure  Research subject  Data collection	The method used in this research is the descriptive qualitative approach. Qualitative research methods are carried out in natural conditions so this method is called the naturalistic research method (Sugiyono, 2018).  <b><i>Participant and context</i></b>	

			<p>Data analysis</p> <p>How many students? 2?</p> <p>Two questions or 5 questions??? I only see two questions in the RESULTS</p> <p>Please kindly add the transcript/excerpts in the results section, I cant see it</p> <p>What are the indicators and descriptor. Kindly add the table and its explanations</p>	<p>This research was conducted in 10th Grade in one of Public Senior High Schools in Jakarta. The subjects were chosen through purposive sampling, where determining subjects is based on recommendations from teachers for subjects that have equivalent communication and mathematics skills. Hence, one was chosen consisting of male students and another consisting of female students. The research instrument was in the form of a description test with a total of 5 questions which contained indicators of the ability to understand conceptual mathematics (Aji Pangestu et al., 2021).</p> <p>Table 1. The Description of Indicators' Mathematics Understanding Concepts</p> <table border="1" data-bbox="1256 874 1899 1441"> <thead> <tr> <th>Num</th> <th>Indicator</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Restate a concepts in writing</td> </tr> <tr> <td>2</td> <td>Classify Objects According To Certain Properties According To The Concept</td> </tr> <tr> <td>3</td> <td>Apply the concept logically</td> </tr> <tr> <td>4</td> <td>Give examples and not examples of a concept they have learned</td> </tr> <tr> <td>5</td> <td>Present concepts in the form of</td> </tr> </tbody> </table>	Num	Indicator	1	Restate a concepts in writing	2	Classify Objects According To Certain Properties According To The Concept	3	Apply the concept logically	4	Give examples and not examples of a concept they have learned	5	Present concepts in the form of	
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ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	OUTFIT ZSTD	MNSQ	ZSTD
1	246	86	-.07	.15	.78	-1.5	.82	-1.1
2	297	86	-1.38	.18	1.03	.2	.85	-.4
3	244	86	-.03	.15	.90	-.7	.84	-1.0
4	206	86	.78	.14	1.34	2.1	1.27	1.7
5	210	86	.70	.14	.99	.0	1.06	.5
MEAN	240.6	86.0	.00	.15	1.01	.0	.97	-1.1
S.D.	32.7	.0	.77	.01	.19	1.2	.18	1.6

Figure 1. Validity of the Question Test

Figure 1 above shows that all items are declared valid because they have fulfilled the 2 suggested criteria, which is; Outfit Mean Square (MNSQ) is about  $0.5 < \text{MNSQ} < 1.5$ ; Outfit Z-Standard (ZSTD)  $-2.0 < \text{ZSTD} < +2.0$ ; Point Measure Correlation (Pt Measure Corr)  $0.4 < \text{Pt Measure Corr} < 0.85$  (Sakakibara et al., 2018). The test of mathematical understanding conceptual consists of five indicator which (1) restate the concepts in writing; (2) classify objects according to certain properties according to the concept; (3) apply the concepts logically; (4) give examples and not examples of a concepts they have learned; (5) able to present concept in the form of mathematical representation (Wibowo et al., 2021). The test assisted with Quick Response (QR) codes. The Cronbach alpha coefficient for the final scale derived from the test is 0.76, as illustrated in Figure 2..

	TOTAL SCORE	COUNT	MEASURE	MODEL ERROR	MNS
MEAN	14.0	5.0	1.62	.69	
S.D.	3.7	.0	1.46	.29	
MAX.	20.0	5.0	4.88	1.80	
MIN.	5.0	5.0	-1.73	.57	.6
REAL RMSE	.79	TRUE SD	1.23	SEPARATION	1.55
MODEL RMSE	.75	TRUE SD	1.25	SEPARATION	1.66
S.E. OF Person MEAN = .16					

Person RAW SCORE-TO-MEASURE CORRELATION = .98  
 CRONBACH ALPHA (KR-20) Person RAW SCORE "TEST" RELIABI

Figure 2. Reliability of the Question Test

Based on the figure 2, KR-20 value is 0.76, with high criteria according to Faradillah if the Cronbach's Alpha value is  $> 0.50$  the instrument is said to be reliable (Faradillah & Septiana, 2022). The selected participants went through a test to evaluate their ability to understand mathematical concepts. The instrument used for the study included a set of 5 trigonometric questions that went through expert validation and was determined suitable for use. After taking the understanding concept ability test, the researcher interviewed the students. The purpose of the interview is to determine the students understanding concept ability, which consists of 5 indicators. Researchers do not ask identical questions for each subject; rather, the questions depend on the quantity of information required.

**Data Analysis**

					<p>Two students from the school were purposely selected according to their last results of students test scores in X grade on mathematics and were interviewed by the researchers. The following shows the results by gender, female student and male student.</p> <p style="text-align: center;">Table 2. Subject Coding</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">No.</th> <th style="width: 60%;">Gender</th> <th style="width: 30%;">Subject</th> </tr> </thead> <tbody> <tr> <td></td> <td style="text-align: center;">Female</td> <td style="text-align: center;">F</td> </tr> <tr> <td></td> <td style="text-align: center;">Male</td> <td style="text-align: center;">M</td> </tr> </tbody> </table>	No.	Gender	Subject		Female	F		Male	M	
No.	Gender	Subject													
	Female	F													
	Male	M													

## Mathematical Understanding Concepts Ability in QR Code-Assisted Problem Solving by Gender

Ayu Faradillah\*, Putri Awalia Rizkia

Department of Mathematics Education, Prof. Dr. Hamka Muhammadiyah University, Jakarta, Indonesia

\*Email: [ayufaradillah@uhamka.ac.id](mailto:ayufaradillah@uhamka.ac.id)

### Abstract

Students must be able to develop an accurate understanding of mathematical concepts since it is essential for them to understand the concepts related to their studies. The purpose of this study is to analyze the ability of students' conceptual understanding assisted by QR codes in solving mathematical problems based on gender. This study is a qualitative research project with a descriptive approach. The data collection techniques used in this study include tests, interviews, and documentation. The subjects of this research were one male and one female students in one of the public high schools in Jakarta. The research findings indicate that both male and female students perform equally well in the indicators of restating concepts and providing examples and non-examples of the material taught. Subsequently, the male student is great in presenting concepts related to the learned material through mathematical representations. On the other hand, the female student is great in applying concepts logically. However, both male and female students still exhibit deficiencies in their ability to classify objects based on the concepts that have been taught.

**Keywords:** Gender, Mathematical Understanding Concepts, Problem Solving, QR codes

**How to Cite:** Faradillah, A., & Rizkia, P. A. (2024). Mathematical understanding concepts ability in QR code-assisted problem solving by gender. *Jurnal Pendidikan Matematika*, 18(3), 313-328. <https://doi.org/10.22342/jpm.v18i3.pp313-328>

## INTRODUCTION

Mathematical understanding involves the knowledge, comprehension, and grasp of both the meaning and connotations of mathematical concepts. This ability to understand mathematics is vital and pivotal in the learning process of the subject (Hartati et al., 2017). Gaining mathematical understanding is essential and fundamental to the process of learning mathematics (Yang et al., 2021). In addition, mathematical understanding encompasses critical knowledge and content that enables students to effectively address mathematical problems encountered during learning (Hernández et al., 2020).

Students' difficulties in understanding concepts and lack of sound reasoning when tackling given problems indicate underlying factors that impede their ability to solve mathematical problems (Pongsakdi et al., 2020; Tsany et al., 2020). This demonstrates that their comprehension of mathematical concepts remains inadequate (Ismail, 2020). The subject of mathematics is perceived as unenjoyable by some individuals due to its inherent difficulty and lack of engaging conditions. Although teachers try to make students understand the concept of mathematics, their efforts fail easily (Papadakis & Kalogiannakis, 2017).

Based on the previously stated explanation, the use of interesting and interactive learning media can foster students' interest and motivation in studying and understanding mathematical concepts (Pongsakdi et al., 2020). One way to increase students' enthusiasm and motivation in understanding mathematical concepts is smartphones. Smartphones are an effective tool to encourage student

motivation to understand concepts through collaborative learning (Iqbal & Bhatti, 2020). It is difficult to write long characters in a site address because typing errors might exist. The subject can be immediately accessed by using Quick Response codes or usually called QR codes. Students can save time by avoiding typing with QR codes, and they will get it straight the very first time (Widyasari et al., 2019). By using a QR code you can directly connect to a website without entering a web address (Park et al., 2019). This is done by scanning a QR code, which is a kind of two-dimensional barcode on smartphones.

There are three gender gaps in mathematics learning, namely ability, attitude and socialization activities. The development of students' self-concept may be closely related to their parents. Therefore, it is very important that parents influence their children's values, beliefs and behavior, self-concept and interest in mathematics (Mejía-Rodríguez et al., 2021; Rodríguez et al., 2020; Wang, 2020). Gender is also an important factor in mathematics learning. In fact, differences between females and male genders exist through any field. According to previous research, gender differences in math learning depend on the type of task, the student's level of understanding and preparation, as well as the situation the task is being carried out now (Gross, 2014).

Gender stereotypes prevalent in society, such as the belief that men have higher mathematical abilities than women, can pose a significant challenge to female students. However, according to Leder and Forgasz's findings, the potential for both genders to excel in various mathematical elements is contingent upon the specific domain of mathematics content being evaluated, as well as the assessment tool employed (Leder & Forgasz, 2018). The study indicated that gender differences did not have any influence on the attitudes towards mathematics. The 2022 PISA survey found that girls performed much better than boys in the ability to understand mathematical concepts (OECD, 2023).

Several studies have been conducted regarding mathematical understanding concepts, QR code and gender. First, Kamid et.al (2020) have conducted research on differences in mathematical communication based on cognitive style and gender, the results showed that there were significant differences in cognitive style but not very significant gender differences in mathematical communication abilities. Male students were able to explain problem solving strategies quite clearly but were less structured. Meanwhile, women explained strategies and steps to solve problems in detail and in a structured manner. Second, another study discussed the theme of mathematical concept with GeoGebra among initial teacher education, the use of technology provides special experiences in learning mathematics in three approaches, namely dynamic, numerical and algebra. Technology in the form of GeoGebra makes it easier for subjects to understand and solve mathematical problems (Hernández et al., 2020). Third, another research project (Widyasari et al., 2019) utilized QR code technology in the learning process has been found to be beneficial for educators as it facilitates access to math games, thereby enhancing children's motivation to learn mathematics. The utilization of the math game as an educational tool is advantageous for students as it provides them with the flexibility to access it at any time and from any location, thereby potentially enhancing their academic

performance.

Meanwhile, previous research used QR code technology to motivate students to learn mathematics. Apart from that, other research also analyzed students' mathematical understanding abilities by looking at gender differences without using QR technology. This research shows the importance of analyzing the ability to understand technology-based mathematical concepts based on gender differences. Thus, this research aims to analyze the comparison of students' mathematical understanding abilities based on QR codes in terms of students' gender.

## METHODS

The method used in this research is the descriptive qualitative approach. Qualitative research methods are conducted in real-world settings, thus classifying this approach as a naturalistic research method (Aspers & Corte, 2019).

This research was conducted in 10<sup>th</sup> grade students of one of public senior high schools in Jakarta. The subjects were chosen through purposive sampling, where subjects determination is based on recommendations from teachers that have equivalent communication and mathematics skills. Hence, the chosen subjects consisted of one male student and one female student. The research instrument was in the form of a description test with a total of five questions which contained indicators of the ability to understand conceptual mathematics. Descriptions related to indicators of mathematics understanding concept's ability are tabulated in [Table 1](#).

**Table 1.** The description of indicators' mathematics understanding concepts

No	Indicator	Description
1	Restating a concept in writing	Ability to describes the concept according to the object
2	Classifying Objects According to Certain Properties Based on the Concept	Ability to analyze objects based on categories, properties, and concepts
3	Applying the concept logically	Ability to identify mathematical operations according to concepts
4	Providing examples and non-examples of a concept they have learned	Ability to present other examples according to the concepts that have been studied
5	Presenting concepts in the form of mathematical representation	Ability to present solutions using other concepts

The research instrument employed was in the form of a description test with a total of five questions containing the indicators of the ability to understand conceptual mathematics and was supported by interview results. The test in this study used mathematical understanding conceptual assisted by QR code, where the validity and reliability of the previously mentioned has been tested

through validation. The validation of the test was conducted through content validity by expert specialists in education, including a lecturer and a mathematics teacher. The result of this validation was changing the words used in the questions to make them easier to understand for the upper high school students.

In the content validation process, there were four classes of 10<sup>th</sup> grade students with a total of 140 students. Validity and reliability test was done using the Winstep software version 3.73. It is seen based on the MNSQ, ZTSD, and PT-MEASURE CORR values which are displayed in [Figure 1](#).

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	ZSTD	OUTFIT MNSQ	ZSTD	PT-MEASURE CORR.	EXP.	EXACT OBS%	MATCH EXP%	Item
1	246	86	-.07	.15	.78	-1.5	.82	-1.1	.76	.71	51.9	51.2	a1
2	297	86	-1.38	.18	1.03	.2	.85	-.4	.59	.61	64.2	64.9	a2
3	244	86	-.03	.15	.90	-.7	.84	-1.0	.76	.71	51.9	51.0	a3
4	206	86	.78	.14	1.34	2.1	1.27	1.7	.68	.74	34.6	48.4	a4
5	210	86	.70	.14	.99	.0	1.06	.5	.72	.74	48.1	46.9	a5
MEAN	240.6	86.0	.00	.15	1.01	.0	.97	-.1			50.1	52.5	
S.D.	32.7	.0	.77	.01	.19	1.2	.18	1.0			9.5	6.4	

**Figure 1.** Validity of the question test

[Figure 1](#) above shows that all items are declared valid because they have fulfilled the 2 suggested criteria, which is Outfit Mean Square (MNSQ) is about  $0.5 < MNSQ < 1.5$ ; Outfit Z-Standard (ZSTD)  $-2.0 < ZSTD < +2.0$ ; Point Measure Correlation (Pt Measure Corr)  $0.4 < Pt Measure Corr < 0.85$  (Sakakibara et al., 2018). The test of mathematical understanding conceptual consists of five indicators including (1) restating the concepts in writing; (2) classifying objects according to certain properties based on the concept; (3) applying the concepts logically; (4) providing examples and non-examples of the concepts they have learned; and (5) able to present concept in the form of mathematical representation (Rohaeti et al., 2023). In this case, the test was assisted with QR codes. The Cronbach alpha coefficient for the final scale derived from the test is 0.76, as illustrated in [Figure 2](#).

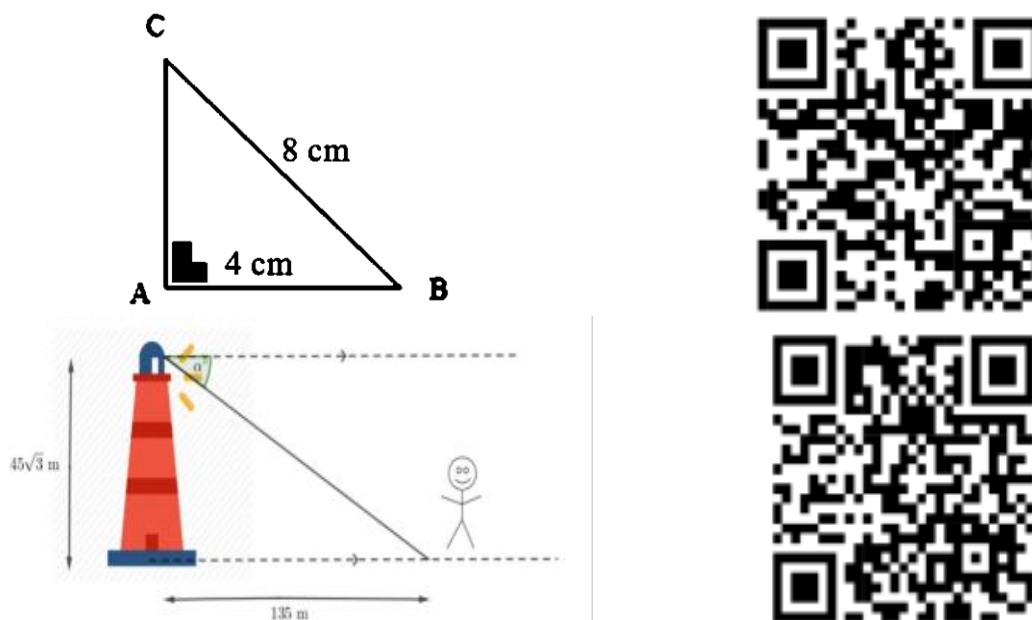
	TOTAL SCORE	COUNT	MEASURE	MODEL ERROR	INFIT MNSQ	ZSTD	OUTFIT MNSQ	ZSTD
MEAN	14.0	5.0	1.62	.69				
S.D.	3.7	.0	1.46	.29				
MAX.	20.0	5.0	4.88	1.80				
MIN.	5.0	5.0	-1.73	.57	.07	-2.5	.08	-2.4
REAL RMSE	.79	TRUE SD	1.23	SEPARATION	1.55	Person RELIABILITY	.71	
MODEL RMSE	.75	TRUE SD	1.25	SEPARATION	1.66	Person RELIABILITY	.73	
S.E. OF Person MEAN = .16								
Person RAW SCORE-TO-MEASURE CORRELATION = .98								
CRONBACH ALPHA (KR-20) Person RAW SCORE "TEST" RELIABILITY = .76								

**Figure 2.** Reliability of the question test

Based on [Figure 2](#), KR-20 value obtained is 0.76 and categorized as high, in which when the Cronbach's Alpha value is above 0.50, the instrument is considered reliable (Faradillah & Febriani, 2021). The selected participants went through a test to evaluate their ability to understand mathematical concepts. The instrument used for the study included a set of five trigonometric questions that went through expert validation and was determined suitable for use. After taking the understanding concept ability test, the researcher interviewed the students. The purpose of the interview is to determine the students understanding concept ability, which consists of 5 indicators. Researchers did not ask identical questions for each subject; rather, the questions depend on the quantity of information required. Two students from a public high school were purposely selected according to their last results of students' test scores in X grade on mathematics and were interviewed by the researchers. The results of student work were analyzed based on gender, reflected by female students (FS) and male students (MS).

## RESULTS AND DISCUSSION

The researchers then analyzed the students' understanding of conceptual ability assisted with QR codes. The QR codes require a smartphone camera to scan a barcode which will show the image on the screen of the students' smartphone. Question numbers three and five are the example of the application of QR code technology (See [Figure 3](#)). The results are written based on each indicator.



**Figure 3.** Questions given to students with QR codes

**1<sup>st</sup> Indicator: Restate a Concept in Writing**

Students were supposed to show their understanding of the topic at issue by restating a significant concept. FS claimed to be familiar with the format of the test questions and able to paraphrase the concepts in her own words.

$$\begin{array}{l}
 \text{Answer :} \\
 \sin B = \frac{6}{10} \quad // \quad 6 : 10 \\
 \sin = \frac{\text{front side}}{\text{hypotenuse}} \\
 \rightarrow \text{Adjacent (BC)} \\
 \sqrt{10^2 - 6^2} = \sqrt{100 - 36} \\
 = \sqrt{64} \\
 = 8
 \end{array}
 \quad \left| \quad \begin{array}{l}
 \text{a.) } \cot B = \frac{8}{10} \\
 \text{b.) } \tan B = \frac{6}{10}
 \end{array}
 \right.$$

**Figure 4.** Results of FS's answer writing the concept of Trigonometry

- Interviewer* : Please explain your understanding for question number 1
- FS* : So, for question number 1 is a right triangle with sides  $AB = 6$ ,  $BC = 10$ , and  $AC = \text{unknown}$ . Then, the question concerns the idea of comparing trigonometric functions. Here, we shall search for  $\sin B$ , which is  $\frac{6}{10} = 6:10$ . A frontal or oblique  $\sin B$ . Therefore, the answer is 8 when the Pythagorean theorem is applied to the other side using the root formula  $\sqrt{(10^2 - 6^2)} = 64 = 8$ . Simply substitute the  $\frac{8}{10}$   $\cos B$  value with the  $\frac{6}{10}$   $\tan B$  value. I made a typo in B. It should read  $\tan$  not  $\cos$ .

Based on the findings of the FS answer sheets and supported by the outcomes of the interviews (See [Figure 4](#)), it can be posited that FS has not satisfactorily fulfilled the criteria for restating concept in their own language, as they have failed to explicate the concept of the Pythagorean triangle that was assessed in the questions, instead solely concentrating on rote memorization of formulas. Then, similar answers were also given by the MS who also excel in expressing concepts. MS claimed to have a complete understanding of the problem's structure and was able to articulate the central idea in his own words.

<input type="checkbox"/>	Dik : Ada sebuah situ-situ dengan situ-situ di B
<input type="checkbox"/>	dengan nilai $\sin \beta = \frac{6}{10}$
<input type="checkbox"/>	
<input type="checkbox"/>	$\sin \beta = \frac{6}{10} = 6:10$
<input type="checkbox"/>	
<input type="checkbox"/>	$\sin = \frac{\text{depan}}{\text{miring}}$
<input type="checkbox"/>	
<input type="checkbox"/>	
<input type="checkbox"/>	Sisi samping : BC :
<input type="checkbox"/>	$\sqrt{10^2 - 6^2} = \sqrt{100 - 36} =$
<input type="checkbox"/>	$\sqrt{64} = 8$
<input type="checkbox"/>	$a \cdot \cos \beta = 8$
<input type="checkbox"/>	10
<input type="checkbox"/>	$b \tan \beta = 6$
<input type="checkbox"/>	10 :

**Figure 5.** Results of MS's answer writing the concept of Trigonometry

*Interviewer* : How can you solve problem number 1? Explain it.

*MS* : To avoid getting lost when determining the trigonometry location, I first write down what I already know. Specifically, the Sin B value is 6/10. Then, I may apply the standard Sin formula (forward/slanted). I can calculate Cos from the BC length, but I did not remember to look up Tan.

According to the findings based on answers and interviews (See [Figure 5](#)), MS exhibit greater abilities in restating a concept and providing clear explanations of answers compared to their male counterparts. The indicator pertaining to the restatement of a concept can be deemed as being fulfilled by MS. Consistent with prior research findings, it was observed that female students exhibited higher ability in the sequential and systematic application of the steps, resulting in clear and neat writing with minimal errors attributable to aesthetic considerations (Faradillah et al., 2018).

### **2<sup>nd</sup> Indicator: Classifying Objects According to Certain Properties Based on the Concept**

In this indicator, researchers deployed technology assisted by QR codes to solve questions. According to the interview findings, FS expressed a high level of confidence in comprehending the structure of the questions that were being evaluated.

*Interviewer* : What method do you use to solve this problem?

*FS* : The formula instructed in school had been used to determine the values of Sin, Cos, and Tan for the improvement of the village in question. First, the length of  $AC^2$  was determined by employing the Pythagorean theorem and a right triangle ABC was also depicted for this purpose.

*Interviewer* : Are you sure with your answer?

*FS* : At school, we often only go as far as Sin, Cos, Tan, thus I am still looking for the solution to the Cosec value.

However, FS also added that she did not fully understand the form of the questions because there was a question regarding the cosecant value for which she did not know the formula.

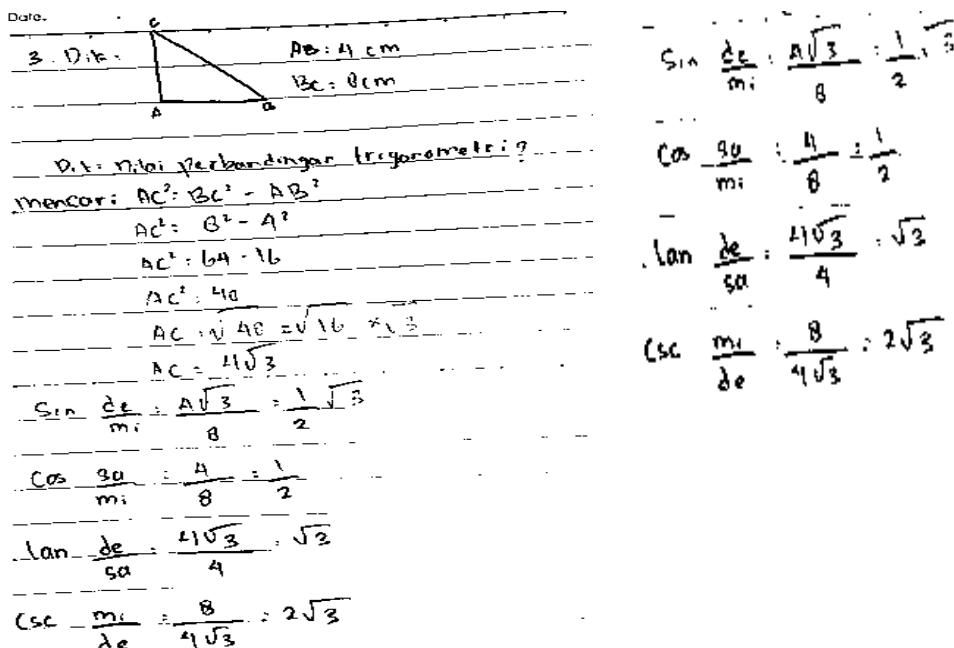


Figure 6. Results of FS’s answer classify objects according to the Trigonometry

Based on Figure 6, the results of student’s answers are not optimal since there are still students who are not independent in working on the questions; many of these students rely on internet searches to find the answers (Gebeyehu et al., 2021). MS said he did not fully get the format of the questions on this indication, but he did his best to answer them using formula number 1.

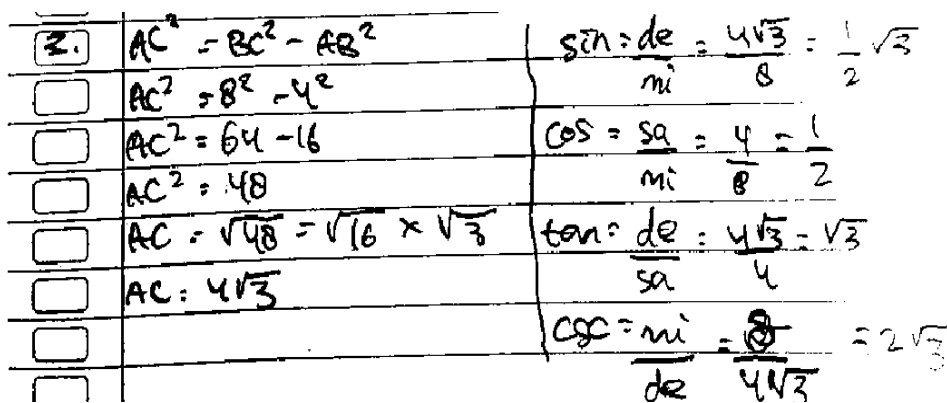


Figure 7. Results of MS’s answer classify objects according to the Trigonometry

Interviewer : What do you recognize to solve this problem?  
 MS : I was confused by this problem, but after giving it some more thought, I realized that its structure was very similar to that of problem 1. To solve this problem, I first applied the Pythagorean theorem to determine the unknown length, and then I used the sin cos tan formula that I had learned at school.

Figure 7 shows that MS’ answer in line with FS, he did not understand the cosecant concept and only memorized the formula taught at school.

- Interviewer* : What made you write that solution?  
*MS* : Looking back at the notes, I realized that we had briefly covered cosecant in class; yet I still did not really get the concept

Consistent with prior research, it was observed that a significant number of students were unable to respond to the teacher's inquiry regarding the previously taught material during the preceding session. (Nurhayati & Hartono, 2017).

### 3<sup>rd</sup> Indicator: Applying the Concept Logically

FS said that in this problem, it is necessary to illustrate the picture first to be able to understand the form of the question properly.

Point : - The height of Pisa is 56 meters  
 - Slope at 44 meters  
 - 55° elevation angle

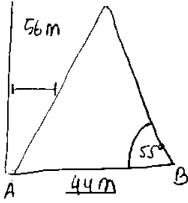
\*) Determine the degree of tilt of the tower!

$$\frac{AB}{\sin C} = \frac{AC}{\sin B} \Rightarrow \frac{44}{\sin C} = \frac{56}{\sin 55}$$

$$\sin C = \frac{44 \sin 55}{56}$$

$$\sin C = 0,6436$$

\*) So, the tilt of the tower is  $\rightarrow X = 90^\circ - 85^\circ$   
 $A = 180 - (B + C)$   
 $A = 180 - (55 + 40)$   
 $A = 85^\circ$   
 $X = 5^\circ$



**Figure 8.** Results of FS's answer apply the concepts logically

- Interviewer* : How do you recognize this problem? And explain the solution you wrote.  
*FS* : It is stated in the question that 44 meter up from the ground, the Tower of Pisa begins to slope. The value of angle C was then calculated using the Sine rule. After determining the value of Sin C, I can find the value at angle A by subtracting 180 from the sum of B and C (the alignment angle) resulting at 85°. Then since  $90^\circ - 85^\circ = 5^\circ$ . The leaning tower of Pisa leans at an angle to 50.

FS satisfied the indicators of being able to apply concepts rationally based on the responses written (See Figure 8) and the results of the interviews. FS used visual aids to demonstrate its findings and offers advice on how to approach problems with assurance and order. This lends credence to the findings of prior studies, which found that female students, in comparison to their male counterparts, tend to generate a larger association between grades and achievement (Lim & Chapman, 2013). MS explained in the interview that he could not explain how to answer this question (Figure 9).

<input type="checkbox"/>		
<input checked="" type="checkbox"/>	5. $AB = AC$	Demikian besar sudut
<input type="checkbox"/>	$\sin C = \sin B$	$A = 180 - (B+C)$
<input type="checkbox"/>	$44 = 56$	$A = 180 - (55+40)$
<input type="checkbox"/>	$\sin C = \sin 55$	$A = 85^\circ$
<input type="checkbox"/>	$\sin C = 0,6436$	
<input type="checkbox"/>	$CC = 40,06 \approx 40^\circ$	Jadi derajat kemiringan menara
<input type="checkbox"/>		atau adalah $x = 90^\circ - 85^\circ = 5^\circ$

Figure 9. Results of MS's answer apply the concepts logically

- Interviewer : Do you understand the concept to solve this problem?  
 MS : I understand this number quite well, but I'm not sure yet.  
 Interviewer : What makes you not sure?  
 MS : I still do not understand the meaning of elevation angle, so maybe if my teacher explains it again, I will understand.

MS continued by saying that he had learned certain things at school, but that he had to consult with his buddies to fully comprehend the questions. The answers show that students have a limited capacity to make connections between mathematical concepts and real-world situations (Legesse et al., 2020).

The MS's answer exhibits an interesting characteristic of utilizing non-sequential steps and putting first the final answer over intermediate calculations. This approach results in extraneous markings and a lack of emphasis on aesthetic presentation and problem-solving sequence. The observation aligns with Gallagher's findings that male students possess the capability to accurately solve non-traditional problems by utilizing their logical reasoning and comprehension skills (Gallagher et al., 2000). The findings of this investigation provide evidence that the inclination of MS to fulfill the criteria of employing concepts in a logical manner has an impact on the capacity to comprehend concepts.

#### 4<sup>th</sup> Indicator: Providing Examples and Non-Examples of a Concept They Have Learned

The student taking the FS exam demonstrates a clear and organized approach to answering questions, beginning with responses labeled as a, b, and c.

- Interviewer : How do you prove that this problem is an example of a trigonometric identity?  
 FS : I understand the methodology behind this proof, wherein I manipulated the formula by transposing the left and right sides. This trigonometry identity has been taught at school and it appears to have no alternative solution.

FS employed the formula for the three trigonometric identities called for in the issue, which is  $\sin^2 a + \cos^2 a = 1$ . Answers and findings from interviews with researchers show that FS completed the indicator of providing examples that are concrete rather than only theoretical ones.

<p>7. Buktikan yg termasuk identitas trigonometri:</p> <p>a. <math>\frac{1}{3} \sin^2 a + \frac{1}{3} \cos^2 a = \frac{1}{3}</math></p> <p>b. <math>3 \cos^2 a - 2 = 1 - 3 \sin^2 a</math></p> <p>c. <math>3 + 5 \sin^2 a = 3 - 5 \cos^2 a</math></p> <p>Jawab:</p> <p>a. <math>\frac{1}{3} \sin^2 a + \frac{1}{3} \cos^2 a = \frac{1}{3}</math></p> <p><math>\frac{1}{3} (\sin^2 a + \cos^2 a) = \frac{1}{3}</math></p> <p><math>\frac{1}{3} (1) = \frac{1}{3}</math></p> <p><math>\frac{1}{3} = \frac{1}{3}</math> (terbukti)</p>	<p>b. <math>3 \cos^2 a - 2 = 1 - 3 \sin^2 a</math></p> <p>(ingat bahwa <math>\sin^2 a + \cos^2 a = 1</math>)</p> <p><math>3 \sin^2 a + 3 \cos^2 a = 3</math></p> <p><math>3 \cos^2 a = 3 - 3 \sin^2 a</math></p> <p>Jadi, <math>3 - 3 \sin^2 a - 2 = 1 - 3 \sin^2 a</math></p> <p><math>1 - 3 \sin^2 a = 1 - 3 \sin^2 a</math> (terbukti)</p> <p>c. <math>3 + 5 \sin^2 a = 3 - 5 \cos^2 a</math></p> <p>(<math>\sin^2 a + \cos^2 a = 1</math>)</p> <p><math>5 \sin^2 a + 5 \cos^2 a = 5</math></p> <p><math>5 \sin^2 a = 5 - 5 \cos^2 a</math></p> <p>Jadi <math>3 + 5 \sin^2 a = 3 - 5 \cos^2 a</math></p> <p><math>3 + 5 - 5 \cos^2 a = 3 - 5 \cos^2 a</math></p> <p><math>8 - 5 \cos^2 a = 3 - 5 \cos^2 a</math></p> <p>(tidak terbukti)</p>
---	---

(a) FS student's answer

Pembuktian

a)  $\frac{1}{3} \sin^2 \alpha + \frac{1}{3} \cos^2 \alpha = \frac{1}{3}$

\*ingat  
 $(\sin^2 \alpha + \cos^2 \alpha = 1)$   
 \* ruas kiri = kanan

$\frac{1}{3} (\sin^2 \alpha + \cos^2 \alpha) = \frac{1}{3}$

$\frac{1}{3} (1) = \frac{1}{3}$  ✓ (terbukti)

b)  $3 \cos^2 \alpha - 2 = 1 - 3 \sin^2 \alpha$

$3 \cos^2 \alpha - 2 = 1 - 3(1 - \cos^2 \alpha)$

$= 1 - (3 + 3 \cos^2 \alpha)$

$= -2 + 3 \cos^2 \alpha$

$3 \cos^2 \alpha - 2 = 3 \cos^2 \alpha - 2$  ✓ (terbukti)

(b) MS student's Answer

**Figure 10.** Results of answers in providing examples and non-examples

In [Figure 10](#), there is a clear distinction between the responses provided by FS and MS. FS responses can fully address questions, whereas MS responses do not possess this capability. MS only fills in points a and b, while point c is empty. This difference was confirmed through interviews with MS students.

Interviewer : Explain your solution to prove this trigonometric identity.

MS : I did not prove it because I do not think it can be proven that point C is a trigonometric identity. Even though I studied trigonometry outside of school (through tutoring), I remember point c in my memory.

According to prior studies' findings that students did not fully understand the idea, the latest findings suggested that students only memorized the formulas and lacked exposure to non-standard examples of trigonometric identity questions (Capraro & Joffrion, 2006).

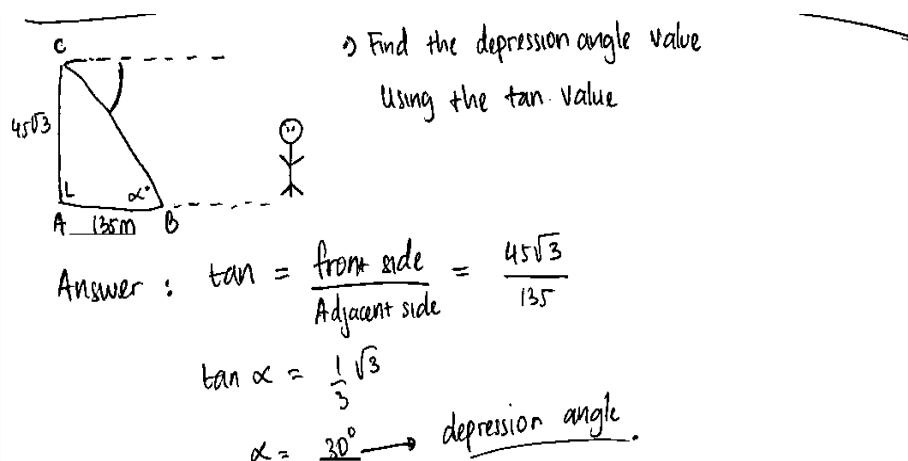
### 5<sup>th</sup> Indicator: Presenting Concepts in the Form of Mathematical Representation

As a result of not completing the interview's answer sheet, FS was unable to demonstrate the indicators of being able to present concepts through mathematical representation. The learning environment significantly influences a student's capacity to grasp new concepts (Hernández et al., 2020). The students' understanding of the concept was closely associated with the context that was involved in the process of learning.

*Interviewer* : Why do not you write down the answer to this problem? Do not you understand it?

*MS* : The depression angle is something I do not understand. I studied this material in school, but I do not know why I had difficulty explaining the problem mathematically. I still do not understand exactly how to describe it.

FS who holds stronger gender roles and beliefs may perceive themselves as having lower abilities in learning mathematics compared to their male classmates. This perception can lead to increased anxiety when engaging in mathematical tasks, ultimately resulting in lower mathematics achievement (Wen & Dubé, 2022). This is in contrast with MS who carefully followed the instructions and filled out all the answer sheets before conducting interviews to back up her findings.



**Figure 11.** Results of MS's answer give examples and not examples

Based on the results of the answer and interviews (see Figure 11), it can be said that MS meets the indicators of being able to present concepts in the form of mathematical representation.

*Interviewer* : *How do you explain this question?*  
*MS* : *There is a QR code, thus I am curious about the answer to this question. Naturally, I started by scanning the QR barcode, then looked at the image, and finally, I re-drew it on the answer sheet. I begin by calculating the depressive angle using the Tan value. This ends up resulting in a depression angle of  $30^\circ$  as  $\text{Tan} = \frac{1}{3}\sqrt{3}$ .*

According to Goos et al., (2016), the differences of students' mathematical learning result influenced by gender differences has not been consistent, some studies have shown differences (male are better than female or vice versa) and some do not show differences both. In general, gender differences in mathematical learning achievement depend on the contents of the task, the nature of the assigned knowledge and skills, and the condition when working the task (Kamid et al., 2020).

## CONCLUSION

Based on the results of data analysis of the research, it can be drawn that students' mathematical concepts understanding ability in QR code assisted problem solving by gender are that female student exhibit greater levels of ability in restating a concept compared to their male classmate. Both male and female students show deficiencies in their ability to classify objects according to certain properties based on the concepts. In terms of the application of concepts in a logical manner, female student exhibits a higher level of ability compared to their male classmate. There are uncertainties regarding the ability of male students to successfully complete their education. Both female and male students demonstrate ability in providing examples and non-examples based on the concepts they have learned. They exhibit accuracy in solving questions as indicated by the results of interviews. Furthermore, male student outperforms female student on the final indicators, in which he can present concepts in the form of mathematical representation. This is because female students do not complete out the answer sheet, preventing this indicator from being reached.

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## REFERENCES

- Aspers, P., & Corte, U. (2019). What is qualitative in qualitative research. *Qualitative Sociology*, 42(2), 139–160. <https://doi.org/10.1007/s11133-019-9413-7>
- Capraro, M. M., & Joffrion, H. (2006). Algebraic equations: Can middle-school students meaningfully translate from words to mathematical symbols? *Reading Psychology*, 27(2–3), 147–164. <https://doi.org/10.1080/02702710600642467>
- Faradillah, A., & Febriani, L. (2021). Mathematical trauma students' junior high school based on grade and gender. *Infinity Journal*, 10(1), 53–68. <https://doi.org/10.22460/infinity.v10i1.p53-68>
- Faradillah, A., Hadi, W., & Tsurayya, A. (2018). Pre-service mathematics teachers' reasoning ability in solving mathematical non-routine problem according to cognitive style. *Journal of Physics: Conference Series*, 948(1). <https://doi.org/10.1088/1742-6596/948/1/012006>
- Gallagher, A. M., De Lisi, R., Holst, P. C., McGillicuddy-De Lisi, A. V., Morely, M., & Cahalan, C. (2000). Gender differences in advanced mathematical problem solving. *Journal of Experimental Child Psychology*, 75(3), 165–190. <https://doi.org/10.1006/jecp.1999.2532>
- Gebeyehu, M., Atnafu, M., & Ejigu, T. (2021). Implementing GeoGebra integrated with multi-teaching approaches guided by the APOS theory to enhance students' conceptual understanding of limits in Ethiopian Universities. *Heliyon*, 7(5), 1-11. <https://doi.org/10.1016/j.heliyon.2021.e07012>
- Goos, M., Stillman, G., Herbert, S., & Geiger, V. (2016). *Teaching Secondary School Mathematics (2nd Edition)*. London: Routledge. <https://doi.org/10.4324/9781003117810>
- Gross, J. J. (2014). *Handbook of Regulation Emotion Second Edition, Conceptual and Empirical Foundations*. London: The Guilford Press.
- Hartati, S., Abdullah, I., & Haji, S. (2017). The influence of concept understanding ability, communication and connection ability on problem solving ability [in Bahasa]. *Journal of Mathematics Education, Science & Technology*, 2(1), 43–72. <https://doi.org/10.30651/must.v2i1.403>
- Hernández, A., Perdomo-Díaz, J., & Camacho-Machín, M. (2020). Mathematical understanding in problem solving with GeoGebra: A case study in initial teacher education. *International Journal of Mathematical Education in Science and Technology*, 51(2), 208–223. <https://doi.org/10.1080/0020739X.2019.1587022>
- Iqbal, S., & Bhatti, Z. A. (2020). A qualitative exploration of teachers' perspective on smartphones usage in higher education in developing countries. *International Journal of Educational Technology in Higher Education*, 17(1). <https://doi.org/10.1186/s41239-020-00203-4>
- Ismail, Y. (2020). Semiotic procedural knowledge model on solution of problems and problem-solving analysis. *International Journal of Educational Administration and Policy Studies*, 12(2), 101–111. <https://doi.org/10.5897/ijeaps2020.0660>
- Kamid, Rusdi, M., Fitaloka, O., Basuki, F. R., & Anwar, K. (2020). Mathematical communication skills based on cognitive styles and gender. *International Journal of Evaluation and Research in Education*, 9(4), 847–856. <https://doi.org/10.11591/ijere.v9i4.20497>
- Leder, G., & Forgasz, H. (2018). Measuring who counts: Gender and mathematics assessment. *ZDM: The International Journal on Mathematics Education*, 50. <https://doi.org/10.1007/s11858-018-0939-z>

- Legesse, M., Luneta, K., & Ejigu, T. (2020). Analyzing the effects of mathematical discourse-based instruction on eleventh-grade students' procedural and conceptual understanding of probability and statistics. *Studies in Educational Evaluation*, 67, 100918. <https://doi.org/10.1016/j.stueduc.2020.100918>
- Lim, S. Y., & Chapman, E. (2013). Development of a short form of the attitudes toward mathematics inventory. *Education Studies in Mathematics*, 82(1), 145-164. <https://doi.org/10.1007/s10649-12-9414-x>
- Mejía-Rodríguez, A. M., Luyten, H., & Meelissen, M. R. M. (2021). Gender differences in mathematics self-concept across the world: An exploration of student and parent data of TIMSS 2015. *International Journal of Science and Mathematics Education*, 19(6), 1229-1250. <https://doi.org/10.1007/s10763-020-10100-x>
- Nurhayati, D. M., & Hartono. (2017). Implementation of cooperative learning model type STAD with RME approach to understanding of mathematical concept student state junior high school in Pekanbaru. *AIP Conference Proceedings*, 1848(1), 040002. <https://doi.org/10.1063/1.4983940>
- OECD. (2023). *PISA 2022 Results (Volume I): The State of Learning and Equity in Education*, PISA. Paris: OECD Publishing. <https://doi.org/10.1787/53f23881-en>
- Papadakis, S., & Kalogiannakis, M. (2017). Mobile educational applications for children: What educators and parents need to know. *International Journal of Mobile Learning and Organization*, 11(2), 256-277. <https://doi.org/10.1504/ijmlo.2017.10003925>
- Park, E. W., Lee, H., & Yun, E. K. (2019). Development and evaluation of a quick response code-based nursing education program for operating and recovery room nurses. *CIN - Computers Informatics Nursing*, 37(11), 599-605. <https://doi.org/10.1097/CIN.0000000000000550>
- Pongsakdi, N., Kajamies, A., Veermans, K., Lertola, K., Vauras, M., & Lehtinen, E. (2020). What makes mathematical word problem solving challenging? Exploring the roles of word problem characteristics, text comprehension, and arithmetic skills. *ZDM - Mathematics Education*, 52(1), 33-44. <https://doi.org/10.1007/s11858-019-01118-9>
- Rodríguez, S., Regueiro, B., Piñeiro, I., Estévez, I., & Valle, A. (2020). Gender differences in mathematics motivation: Differential effects on performance in primary education. *Frontiers in Psychology*, 10. <https://doi.org/10.3389/fpsyg.2019.03050>
- Rohaeti, E. E., Evans, B. R., Wiyatno, T., Prahmana, R. C. I., & Hidayat, W. (2023). Differential learning assisted with SANTUY mobile application for improving students' mathematical understanding and ability. *Journal on Mathematics Education*, 14(2), 275-292. <https://doi.org/10.22342/jme.v14i2.pp275-292>
- Sakakibara, B. M., Miller, W. C., Rushton, P. W., & Polgar, J. M. (2018). Rasch Analyses of the Wheelchair Use Confidence Scale for Power Wheelchair Users. *Archives of Physical Medicine and Rehabilitation*, 99(1), 17-25. <https://doi.org/10.1016/j.apmr.2017.09.004>
- Tsany, U. N., Septian, A., & Komala, E. (2020). The ability of understanding mathematical concepts and self-regulated learning using macromedia flash professional 8. *Journal of Physics: Conference Series*, 1657(1). <https://doi.org/10.1088/1742-6596/1657/1/012074>
- Wang, L. (2020). Mediation relationships among gender, spatial ability, math anxiety, and math achievement. *Educational Psychology Review*, 32(1), 1-15. <https://doi.org/10.1007/s10648-019-09487-z>

- Wen, R., & Dubé, A. K. (2022). A systematic review of secondary students' attitudes towards mathematics and its relations with mathematics achievement. *Journal of Numerical Cognition*, 8(2), 295–325. <https://doi.org/10.5964/jnc.7937>
- Widyasari, W., Sutopo, H., & Agustian, M. (2019). QR code-based learning development: Accessing math games for children learning enhancement. *International Journal of Interactive Mobile Technologies*, 13(11), 111–124. <https://doi.org/10.3991/ijim.v13i11.10976>
- Yang, Z., Yang, X., Wang, K., Zhang, Y., Pei, G., & Xu, B. (2021). The emergence of mathematical understanding: Connecting to the closest superordinate and convertible concepts. *Frontiers in Psychology*, 12. <https://doi.org/10.3389/fpsyg.2021.525493>

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Name of Principal Authors: Ayu Faradillah.....  
Address of Principal Authors: Indah Residence No. D14, Jati murni, Pondok Melati, Kota Bekasi 17415  
.....  
.....

Tel: 083876230484 Fax: \_\_\_\_\_

E-mail: ayufaradillah@uhamka.ac.id \_\_\_\_\_

Author(s) Name: Ayu Faradillah dan Putri Awalia \_\_\_\_\_

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