

Nearpod-Assisted PBL on Integration Techniques: Mathematical Problem-Solving and Self-Confidence

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Abstrak

Kurangnya keterlibatan aktif mahasiswa dapat menghambat perkembangan pemecahan masalah matematis. Inovasi dalam pembelajaran diperlukan untuk meningkatkan percaya diri, yang berhubungan erat dengan kemampuan pemecahan masalah matematis. Penelitian ini bertujuan mengetahui hubungan antara tingkat percaya diri mahasiswa dengan kemampuan pemecahan masalah matematis dalam konteks penggunaan Nearpod dan model Pembelajaran Berbasis Masalah (PBL). Metode penelitian yaitu kualitatif dengan strategi studi kasus, berfokus pada mahasiswa yang mengikuti mata kuliah Kalkulus Integral di Program Studi Pendidikan Matematika Universitas Islam Nusantara. Teknik pengumpulan data melibatkan wawancara, observasi, dokumentasi, dan angket. Data dianalisis melalui proses pengumpulan, reduksi, penyajian, dan penarikan kesimpulan. Temuan penelitian menunjukkan mahasiswa dengan tingkat percaya diri tinggi menunjukkan kemampuan pemecahan masalah matematis yang tinggi hingga sedang, mahasiswa dengan percaya diri sedang menunjukkan kemampuan yang bervariasi dari tinggi hingga rendah, dan mahasiswa dengan percaya diri rendah cenderung menunjukkan kemampuan pemecahan masalah matematis yang sedang hingga rendah. Implikasi penelitian yaitu pentingnya merancang pembelajaran berbantuan teknologi yang dapat meningkatkan percaya diri mahasiswa, sehingga akan meningkatkan kemampuan pemecahan masalah matematis. Kata Kunci: Kemampuan Pemecahan Masalah Matematis; Nearpod; Percaya Diri; Teknik Pengintegralan

Abstract

Lack of active student involvement can hinder the development of mathematical problem-solving. Innovation in learning is needed to increase self-confidence, which is closely related to mathematical problem-solving ability. This study aims to determine the relationship between students' self-confidence levels and mathematical problem-solving abilities in the context of using Nearpod and the Problem-Based Learning (PBL) model. The research method is qualitative with a case study strategy, focusing on students taking the Integral Calculus course in the Mathematics Education Study Program at Universitas Islam Nusantara. Data collection techniques include interviews, observations, documentation, and questionnaires. Data are analyzed through the processes of collection, reduction, presentation, and drawing conclusions. The research findings show that students with high self-confidence show high to moderate mathematical problem-solving abilities, students with moderate self-confidence show abilities that vary from high to low, and students with low self-confidence tend to show moderate to low mathematical problem-solving abilities. The implications of this research are the importance of designing technology-assisted learning that can increase student self-confidence, thereby improving mathematical problem-solving abilities.

Keywords: Mathematical Problem-Solving; Nearpod; Self-Confidence; Integration Techniques

I. INTRODUCTION

Integral Calculus is a required course in the third semester with a weight of three credits, and is a continuation of the Differential Calculus course as well as a prerequisite for the Advanced Calculus course in the Mathematics Education program at Universitas Islam Nusantara. One of the important topics in Integral Calculus is integration techniques. According to Sanjaya's research (2020), this topic is highly relevant for mathematics education students as they may teach integration techniques after graduation. However, many students find it challenging to understand integration techniques when performing integral calculations or applying these concepts to contextual problems.

Previous research by Franita et al. (2020) states that low student engagement in developing mathematical thinking skills leads to weak understanding of concepts, formulas, and integration techniques. This is in line with Schoenfeld's (2013) findings, which show that mathematical problem-solving skills are closely related to active cognitive engagement and metacognitive regulation during the learning process. This low level of active engagement also hinders cognitive skills, leading to difficulties in understanding concepts and applying integration techniques independently.

In this context, mathematical problem-solving skills are very important in learning integral calculus. Dewi et al. (2020) state that this ability is necessary in many problems in integral calculus. However, mathematical problem-solving skills in Indonesia remain low, as reflected in the TIMSS study results (Mullis et al., 2020), which ranked Indonesia 44th out of 49

countries, with an average score of 397, far below the international average. These results indicate the weakness of Indonesian students' mathematical problem-solving skills, including at the university level. Stacey (2005) also adds that students often struggle with non-routine problems due to a lack of strategies and confidence, especially if they are only exposed to procedural learning.

Observations and interviews conducted prior to the study at the Mathematics Education Study Program of Universitas Islam Nusantara showed that students tended to rely on examples provided by lecturers, were reluctant to try alternative strategies, and were not accustomed to solving problems in everyday contexts. If this condition continues, students will continue to rely on standard solution patterns and fail to develop critical and creative thinking skills.

Mathematical problem solving plays a very important role in mathematics education because it encourages students to generate solutions and think reflectively (Marianti, 2023; Talia, Afriansyah, & Sumartini, 2024). Polya (1957) stated that problem solving is the core of mathematics. This is in line with the opinion of Mualifah et al. (2020), who emphasized that this ability is important not only for learning mathematics but also for life and work. Schoenfeld (1992) also mentioned that developing problem-solving skills provides the cognitive tools necessary for higher-level thinking. In addition to cognitive factors, affective aspects such as self-confidence also influence this ability (Monalisa et al., 2024). Jatisunda (Putri & Juandi, 2022) states that self-confidence

influences problem-solving ability. Bandura (1997) emphasizes that self-efficacy beliefs influence how people think, feel, and motivate themselves to act.

Students with high levels of self-confidence tend to be more active and optimistic when solving problems and more persistent in facing challenges (Faturohman, Iswara, & Gozali, 2022; Gunawan et al., 2024). Research by Pajares and Graham (1999) also shows that self-efficacy beliefs can facilitate problem-solving. Moreover, Zamir et al. (2022) found that confidence in mathematics plays a significant role in students' attitudes toward problem-based learning (PBL), which directly impacts their problem-solving ability. Rangkuti (2022) further supports this by showing that using manipulative teaching aids through PBL improves students' problem-solving skills and confidence in mathematics.

To increase student engagement, one approach that can be used is interactive learning technology, such as Nearpod. According to Andriani et al. (2024), Nearpod is an interactive learning platform that facilitates two-way communication between educators and learners. Features such as polls, audio, video, and images encourage active participation. Wang, Wu, and Wang (2009) found that students are more engaged and motivated when learning with interactive technology integrated into a collaborative learning environment. Huang et al. (2021) also stated that app-assisted learning, such as with Nearpod, can significantly improve engagement, conceptual understanding, and mathematics learning outcomes.

Nearpod is highly effective when used with the Problem-Based Learning (PBL) approach, which places students at the center of the learning process and encourages real-world problem solving (Rinaldi & Afriansyah, 2019; Kanah & Mardiani, 2022; Rahayu, Puspitasari, & Luritawaty, 2024). Ramdhani et al. (2024) and Junaid et al. (2021) confirm that integrating Nearpod into the PBL model enriches learning, improves conceptual understanding, and hones students' practical skills. This aligns with Barrows' (1986) assertion that PBL enhances student motivation and engagement while fostering deeper understanding through contextual problem-solving.

Based on previous research findings and field conditions, students' mathematical problem-solving skills, particularly in integration techniques, remain low. Self-confidence is a crucial factor in independently solving mathematical problems. Therefore, this study aims to explore Mathematical Problem-Solving Ability from a Self-Confidence Perspective through Nearpod-Assisted Learning.

II. METHOD

The research method used in this study is qualitative. Observations, interviews, and document reviews were conducted to examine the integration of mathematical problem-solving techniques with the assistance of Nearpod and the Problem-Based Learning (PBL) model (Hsu & Wu, 2020; Hung, 2011). According to Kusumastuti and Khoiron (2019), qualitative research employs methods like observation,

interviews, and document reviews to gather rich, detailed data.

A case study strategy was employed to explore students' mathematical problem-solving skills with a focus on integration techniques facilitated by Nearpod and the PBL model, with particular attention to the role of student confidence. Case studies were chosen because they allow for a thorough investigation of the context and interactions between learning components (Baxter & Jack, 2008; Thomas, 2011). Widhagdha and Ediyono (2022) further argue that case studies are ideal for examining programs, events, or individuals in-depth, making them particularly appropriate for this study.

The data sources for this research were the spoken and written words of students enrolled in the Integral Calculus course during the odd semester of the Mathematics Education Study Program at Universitas Islam Nusantara in the 2024/2025 academic year. Consistent with Inco and Rofiq (2022), qualitative research data sources include oral and written expressions, as well as actions observed by the researcher (Merriam, 2009).

Initially, 14 students were selected for the study through purposive sampling, a technique based on deliberate selection criteria (Mukti & Aprianti, 2021; Palinkas et al., 2015). The participants were categorized based on their achievements in the previous Differential Calculus course as follows: M6 (high category), M9 (medium category), and M10 (low category). However, due to attrition, M10 did not fully participate in the research, leading to the exclusion of this subject from the analysis.

Thus, the research primarily focused on M6 (high category) and M9 (medium category).

This exclusion of M10 could introduce attrition bias, which must be acknowledged when interpreting the results. Furthermore, future research should consider how to address such attrition bias to enhance the generalizability of findings.

The study followed Institutional Review Board (IRB) approval and obtained informed consent from all participants, ensuring ethical guidelines were followed throughout the research process.

Regarding the integration of PBL, the model was employed by designing real-world problem scenarios that encouraged students to apply integration techniques, thereby promoting active learning and fostering collaboration. The Nearpod platform was used to facilitate real-time engagement with these problems, allowing for seamless integration of multimedia resources to support learning.

Lastly, a validated questionnaire was used to assess student confidence and learning outcomes, ensuring that the data collected was both reliable and relevant for addressing the research questions.

III. RESULT AND DISCUSSION

A. Result

The results of this study were compiled based on data obtained from mathematical problem-solving ability tests, and confidence questionnaires.

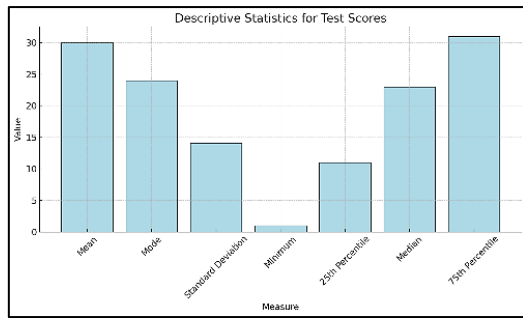


Figure 1. Results of the Mathematical Problem-Solving Ability Test

Table 1. Confidence Questionnaire Results

Category	Value Category	Sum	Percentage
High	$X \geq 76,96$	3	21,42%
Moderate	$66,42 \leq X < 76,96$	9	64,28%
Low	$X \leq 66,42$	2	14,28%

B. Discussion

1. Mathematical Problem-Solving Ability Reviewed from High Confidence

Based on the results of the questionnaire before the study, M3, M6, and M11 are students with high confidence, M6 is students selected from data sources. The following are the answers to the mathematical problem-solving ability test by M6 subjects.

$$\int (x^n + 1)^m \cdot nx^{n-1} dx = \int u^m du$$

$$\text{misal: } u = x^n + 1 \Rightarrow du = nx^{n-1} dx$$

$$= \frac{1}{m+1} u^{m+1} + C$$

$$= \frac{1}{m+1} (x^n + 1)^{m+1} + C$$

$$\text{Jadi } \int (x^n + 1)^m \cdot nx^{n-1} dx = \frac{1}{m+1} (x^n + 1)^{m+1} + C$$

Figure 2. Answer M6 Indicator of Ability to Generalize Based on Examples

Figure 2 shows M6's response to indicator one: a student in the top category scored seven out of a possible ten. This means that M6 has not fulfilled the 'ability to generalise based on examples' indicator,

as it does not write what is known and asked, resulting in a score of three being deducted according to the scoring guidelines. In the interview results, M6 can solve the problem by memorising U, but cannot speak what is known and asked. Based on observations of the group to which M6 belonged, the ability to generalise based on examples fell into the 'good' category, reaching a percentage of 75%, while mastery of integral material using the substitution method fell into the 'excellent' category, reaching a percentage of 100%. During learning, M6 utilises Nearpod very well, achieving a score of 96.6%. The implementation of the PBL model for students falls into the 'good' category, but has not been able to arrange solutions systematically or in a structured manner, meaning that during the test, they were unable to answer the questions.

$$\text{miscal: } \int x^2 \sqrt{x^3 + 1} dx = \int \sqrt{u} \cdot \frac{1}{3} du$$

$$= \frac{1}{3} \int u^{\frac{1}{2}} du$$

$$= \frac{1}{3} \cdot \frac{2}{3} u^{\frac{3}{2}} + C$$

$$= \frac{2}{9} u^{\frac{3}{2}} + C$$

$$= \frac{1}{3} u^{\frac{3}{2}} + C$$

$$= \frac{1}{3} (x^3 + 1)^{\frac{3}{2}} + C$$

$$= \frac{1}{3} \sqrt{(x^3 + 1)^3} + C$$

$$\text{Jadi: } \int x^2 \sqrt{x^3 + 1} dx = \frac{1}{3} \sqrt{(x^3 + 1)^3} + C$$

Figure 3. Answer M6 Indicator Ability to Understand Mathematical Concepts and Terms

Figure 3 shows M6's response to indicator two: a student in the top category scored five out of a possible ten. This means that M6 has not fulfilled the indicator of the ability to understand mathematical concepts and terms because they did not write down what was known or asked, and their calculation was incorrect. The correct

answer is $13 \times 23 = 29$, but M6 answered 26, so the score was reduced by five according to the scoring guidelines. During the interview, M6 explained that they solved the problem by initialising first, and that the initialisation must be the same as $x^2 dx$, but they did not realise that there was something wrong with the calculation.

Based on observations of M6's group, understanding mathematical concepts and terms fell into the good category, reaching 75%, while mastery of integral material with the substitution method fell into the excellent category, reaching 100%. During learning, M6 utilised Nearpod very well, reaching a percentage of 96.6. The implementation of the PBL model for students fell into the 'good' category, but they were unable to compile solutions systematically or in a structured manner, and they were less thorough when solving problems. Consequently, during the test, they did not write what was known or asked, and they made a mistake in the calculation.

M6 demonstrated a satisfactory comprehension of the indicators of understanding mathematical concepts and terminology. However, there were some shortcomings in their approach to answering the questions. Specifically, they did not write down the known quantities and were not careful with their calculations, which resulted in errors and a consequent reduction in their score. In addition, M6 demonstrated a commendable aptitude for Nearpod and exhibited a strong grasp of the substitution method, as asserted by Suryani's opinion (Minarsi et al., 2022).

This suggests that the mathematical problem-solving abilities of students can be enhanced through experience and the

application of their existing knowledge and skills.

$$\begin{aligned} \int \tan^3 y \, dy &= \int \tan^2 y \cdot \tan y \, dy \\ &= \int \frac{\sin^2 y}{\cos^2 y} \cdot \tan y \, dy \\ &= \int \frac{1}{\cos^2 y} \cdot \sin^2 y \cdot \tan y \, dy \\ &= \int \frac{1}{\cos^2 y} \cdot \sin^2 y \cdot \frac{\sin y}{\cos y} \, dy \\ &= \int \frac{1}{\cos^3 y} \cdot \sin^2 y \, dy \end{aligned}$$

Figure 4. Answer M6 Indicator Ability to Switch to a Known Method

As illustrated in Figure 4, the response to indicator three from a student in the high category resulted in a score of four out of a maximum of ten. This indicates that M6 has not met the criterion of demonstrating the capacity to modify methods that have been established, as evidenced by the absence of documentation of the known and requested information, the failure to formulate a plan that involves method alteration based on the problem's nature, the inadequacy of the execution of the plan through the incomplete presentation of the answer, and the omission of the conclusion. M6 has begun to demonstrate an understanding of the necessity to adapt methodologies, a capacity that diverges from the paradigm outlined in the problem statement. However, this approach is accompanied by a certain degree of imprecision and incompleteness, factors that, according to the established scoring rubric, result in a reduction of the overall score from six. During the interview, M6 declined to amend their methods. The results of the observations conducted on the group to which M6 belonged indicated that the indicator of the ability to modify methods

that had previously been categorised as excellent attained a percentage of 100 per cent, signifying a comprehensive mastery of the subject matter.

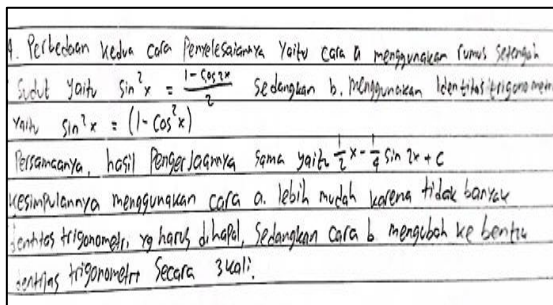


Figure 5. Answer M6 Indicator Ability to Note Similarities, Differences and Analogies

As illustrated in Figure 5, the response to indicator four from M6, a student operating within the high category, yielded a score of five out of a maximum possible score of ten. This indicates that M6 has not demonstrated the capacity to identify, describe and draw analogies between concepts, as evidenced by its failure to articulate the known and asked information and to provide a conclusion to the problem. Consequently, its score according to the established guidelines is reduced to five. The results of the interview demonstrate that M6 is capable of resolving the issue. Specifically, the equation yields identical results despite the utilisation of disparate methods. The distinction lies in the application of these methods. The initial method employs the half-angle formula, while the subsequent method utilises the same formula.

It was evident that both M6 exhibited an inability to recognise similarities, differences and analogies. M6 demonstrated an aptitude for identifying similarities, differences and analogies;

however, they did not contribute to the conclusion.

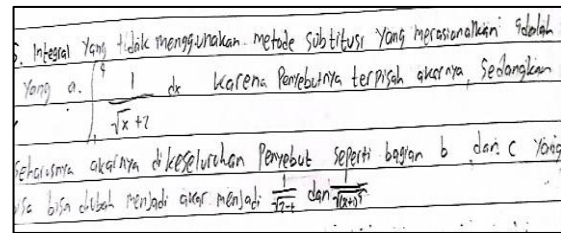


Figure 6. Answer M6 Indicator Ability to Know Irrelevant Things

M6 is a subject selected from the data source as a student with a high category. However, with regard to the capacity to discern unrelated concepts, M6 does not feature among the highest or lowest scorers.

As illustrated in Figure 6, M6 attained a score of two out of a maximum of ten on indicator five, indicating a satisfactory level of performance. This suggests that M6 has not yet demonstrated the capacity to comprehend concepts that are not directly related to the task at hand. It does not document the knowledge and inquiries that have been posed, nor does it formulate a problem model. Instead, it merely executes the plan without incorporating any unrelated information.

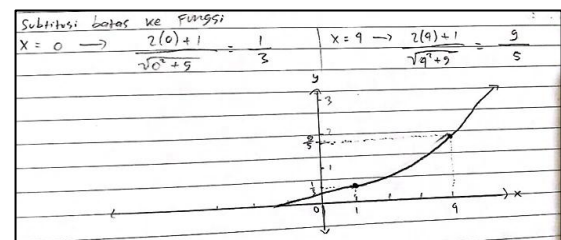


Figure 7. Answer M6 Indicator Ability to Visualize and Interpret Quantity or Space

As illustrated in Figure 7, M6 attained a score of seven out of a maximum of ten on indicator six. This indicates that M6 has not met the indicator of the ability to visualize and interpret quantity or space, as it does

not address the known and asked, resulting in a reduction of three scores according to the scoring guidelines. In the interview results, it is evident that M6 has demonstrated an ability to address the problem by substituting the upper and lower limits into the function. The results of the observations conducted on the group to which M6 belonged indicated that the ability to visualize and interpret quantity or space was classified as 'excellent', with a percentage of 100 per cent. Conversely, the mastery of material pertaining to several trigonometric functions was classified as 'below average', with a percentage of 50 per cent. During the learning process, M6 demonstrated a commendable utilisation of Nearpod, attaining a noteworthy success rate of 96.6 percent.

M6 makes very good use of Nearpod because it can be accessed outside of the classroom, in line with Ami's opinion (Feri & Zulherman, 2021), which states that interactive multimedia learning resources such as those provided by Nearpod can be used by students independently at any time.

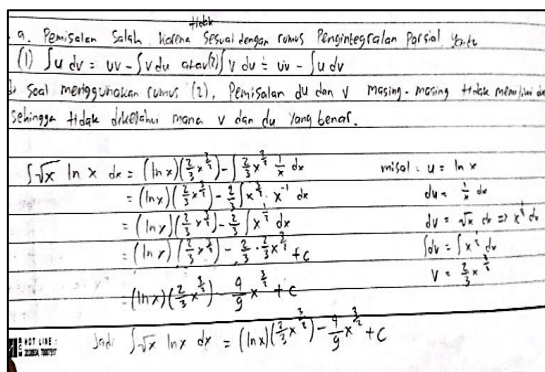


Figure 8. Answer M6 Indicator Ability to Estimate and Analyze

Figure 8. shows M6's response to indicator seven out of a maximum of ten. Despite achieving the highest score, M6 did not fulfil

the indicator of the ability to estimate and analyse because it did not write what was known and asked. According to the scoring guidelines, this resulted in a reduction of three scores. In the interview results, M6 identified a problem with the partial formula. Based on observations of the group to which M6 belonged, the ability to estimate and analyse fell into the excellent category, reaching a percentage of 100, while mastery of partial integration material fell into the good category, reaching a percentage of 75. During the learning process, M6 utilised Nearpod very well, achieving a score of 96.6%.

M6 utilised Nearpod very well, demonstrated excellent abilities and mastered the partial integration material and the implementation of the PBL model for students. In line with Risky et al. (2023), Nearpod can develop students' mathematical abilities and motivation in the learning process. However, M9 experienced difficulties in planning solutions and made errors when memorising and applying partial formulas, resulting in incorrect answers.

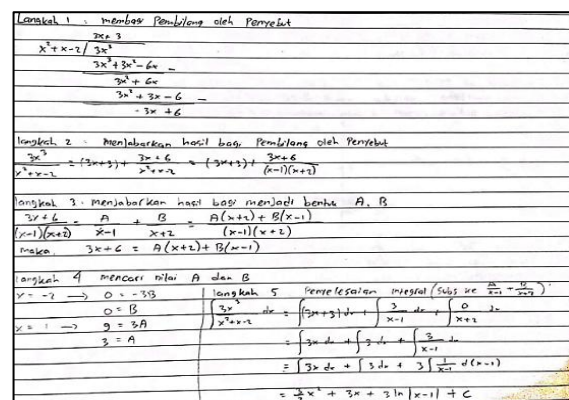


Figure 9. Answer M6 Indicator Ability to identify the Most Important Elements and Choose The Correct Procedure

Figure 9 shows M6's response to indicator eight, scoring four out of a

maximum of ten. This means that M6 has not fulfilled the indicator of the ability to identify the most important elements and choose the correct procedure. This is because M6 does not write down what is known and asked, does not plan the solution by dividing the numerator by the denominator, does not carry out the plan by writing the correct procedure, and does not interpret the results obtained by making conclusions. According to the scoring guidelines, the score is therefore reduced to six. In the interview, M6 could answer in five steps. However, it was still less precise at this stage. Based on observations of the group to which M6 belonged, the ability to identify the most important elements and choose the correct procedure fell into the 'excellent' category, reaching a percentage of 100, as did mastery of rational function integration material. During the learning process, M6 utilised the Nearpod platform very well, achieving 96.6%.

Although the M6 group has high mathematical problem-solving ability, it has not met any indicators of mathematical problem-solving ability because the indicator of the ability to generalize based on examples does not write known and questioned. An indicator of the ability to understand mathematical concepts and terms, not writing down what is known and asked and wrong in the calculations that should have been done but M6 answered $\frac{1}{3} \times \frac{2}{3} = \frac{2}{6}$. An indicator of the ability to change the method that has been known, not writing down what is known and asked, planning a solution by changing the method based on the problem appropriately,

carrying out the plan by writing down the answer but not complete, and not writing the conclusion.

An indicator of the ability to note similarities, differences and analogies, not to write down what is known and asked and not to write down the conclusion of the problem. An indicator of the ability to know irrelevant things, not writing down what is known and asked, not making any reasoning about problems at all, implementing plans but not writing down irrelevant things, interpreting the results obtained by making conclusions but not precise. An indicator of the ability to visualize and interpret quantities or spaces, not write known and asked. An indicator of the ability to estimate and analyze, not write known and questioned. An indicator of the ability to identify the most important elements and choose the correct procedure, not write down what is known and asked, plan the solution by dividing the numerator by denominator but not exactly, carry out the plan by writing down the correct but not precise procedure, interpret the results obtained by making conclusions but not exactly. In addition, in Nearpod-assisted learning, M6 showed excellent results, especially in accessing and interacting with learning features as well as good application of the PBL model, especially in group discussions. Therefore, even though M6 does not write down the knowledge and questions on the test questions, the use of Nearpod is very good, the implementation of the PBL model for students is good, and the level of self-confidence is high. Based on the results of the analysis of mathematical problem-solving ability, it was

found that M6 with a high confidence category was in the category of high mathematical problem-solving ability, but did not meet the correct problem-solving indicators. It can be seen that the confidence that M9 has is related to and helps students develop mathematical problem-solving skills related to integration engineering materials. This is in line with Fauziah's findings (Dewi et al., 2023) that who gains the fact of self-confidence contributes to mathematical problem-solving abilities and has a strong one-way relationship.

2. Mathematical Problem Solving Ability Reviewed from Medium Confidence

The following are the answers to the M9 mathematical problem-solving ability test.

1) Dik: a) $\int (x+1)^3 dx = \frac{1}{10} (x+1)^{10} + c$
 b) $\int (x^2+1)^2 2x dx = \frac{1}{10} (x^2+1)^{10} + c$
 c) $\int (x^2+1)^3 3x dx = \frac{1}{10} (x^2+1)^{10} + c$
 Dit: $\int (x^n+1)^m n x^{n-1} dx$
 Jawab
 $\int (x^n+1)^m n x^{n-1} dx = \frac{1}{m+1} (x^n+1)^{m+1} n x^{n-1} dx$
 misal
 $n = x^n + 1$
 $du = n dx$
 $\frac{1}{n} du = dx$
 Jadi, $\int (x^n+1)^m n x^{n-1} dx = \frac{1}{m+1} (x^n+1)^{m+1} n x^{n-1} + c$

Figure 10. Answer M9 Indicator of Ability to Generalize Based on Examples

Figure 10 shows M9's response to indicator one: a student in the moderate category scored six out of a maximum of ten. This means that M9 has not fulfilled the ability-to-generalise indicator, because they rely on memorisation, which is less precise, and carry out the plan by writing the answer, but the completion step does not follow the plan. Therefore, the lack of a score of four is in accordance with the scoring guidelines. In the interview, M9

solved the problem by following the example.

However, M9 was unable to solve the derivative and integral concepts of the problem because they only looked at the example. Based on observations of the group to which M9 belongs, the ability to generalise based on examples falls into the 'good' category, reaching a percentage of 75%, while mastery of integral material using the substitution method falls into the 'less' category, reaching a percentage of 50%. During the learning process, M9 utilised Nearpod very well, achieving a score of 95%.

misalkan $u = x^3 + 1$
 $du = 3x^2 dx$
 $\frac{1}{3x^2} du = dx$
 $\int x^2 \sqrt{x^3+1} dx = \int x^2 \sqrt{u} \cdot \frac{1}{3x^2} du = \int \sqrt{u} \cdot \frac{1}{3} du$
 $= \frac{1}{3} \int \sqrt{u} du$
 $= \frac{1}{3} \int u^{\frac{1}{2}} du$
 $= \frac{1}{3} \cdot \frac{2}{3} u^{\frac{3}{2}} + c$
 $= \frac{2}{9} (x^3+1)^{\frac{3}{2}} + c$
 Jadi, $\int x^2 \sqrt{x^3+1} dx = \frac{2}{9} (x^3+1)^{\frac{3}{2}} + c$

Figure 11. Answer M9 Indicator Ability to Understand Mathematical Concepts and Terms

Figure 11 shows M9's response to indicator two. As a student in the moderate category, he scored five out of a possible ten. This means that M9 has not fulfilled the indicator of the ability to understand mathematical concepts and terms because he did not write down what was known or asked; he did not plan the solution by making a memorisation based on the problem, and his solution was less precise. M9 wrote $\int x^2 \sqrt{u} \cdot 13x^2$, which is not in accordance with the solution, but the next step is correct, so the lack of a score of five is in accordance with the scoring guidelines.

During the interview, M9 stated that he did not fully understand how to solve the problem. Based on observations of M9's group, the understanding of mathematical concepts and terms indicator was in the good category, reaching 75%, while mastery of integral material with the substitution method was in the poor category, reaching 50%. During learning, M9 utilised Nearpod very well, reaching 95%.

$$\int \tan^3 y \, dy = \int (\sec^2 y - 1) \tan y \, dy$$

$$= \int \sec^2 y \tan y \, dy - \int \tan y \, dy$$

$$= \int \tan y \sec^2 y \, dy = \int \frac{\sin y}{\cos^2 y} \, dy$$

$$= \int \tan y \sec^2 y \, dy = \int \frac{1}{\cos y} d(\cos y)$$

$$= \frac{1}{2} \tan^2 y - \ln |\cos y| + C$$

Figure 12. Answer M9 Indicator Ability to Switch to a Known Method

Figure 12 shows M9's response to indicator 3 as a student in the moderate category, but he received the lowest score. This means that M9 did not fulfil the indicator of having the ability to change the known method: he did not write down what he knew, did not change the method of solving the problem at all and did not write the conclusion, so he received a score of zero. During the interview, M9 stated that he was unable to change methods. Based on observations of M9's group, the ability to change known methods fell into the 'good' category, reaching 75%, while mastery of several trigonometric functions fell into the 'less' category, reaching 50%. During the learning process, M9 utilised Nearpod very well, achieving a score of 95%.

Despite using Nearpod effectively, M9 falls into the category of struggling to answer questions from other groups and

having difficulty mastering the material. Therefore, it still uses the same method as the example given, in line with Inanta et al.'s (2022) opinion that Nearpod is one of the learning platforms that facilitates interaction between learners and educators through the use of images, text, videos and quizzes.

Persamaan = hasilnya sama
Perbedaan = bagian a menggunakan metode n ganjil
bagian b menggunakan metode n genap

Figure 13. Answer M9 Indicator Ability to Note Similarities, Differences and Analogies

Figure 13 shows M9's response to indicator four: a student in the moderate category scored three out of a maximum of ten. This means that M9 has not fulfilled the indicator of the ability to note similarities, differences and analogies because they did not write down what was known or asked. Planning the solution only involved identifying similarities and differences. Carrying out the plan by writing answers was incomplete, and no conclusions were drawn from the problem. Therefore, the lack of a score of seven is in accordance with the scoring guidelines. In the interview, M9 stated that the equation must produce the same result; that a different method is used for a difference; and that there is no conclusion. Based on the interview results, M9 mentioned that there was no conclusion, so he did not write one during the test. Based on observations of the group, members, M9 showed indicators of the ability to note similarities, differences and analogies, reaching a percentage of 75%, and mastery of integral material with the substitution method, reaching a percentage of 50%. During learning, M9

utilised Nearpod very well, reaching a percentage of 95. However, when it came to implementing the PBL model for students to answer questions from other groups during presentations, M9 fell into the 'less' category, reaching a percentage of 50. Therefore, M9 did not master the material, which caused him to be confused when answering and not stick to the presentation.

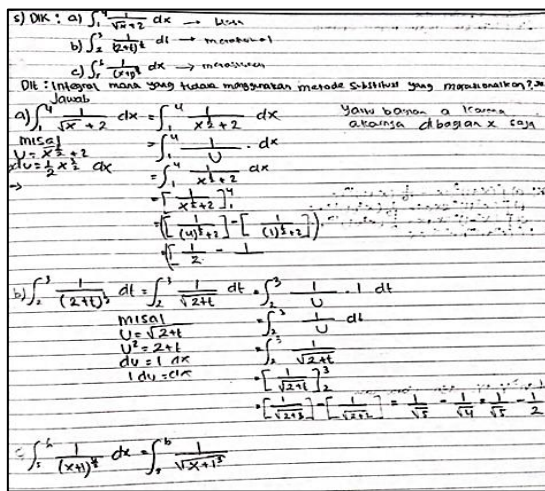


Figure 14. Answer M9 Indicator Ability to Know Irrelevant Things

Figure 14. shows M9's response to indicator five, scoring six out of a maximum of ten. Despite achieving the highest score, M9 has not fulfilled the indicator of the ability to recognise unrelated things, as evidenced by the following: Planning the solution by memorising, but not in a precise manner; Implementing the plan without writing down unrelated things; Interpreting the results by drawing conclusions, but not in a precise manner.

Consequently, the lack of a score of four is in accordance with the scoring guidelines. In the interview results,

M9 said that he had to calculate in advance which things were and were not related. Even though he calculated the answer first, it was still incorrect. Based on observations of the group to which M9

belonged, the ability to recognise unrelated items falls into the excellent category, reaching a percentage of 100, while mastery of integral material using the substitution method falls into the lower category, reaching a percentage of 50. During the learning process, M9 utilised Nearpod very well, achieving a score of 95%.

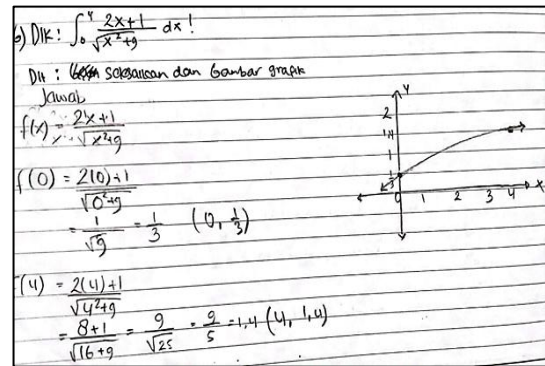


Figure 15. Answer M9 Indicator Ability to Visualize and Interpret Quantity or Space

Figure 15. shows M9's response to indicator six, achieving a score of eight out of a maximum of ten. Despite achieving the highest score, M9 has not fulfilled the indicator of the ability to visualise and interpret quantity or space because it substitutes the problem boundary value, miscalculates, and interprets the results obtained by creating a less precise graph, resulting in a deduction of two points according to the scoring guidelines. The interview results show that M9 can solve the problem by finding the values of x and y, and then making a graph. While the answer is correct, the calculation is imprecise: it should be $95 = 1.8$, but M9 wrote 1.4. Therefore, the graph is incorrect. Based on observations of M9's group, the ability to visualise and interpret quantity or space is in the 'good' category, reaching 75%, while mastery of integral material using the substitution method is in the 'poor'

completion even though it has used the correct procedure. M9 was able to utilize Nearpod well, mastery of rational function integration material was still lacking and the implementation of the PBL model for students was low in answering questions from other groups. While M6 is included in the high student category but not in the highest score and lowest score because M6 can answer with five steps of completion, but the steps are still not correct. Nevertheless, M6 obtained the results of the ability to identify the most important elements and choose the correct procedure very well, mastery of the material of integrating rational functions M6 is very good, utilizing Nearpod is very good.

M9 has not met any indicators of mathematical problem-solving ability because the indicator of the ability to generalize based on examples, make examples but not precise, and carry out the plan by writing down the answer but the solution step is not according to the plan. Indicators of the ability to understand mathematical concepts and terms, not writing down what is known and asked, planning solutions by making analogies based on problems but not precise and M9 writing down things that should not be written because they are not in accordance with the solution. An indicator of the ability to change the method that has been known, not writing down what is known and asked, not changing the method of solving problems at all, not writing conclusions. An indicator of the ability to note similarities, differences and analogies, not to write down what is known and asked and not to write down the conclusion of the problem.

Indicators of the ability to know things that are not related, not writing down what is known and asked, planning solutions only makes similarities and differences, implementing the plan by writing down answers but not complete and not drawing conclusions from problems. An indicator of the ability to visualize and interpret quantities or spaces, execute plans by substituting problem boundary values but miscalculating and interpreting results obtained by creating graphs but less precisely. Indicators of the ability to estimate and analyze, plan solutions by writing down reasoning answers but not precise, carry out plans by writing down answers but use the wrong formula, and interpret the results obtained by making conclusions but not precise. An indicator of the ability to identify the most important elements and choose the correct procedure, plan the completion by dividing the numerator by denominator but not exactly, execute the plan by writing down the correct but not precise procedure, and interpret the results obtained by making conclusions but not precise.

In addition, in Nearpod-assisted learning, M9 showed excellent results in accessing and interacting with learning features as well as good application of PBL models in group discussions. Therefore, the utilization of Nearpod is very good, the implementation of the PBL model for students is good, and the level of confidence is moderate despite the high mathematical problem-solving ability.

M9 subjects were found to have a level of student confidence that was not always directly proportional to their mathematical problem-solving skills. M9 shows better

achievement of advanced problem-solving skills than confidence level. M9 in the previous course or differential graduate course is in the medium category, but there is an improvement in ability in integral calculus courses with high problem-solving ability, although the confidence category is moderate. During the learning, M9 showed excellent results in the use of Nearpod and good in the implementation of the PBL model for students. This is not in line with the opinion Jastisunda (Putri & Juandi, 2022) which states that the factor that affects students' mathematical problem-solving ability is self-confidence. Because, there are other factors that support it, such as thoroughness, willingness to study material outside of lectures and so on.

By explicitly comparing the findings with previous research, it can be seen that, although the confidence level of M9 is moderate, they show a significant improvement in mathematical problem-solving skills, particularly in integral calculus. This is in line with previous research, which revealed that other factors such as accuracy and the desire to study material outside of lectures also play a role in improving problem-solving abilities, in addition to relying solely on confidence. In this context, further analysis of features that enhance self-confidence, such as the use of interactive learning platforms like Nearpod, could be key to understanding the factors influencing mathematical problem-solving skills more comprehensively. Additionally, it is important to address the issues of small sample size and friction between the variables analysed, which may affect the generalizability of these findings to a

broader population. M10 (low category) did not fully participate in the study and was therefore not analysed.

IV. CONCLUSION

The use of Nearpod with the Project-Based Learning (PBL) model in teaching integration techniques enhances students' confidence, leading to improved problem-solving abilities. From a theoretical perspective, this supports the idea that combining digital tools (Nearpod) with active learning strategies (PBL) can effectively foster both subject mastery and the confidence required to solve complex mathematical problems.

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