

UNDERSTANDING OF COMPUTER SCIENCE STUDENTS' CONCEPTS IN SOLVING PROBLEMS INTEGRAL BASED ON GENDER

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ARTICLE INFO

Article History

Received: 30 May 2025

Revised: 19 Dec 2025

Accepted: 30 Dec 2025

Published: 31 Dec 2025

Keywords:

Calculus

Computer Science Students

Gender

Understanding Concepts



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ABSTRACT

This study aims to determine the extent of students' understanding concepts in solving problems integral based on gender. This study employed a descriptive qualitative approach involving four computer science students from Universitas Pamulang consisting of two females and two males with varying ability levels. The results of this study that female and male students in the high category were able to restate concepts well. While on the indicator of being able to use, utilize and select certain procedures or operations, presenting concepts in various forms of representation and applying concepts or algorithms to problem solving, high-ability female students obtained a score of 3 which means they were able to answer but not correctly. Meanwhile, high-ability male students were able to master the indicator of restating the concept, while on the indicator of being able to use, utilize and select certain procedures or operations, presenting concepts in various forms of representation and applying concepts or algorithms to problem solving, high-ability male students obtained a score of 2 which means they still made mistakes. Furthermore, female and male students with low category were unable to master all the questions on the indicator namely restating concepts, being able to use, utilize, and select certain procedures or operations, presenting concepts in various forms of representation, and applying concepts or algorithms to problem solving. The impact of this study is expected to be used by lecturers to design relevant learning designs to improve students' to understand the concept of integral based on gender.

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How to cite:

Noviana, W., Hadi, W.. (2025). Understanding Of Computer Science Students' Concepts In Solving Problems Integral Based On Gender. *Koordinat Jurnal Pembelajaran Matematika dan Sains*, 6(2), 176-184. <https://doi.org/10.24239/koordinat.v6i2.165>.

INTRODUCTION

Mathematics is a basic science that must be mastered by a student in preparing themselves to solve everyday problems in various aspects. Therefore, the basics of studying mathematics must also be instilled from an early age in order to make it easier for students to develop their thinking skills to face more difficult problems. In line with (Sholihah & Mubarak, 2016) mathematics is a universal science that underlies the development of modern technology, has an important role in various disciplines, and develops human thinking power. In addition to having an abstract nature, a good understanding of mathematical concepts is very important for understanding new concepts, so during the teaching and learning process, teachers can provide assignments according to learning objectives (Asa et al., 2023) Furthermore, according to Noviana, (2024) Mathematics is a field of study regarding structures, patterns, forms, theories, and theorems that are developed and proven for the needs of empirical science and mathematics itself. Based on the opinion of the researcher above, it can be concluded that mathematics plays an important role in developing a person's thinking skills; the more it is trained, the better a person's mathematical concept ability will be because in mathematics there are various structures, patterns, forms, theories that must be proven true.

Mathematical comprehension ability is a level of thinking ability that students must have to move to other higher levels of thinking ability. In line with (Karim & Nurrahmah, 2018) if someone has optimal comprehension ability, then other mathematical abilities can also be developed and mastered well. According to (Sudarman & Linuhung, 2017) students' conceptual comprehension ability is one indicator of students' achievement in understanding mathematical concepts that have been

learned during the learning process. Furthermore (Putri et al., 2020) stated that conceptual understanding is the basis for understanding principles and theories, so the consequences are fatal if students do not understand mathematical concepts.

Calculus is part of the branch of mathematics that is important to learn. Calculus II is a compulsory course with a weight of 3 credits taken by Informatics Engineering students. The purpose of the Calculus II course is to provide students with an understanding of the basic rules of integrals, integral substitutions, integrals of rational functions, partial integrals, areas of regions bounded by the x and y axes, areas of regions bounded by lines and curves and with various methods. After taking this course, students are expected to have knowledge, explore, argue and other high-level thinking skills through a good understanding of concepts.

Based on the results of observations during teaching the Calculus II course for integral material, some students experienced difficulties due 1) lack of student understanding of the basic rules of integrals, 2) lack of student understanding in using and choosing procedures to be used to solve problems, 3) lack of student understanding in presenting concepts in various forms of representation, and 4) student carelessness in solving problems. From the results of the study (Nurhikmah & Febrian, 2016) the most dominant error made in definite and indefinite integral material is the error of incorrect data. The incorrect data in question is an error in writing data and the lack of data entered in the problem solving process.

Each student has a different conceptual understanding ability. The difference that is often studied is gender differences. Gender differences can affect a person's mathematics learning process. According to (Karina & Eridani, 2020) stated that hormonal differences between

men and women also cause differences in reasoning to understand and analyze in solving problems found in mathematics problems. The results of the study (Jati et al., 2021; Sakti et al., 2023; Syaifar et al., 2022) show that the conceptual understanding ability of female students is better than that of male students. The results of the study (Alamanda et al., 2023) show that the conceptual understanding of the indefinite integral material of algebraic functions of female students is very good. Based on the description above, a study was conducted entitled understanding of computer science student' concepts in solving problem integral based on gender.

Many studies have discussed conceptual understanding abilities in relation to gender, but only in samples of secondary school students and for material that is more focused on calculus. However, there has been no research on the abilities of students majoring in computer science. The research questions in this study are 1) how is the ability to understand integral concepts of female students in the high category 2) how is the ability to understand integral concepts of male students in the high category 3) how is the ability to understand integral concepts of female students in the low category, and 4) how is the ability to understand integral concepts of male students in the low category?

METHOD

The research method used in this study was qualitative descriptive research. This study was conducted to determine the extent of students' understanding concepts in

solving problems integral based on gender. Twenty-five computer science students took the test and were then classified based on high, medium, and low abilities. Representatives of each gender were then randomly selected from the high and low ability groups. This study did not include medium ability students because it focused on high and low abilities. This selection was based on the consideration that the high and low categories are more contrasting for analysis.

Computer science students were chosen because mathematics is the basis for their advanced courses. High and low abilities were chosen to classify indicators of conceptual understanding abilities. The data collection techniques in this study were 1) a test of conceptual understanding of calculus material and 2) interviews. The conceptual understanding indicators used in this study were 1) repeating concepts, 2) being able to use, utilize, and select certain procedures or operations, 3) presenting concepts in various forms of representation, and 4) applying concepts or algorithms in problem solving. The assessment guidelines for students' mathematical comprehension abilities were adjusted to the indicators to determine the students' scores. The following are the assessment guidelines for the mathematical concept comprehension test adapted from (Fenti Agustin, 2024).

The test consists of 4 questions and is in essay form. The test instruments have been validated through quality assurance within the faculty. Tests are given during the final exams. Below are the indicators of conceptual understanding that were studied.

Table 1. Scoring Guidelines for Mathematical Concept Understanding Ability

No	Indicator of Concepts Understanding	Information	Score
1	Restating the Concept	No answer	0
		Unable to restate concept	1
		Able to restate concept but still contains errors	2
		Able to restate concepts but not accurately	3
		Able to restate concepts accurately	4
2	Able to use, utilize, and select certain procedure or operations	No answer	0
		Unable to use, utilize and select certain procedure or operations	1
		Able to use use, utilize and select certain procedure or operations but still make mistake	2

		Able to use use, utilize and select certain procedure or operations but not yet correct	3
		Able to use use, utilize and select certain procedure or operations correctly	4
3	Presenting concepts in various form of representation	No answer	0
		Unable to present concepts in various form of representation	1
		Able to present concepts in various form of representation but still make errors	2
		Able to present concepts in various form of representation but not yet accurate	3
		Able to present concepts in various form of representation accurately	4
4	Applying concepts or algorithms to problem solving	No answer	0
		Unable to apply concepts or algorithms to problem solving	1
		Able to apply concepts or algorithms to problem solving but still mistakes	2
		Able to apply concepts or algorithms to problem solving correctly	3

After the results of the student instrument are scored according to the scoring guidelines above, the next step is to determine the criteria for students'

mathematical concept understanding abilities. The following is a table of mathematical concept understanding criteria:

Criteria for Mathematical Concepts Understanding Ability	Category
$x > (\bar{x} + SD)$	High
$(\bar{x} - SD) \leq x \leq (\bar{x} + SD)$	Medium
$x < (\bar{x} - SD)$	Low

Notes:

x : Mathematical concept understanding scores

\bar{x} : Average score of understanding mathematical concepts

SD: Standard Deviation of Mathematical Concept Understanding Scores

Furthermore, from the results of the mathematical concept understanding ability criteria, representatives will be selected based on gender to be re-analyzed through interviews

Analysis of Students' Understanding Mathematical Concept

The researcher analyzed students' mathematical concept understanding ability according to the mathematical concept understanding ability indicators. The following are the results of students' understanding integral concepts scores:

RESULT AND DISCUSSION

Table 3. Results of Understanding Mathematical Concept

	Number Of Problems			
	1	2	3	4
Total	57	35	44	43
Average	2,28	1,4	1,76	1,68
Percentage	57%	35%	44%	42%
Maximum Score	4	4	4	4

Based on Table 3, it can be seen that the percentage of students who answered question 1 correctly was higher than the percentage of students who answered other questions correctly. From the table above for questions number 2, 3 and 4 it shows that students' mathematical understanding ability for integral material is still lacking. After the

students' mathematical understanding ability scores were analyzed, the researcher then categorized the students' mathematical understanding ability from high, medium and low. The following is a table of criteria for mathematical concept understanding ability:

Table 4. Percentage of Understanding Mathematical Concept

Category	Criteria Mathematical Concept Understanding Ability	Number of Students	Percentage
High	$x > 9.92$	3	12%
Medium	$4.32 \leq x \leq 9.92$	15	60%
Low	$x < 4,32$	7	28%

Table 4 show the percentage of understanding mathematical concept. Based on this table, the majority of students' fall into the medium category, while the proportion of students' with high category is relatively small compared to other categories. Based on the table above, because the medium category has the largest percentage, the research selected subjects with low percentages, namely the high and low categories, for further interviews regarding student gender. This selection was based on the consideration that the high and low categories are more contrasting for analysis. In the high category, one female

and one male student were randomly selected, while in the low category one female dan on male students were randomly selected. To see the extent of students understanding integral concepts, as seen from how they answered, interview were conducted. The following are the results of interviews with students in the high and low categories based on gender.

Interviews with Several Students

Understanding of Integral Concepts of Female Students in the High Category (S1) and Male Students in the High Category (R1) Analysis of S1 and R1 Data in restating the concept

The figure contains two handwritten mathematical solutions for the integral $\int \frac{3}{4} x^{-6} dx$.
 On the left (S1's work):

$$1. \int \frac{3}{4} x^{-6} dx = \frac{3}{4} \int x^{-6}$$

$$= \frac{3}{4} \cdot \frac{x^{-6+1}}{-6+1} + C$$

$$= \frac{3x^{-5}}{-10} + C = -\frac{3}{20} x^{-5} + C$$

 On the right (R1's work):

$$1) \int \frac{3}{4} x^{-6} dx$$

$$= \frac{3}{4} \int x^{-6} dx$$

$$= \frac{x^{-6+1}}{-6+1} + C$$

$$= \frac{3}{4} \cdot \frac{x^{-5}}{-5} + C$$

$$= -\frac{3}{20} x^{-5} + C$$

Figure 1. Answers of S1 and R1 on question number 1

Based on figure 1, S1 and R1 can provide answers according to what is asked in the question. S1 and R1 can restate the concept of the basic rules of integrals correctly. The following are the results of interviews with S1 and R1 regarding their understanding in solving question number 1.
 Researcher: What types of integrals do you know for question number 1, please explain?

S1: This is an indefinite integral, ma'am, because it does not have upper and lower limits

Researcher: Please explain how to do it?

R1: The way to do it is using the basic rules of integrals, ma'am. The constant part is placed in front, after that we integrate the x^{-6} ma'am. So it becomes $\frac{1}{-5} x^{-5} + c$ ma'am. Then we multiply it by the constant, which is $\frac{3}{4}$ ma'am. So it becomes $\frac{3}{20} x^{-5} + c$

Researcher: why do the denominator and exponent become -5?

S1: because $-6+1 = -5$ ma'am

Based on the interview results, S1 is very confident with the answers explained. S1 is able to answer the basic rules of integrals and arithmetic operations correctly.

Understanding of Integral Concepts of Female Students in Low Category (S2) and Male Students in Low Category (R2)

Data Analysis of S2 and R2 in using, utilizing and selecting certain procedures or operations

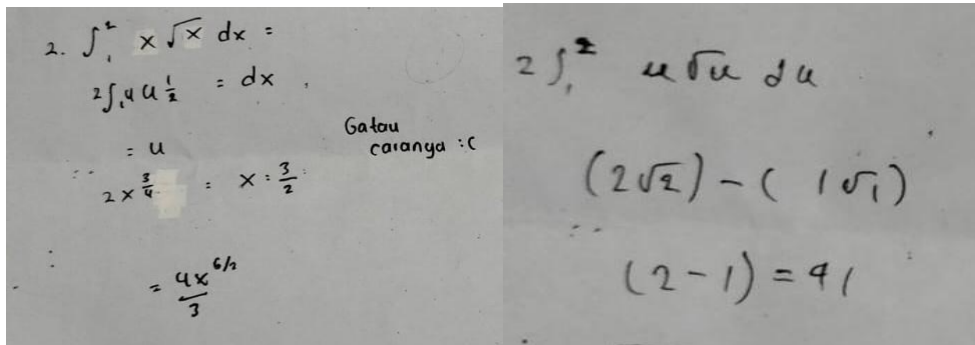


Figure 2. S2 and R2's answers to question number 2

Based on figure 2, S2 and R2 cannot use, utilize and select certain procedures or operations. S2 and R2 cannot determine the initial steps of the work by not changing \sqrt{x} into exponents. The following are the results of interviews with S2 and R2 regarding their understanding in solving question number 2

Researcher: for question number 2, why is it wrong?

S2: because it was not changed first ma'am, it should have been changed first

Researcher: as for you, why is it wrong?

R2: I don't understand how to change it ma'am, so I immediately substituted 2 and 1 into the question.

Researcher: so what makes you unable to do it?

S2: for me, if the example question is different from what was taught, I get confused Ma'am

R2: me too ma'am.

Understanding of Integral Concepts of Female Students in Low Category (S2) and Male Students in Low Category (R2)

Data Analysis of S2 and R2 in presenting concepts in various forms of representation

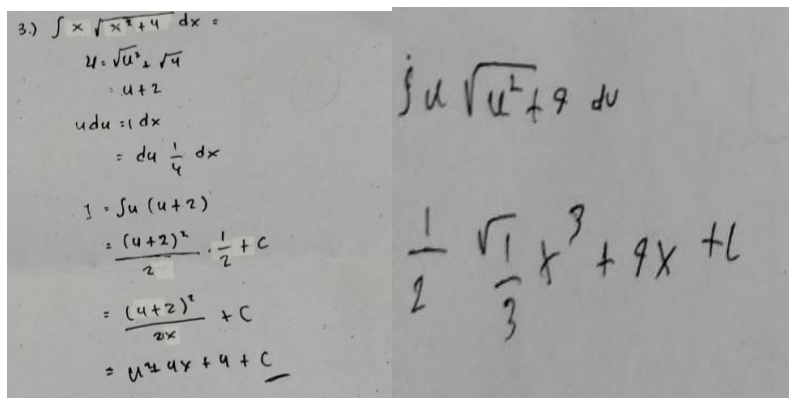


Figure 3. Answers of S2 and R2 on question number 3

Based on figure 3, S2 and R2 were unable to present concepts in various forms of representation. S2 and R2 were wrong in determining the initial steps of the work. Both of them were wrong in determining the U example, so that to continue to the next step there were many errors. The following are the results of interviews with S2 and R2 regarding their understanding in solving question number 3.

Researcher: for question number 3, what type of integral is R2 included in?

R2: indefinite integral ma'am

Researcher: so what material is it included in S2?

S2: material on the substitution rule of indefinite integrals of algebraic functions ma'am

Researcher: how do you work on the integral substitution rule?

S2: use an example ma'am

Researcher: so which example should be used?

S2: the $x^2 + 4$ ma'am

Researcher: is it true that the U example is like this?

S2: wrong ma'am

Researcher: what about you R2

R2: I don't understand ma'am

Understanding of Integral Concepts of Female Students in the High Category (S1) and Male Students in the High Category (R1) Data Analysis of S1 and R1 in applying concepts or algorithms to problem solving

Figure 4. S1 and R1's answers to question number 4

Based on figure 4, S1 can apply concepts or algorithms to problem solving. S1 can write an example. S1 can example $-10x + 5$ with U and then use the integral substitution rule. While R1 has only reached the example step. The following are the results of interviews with S1 and R1 regarding their understanding in solving question number 4.

Researcher: what rule is used in question number 4?

S1: definite integral substitution rule for algebraic functions

Researcher: what initial step is used in the substitution rule?

R1: using an example ma'am

Researcher: which part is used as an example?

S1: which has an exponent ma'am

Researcher: please explain?

S1: what is used as an example of U is $-10x+5$ ma'am, after that it is reduced to du and determines the value of dx. Then it is returned to the question and determines the result with the given limit.

Researcher: what about you R1?

R1: I only understand up to the analogy, ma'am

The results of the study showed that the mathematical understanding ability of high-ability female students almost mastered all the questions on the indicator. High-ability female students were able to master the indicator of restating the concept, while on the indicator of being able to use, utilize and select certain procedures or operations, presenting concepts in various forms of representation and applying concepts or

algorithms to problem solving, high-ability female students obtained a score of 3 which means they were able to answer but not correctly. Meanwhile, high-ability male students were able to master the indicator of restating the concept, while on the indicator of being able to use, utilize and select certain procedures or operations, presenting concepts in various forms of representation and applying concepts or algorithms to problem solving, high-ability male students obtained a score of 2 which means they still made mistakes. However, the results of the mathematical comprehension test showed that female students' mathematical comprehension test scores were higher than male students' mathematical comprehension test scores. This finding is in line with research conducted by (Alamanda et al., 2023; Jati et al., 2021; Sakti et al., 2023; Syaifar et al., 2022) which stated that female students' mathematical comprehension skills were better than male students' mathematical comprehension skills. Furthermore, both female and male students with low abilities did not master all the questions on the indicator. Both female and male students with low abilities obtained a score of 1 on all question indicators, namely restating concepts, being able to use, utilize, and select certain procedures or operations, presenting concepts in various forms of representation, and applying concepts or algorithms to problem solving. This is in line with Mulyadi's (Riska & Kurniawati, 2018) research, which states that understanding the meaning of a problem requires mastery of the material and concepts related to the problem. Students who lack self-confidence and prioritize memorization tend to be weak in decision-making due to a lack of conceptual understanding, which results in an inability to solve mathematical problems (Pebianto et al., 2018). Previous research has concluded that students' mathematical abilities are low if they lack conceptual understanding, resulting in an inability to solve mathematical problems.

These findings are crucial because they can serve as a reference for researchers and instructors in providing gender-sensitive treatment. Interviews with low-ability male and female students revealed that they

forget, are careless, and rush when completing assignments. These findings suggest that future researchers involve a larger, more diverse sample and consider other variables such as learning styles, learning models, and the instructor's role in using instructional media.

CONCLUSION

Based on the research results and discussions, it can be concluded that high-ability female students met almost all indicators of mathematical comprehension ability. Meanwhile, high-ability male students did not meet the indicators of mathematical comprehension ability, as they still made errors in several questions. Both low-ability female and male students failed to master the indicators of mathematical comprehension ability. Interview results indicated that high-ability female students were more confident and certain of their answers, while low-ability female and male students often did not understand the questions, forgot formulas, and were careless in restating the questions.

ACKNOWLEDGMENT

Thank you to all parties who have participated in this research, including computer science students' of Universitas Pamulang, class 02TPLP038, validators and other parties involved.

AUTHOR CONTRIBUTIONS

The First Author: Conceptualization, writing, analysis, editing, and visualization;
The Second Author: Writing, review and editing.

REFERENCES

- Alamanda, N., Lefrida, R., Murdiana, I. N., & Bakri M, B. M. (2023). Profil Pemahaman Konsep Siswa dalam Menyelesaikan Soal Integral Tak Tentu Fungsi Aljabar Ditinjau dari Jenis Kelamin. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, 7(2), 1700–1714.
<https://doi.org/10.31004/cendekia.v7i2.2362>
- Asa, E. M., Zulfkar, R. N., & Syarief, N. H. (2023). Problem Solving Untuk

- Mengukur Tingkat Kemampuan Berpikir Kreatif Matematis Siswa. *MEGA: Jurnal Pendidikan Matematika*, 4(2), 633–644.
- Fenti Agustin, N. E. Z. dan S. S. (2024). Kemampuan Pemahaman Konsep Matematis Siswa pada Materi Persegi dan Persegi Panjang. *Proceeding Galuh Mathematics National*, 4(1), 128–138.
- Jati, hasna salsabilla, Amalia, H., Putri, A. A., Faradillah, A., & Siswanto, rizki D. (2021). Analisis Kemampuan Pemahaman Konsep Siswa ditinjau dari Gender dalam Menyelesaikan Soal Matematika. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, 2, 2–8.
- Karim, A., & Nurrahmah, A. (2018). Analisis Kemampuan Pemahaman Matematis Mahasiswa Pada Mata Kuliah Teori Bilangan. *Jurnal Analisa*, 4(1), 24–32. <https://doi.org/10.15575/ja.v4i1.2101>
- Karina, A., & Eridani, P. (2020). Mathedunesa Profil Penalaran Matematika Siswa Smp Dalam Menyelesaikan Soal Timss Ditinjau Dari Jenis Kelamin Pradnyo Wijayanti. *MATHEdunesa*, 8(3), 543–549.
- Nurhikmah, S., & Febrian, F. (2016). Analisis Kesalahan Siswa Dalam Menyelesaikan Permasalahan Integral Tak Tentu. *Jurnal Tatsqif*, 14(2), 218–237. <https://doi.org/10.20414/jtq.v14i2.30>
- Pebianto, A., Suhartina, R., Yohana, R., Mustaqimah, I. A., & Hidayat, W. (2018). Kemampuan berpikir kritis matematis siswa sma ditinjau dari gender. *Jurnal Pembelajaran Matematika Inovatif*, 1(4), 631–636.
- Putri, D., Indiana, M., & Aan, P. S. (2020). Kemampuan Pemahaman Konsep Matematis Siswa: Ditinjau dari Kategori Kecemasan Matematik. *SJME (Supremum Journal of Mathematics Education)*, 4(1), 24–32.
- Riska, K., & Kurniawati, A. (2018). Analisis Kesulitan Siswa Dalam Menyelesaikan Soal Cerita Matematika Topik Pecahan Ditinjau Dari Gender. *Jurnal Teori Dan Aplikasi Matematika*, 2(2), 118–122.
- Sakti, Z. R., Jazuli, L. O. A., & Fahinu. (2023). PERBEDAAN KEMAMPUAN PEMAHAMAN MATEMATIS BERDASARKAN JENIS KELAMIN. *Jurnal Penelitian Pendidikan Matematika*, 11(3), 407–420.
- Sholihah, U., & Mubarak, D. A. (2016). Analisis Pemahaman Integral Taktentu Berdasarkan Teori Apos (Action, Process, Object, Scheme) Pada Mahasiswa Tadris Matematika (Tmt) Iain Tulungagung. *Cendekia: Jurnal Kependidikan Dan Kemasyarakatan*, 14(1), 125. <https://doi.org/10.21154/cendekia.v14i1.551>
- Sudarman, S. W., & Linuhung, N. (2017). Pengaruh Pembelajaran Scaffolding terhadap Pemahaman Konsep Integral Mahasiswa. *The New Oxford Shakespeare: Critical Reference Edition, Vol. 2*, 6(1), 2490–2492. <https://doi.org/10.1093/oseo/instance.00191376>
- Syaifar, M. H., Maimunah, M., & Roza, Y. (2022). Analisis Kemampuan Pemahaman Konsep Matematis Peserta Didik pada Materi Bangun Ruang Sisi Datar Ditinjau dari Gender. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, 6(1), 519–532. <https://doi.org/10.31004/cendekia.v6i1.1097>
- Widyah Noviana, I. H. (2024). MAHASISWA DENGAN MENGGUNAKAN STRATEGI BLENDED LEARNING DAN STRATEGI OFFLINE LEARNING. *Indo-MathEdu Intellectuals Journal*, 5(3), 4188–4195.