

The Effectiveness of the Probing-Prompting Learning Model on Students' Mathematics Learning Mastery in Three-Variable Linear Equation Systems

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Abstrak

Penelitian ini bertujuan untuk menentukan penguasaan hasil belajar matematika di kalangan siswa kelas X di SMAN 1 Peukan Bada melalui penerapan model pembelajaran Probing-Prompting. Populasi penelitian terdiri dari seluruh siswa kelas X di SMAN 1 Peukan Bada, dengan sampel dipilih menggunakan purposive sampling. Sampel terdiri dari 20 siswa dari kelas X-2. Data dikumpulkan melalui tes akhir yang terdiri dari tiga pertanyaan esai yang diberikan setelah perlakuan. Hasil menunjukkan rata-rata sampel sebesar 86,15, melebihi kriteria penguasaan minimum (KKM) sebesar 70. Pengujian hipotesis menggunakan uji-t dengan tingkat signifikansi $\alpha=0,05$ dan 19 derajat kebebasan (df) menghasilkan $t_{observed} > t_{table}$ ($7,78 > 1,729$). Akibatnya, H_0 ditolak dan H_a diterima. Dapat disimpulkan bahwa hasil belajar siswa menggunakan model Probing-Prompting berhasil mencapai penguasaan.

Kata kunci: Probing-Prompting; Hasil Belajar; Sistem Persamaan Linear Tiga Variabel.

Abstract

This study aims to determine the mastery of mathematics learning outcomes among Grade X students at SMAN 1 Peukan Bada through the implementation of the Probing-Prompting learning model. The research population consisted of all Grade X students at SMAN 1 Peukan Bada, with the sample selected using purposive sampling. The sample included 20 students from class X-2. Data were collected through a post-test consisting of three essay questions administered after the treatment. The results showed a sample mean of 86.15, exceeding the minimum mastery criterion (KKM) of 70. Hypothesis testing using a t-test with a significance level of $\alpha=0,05$ and 19 degrees of freedom (df) resulted in $t_{observed} > t_{table}$ ($7,78 > 1,729$). Consequently, H_0 was rejected and H_a was accepted. It can be concluded that student learning outcomes using the Probing-Prompting model successfully achieved mastery.

Keywords: Probing-Prompting; Learning Outcomes; Three-Variable Linear Equation Systems.

I. INTRODUCTION

Mathematics is essential for students as it is useful not only in academic settings but also within the community. Wherever we go, we are never far from mathematical applications, such as in purchasing food and other goods. However, many students still perceive mathematics as a very difficult subject, which adversely affects their thinking patterns and leads to suboptimal learning outcomes (Nurmajumitasari, 2023). According to Mulyasa (2006), students' understanding of mathematical concepts is influenced by several factors, one of which is the teacher. This is consistent with Sullivan's view (Upu, 2003), stating that mathematics learning in the classroom is generally teacher-centered, which causes students to become passive and unenthusiastic in receiving lessons. This indicates that a primary cause for the lack of student participation in instruction is the application of inappropriate teaching methods and approaches. Students generally tend to be passive recipients of knowledge transfer, while teachers often merely deliver information without involving students in active and generative processes (Luritawaty, Herman, & Prabawanto, 2022). Consequently, students only memorize formulas and accept existing concepts without direct engagement, making the learning process less meaningful and poorly retained in their minds (Latifah et al., 2022).

A similar point is made by Abbas (2004) and Ansari et al. (2021), who state that many factors contribute to low mathematics learning outcomes, including the inappropriate use of models, methods, strategies, and learning approaches by

teachers in the classroom. Given the importance of using learning models to determine the effectiveness and efficiency of instruction, it is necessary to improve and emphasize the concept-building process while providing students with broad opportunities to play an active role in learning activities. Thus, the low level of student understanding is influenced by several factors, including the students themselves and the teachers' instructional methods that fail to involve students actively, resulting in a lack of comprehension of the material explained. Teaching requires precision or learning models that can encourage active student participation in the teaching and learning process. Sulistyanto (2009) states that instructional precision can be determined by the approach or model used by the teacher to achieve maximum learning objectives. An inappropriate choice of learning model fails to arouse student motivation and interest, particularly in challenging topics such as the Three-Variable Linear Equation System (SPLTV).

In the SPLTV material, students often answer questions incorrectly because they do not fully understand the problem's content; consequently, their solutions do not align with the requirements of the questions (Hapsoh & Sofyan, 2022). Furthermore, students complain about difficult-to-understand phrasing, which prevents them from proceeding with the problem-solving steps correctly. A similar situation occurs at SMAN 1 Peukan Bada, where students also face difficulties with SPLTV. This is evident from student learning outcomes that remain low or do not reach the Minimum Mastery Criterion

(KKM). Specifically, students find determining variables, terms, and the final solution difficult due to the many sequential steps involved.

One effort to overcome these difficulties is by designing an appropriate learning model so that students can understand the material more deeply. In this regard, the Probing-Prompting model is a learning model capable of addressing these challenges. The Probing-Prompting model is a presentation method that ensures concept understanding is well-directed (Silviana & Maryati, 2021). This model explores students' prior knowledge and سپس guides them to understand new material based on prerequisite topics they have mastered. This aligns with Widyastuti et al. (2014), who state that Probing-Prompting involves questions aimed at exploring and guiding students to link prior knowledge with new information. According to Siregar and Mulyana (2016), it is a model that probes previously acquired knowledge—in this case, prerequisites like relations and functions—and then leads students to understand the new material. Additionally, Lasmo et al. (2017) note that this model directs students toward independent learning while the teacher acts as a facilitator, achieving a student-centered process.

In the Probing-Prompting model, students are given probing questions to explore their prerequisite knowledge. This is followed by the prompting question stage, which aims to guide students in discovering new learning concepts. Implementing this model involves active student participation under teacher

guidance. The teacher acts as the designer of classroom strategies to ensure learning objectives are met. One such role is that of a demonstrator, where the teacher must show how each material can be better understood. Probing-Prompting is defined as an instructional method where the teacher presents a series of guiding and exploratory questions, triggering a thought process that links each student's knowledge and experience with the new information being studied.

The Probing-Prompting model is suspected to be suitable for the learning process as it can arouse student interest and motivation, particularly in SPLTV. During lessons, the teacher asks a student to answer a question, and once answered, the same question is redirected to another student to ensure active engagement. Students are required to be active in solving SPLTV problems through this model. Previous research, such as Swara (2010) on Limit Functions, showed that the application of Probing-Prompting was effective, as students were able to provide responses and answer the teacher's questions well. Julianti (2015) demonstrated that the model improved the learning abilities of vocational students and deepened their insights. Furthermore, research on word problems using this model showed significant benefits, making students more responsive.

Based on the description above, the researcher is interested in investigating the mathematics learning outcomes of Grade X students at SMAN 1 Peukan Bada through the implementation of the Probing-

Prompting learning model on the topic of Three-Variable Linear Equation Systems.

II. METHOD

This study employed a quantitative approach. The research design is categorized as a one-shot case study, involving a single class and a post-test administered after the learning process. This design was selected due to certain practical constraints; however, the results are expected to provide an accurate representation of the students' actual academic achievement. The population of this study consisted of all Grade X students, totaling 90 students across four classes. The sample comprised 20 students from class X-2, selected using a purposive sampling technique (referred to in the text as random-based but aligned with specific research objectives) to ensure the sample met the criteria necessary for the study's goals.

Data were collected through a test instrument consisting of subjective or essay-type questions. The use of essay questions aimed to evaluate student learning outcomes following the implementation of the Probing-Prompting model on the topic of Three-Variable Linear Equation Systems (SPLTV). The test included three items to be completed within a duration of 2x45 minutes.

The collected data were subsequently processed using several statistical analyses, as follows:

1. Normality Test of Data Distribution

To determine whether the data were normally distributed, a Chi-Square test (χ^2) was conducted at a significance level of $\alpha=0,05$ with degrees of freedom (df) = k - 3,

as proposed by Sugiyono (2013). The formula used is:

$$\chi^2 = \sum_{i=1}^k \frac{oi - Ei}{Ei}$$

Where:

- O_i = Observed frequency
- E_i = Expected frequency
- k = Number of interval classes

A normality test is essential to verify if the population follows a normal distribution. The distribution is considered normal if $\chi^2_{\text{observed}} < \chi^2_{\text{table}}$.

2. Hypothesis Testing

If the data distribution is normal, the hypothesis is tested using a one-sample t-test:

$$t = \frac{\bar{x} - \mu_0}{s/\sqrt{n}}$$

Where:

- t = Student's t-distribution for a one-tailed test
- \bar{x} = Sample mean
- μ_0 = Minimum Mastery Criterion (KKM = 70)
- s = Standard deviation
- n = Number of observations (sample size)

Since this study utilized a right-tailed test, the testing criteria, according to Sudjana (2002), specify that H_0 is rejected if $t_{\text{observed}} \geq t_{\text{table}(1-\alpha)}$; otherwise, H_0 is accepted. The degrees of freedom for the t-distribution are $df = n - 1$.

III. RESULT AND DISCUSSION

This study aims to determine student mathematics learning outcomes using the Probing-Prompting learning model on the topic of Three-Variable Linear Equation Systems (SPLTV). Based on the research

findings, the implementation of the Probing-Prompting model showed an improvement in student learning outcomes compared to conventional learning. This is evident from the development of students' abilities to understand concepts, answer questions, and solve problems provided during the learning process.

The success of the Probing-Prompting model is attributed to its characteristics, which necessitate active student engagement in the teaching and learning process. In this model, the teacher serves as a facilitator who guides students through probing (exploratory) and prompting (guiding) questions. This approach encourages students to think critically, express their opinions, and independently discover the concepts being studied. Such active involvement ensures that students do not merely receive information passively but strive to understand the material more deeply.

During the first meeting, students encountered difficulties in completing the provided Student Worksheets (LKS). This was due to their lack of familiarity with a learning pattern that required them to independently search for and process information within the problems. Most students still relied on direct explanations from the teacher and felt confused when required to determine solution steps autonomously through the posed questions. Furthermore, high-achieving students tended to work individually rather than collaborating with their peers. During group presentations, students appeared hesitant and struggled to communicate their discussion results to the class. This

behavior stemmed from a habit of teacher-centered learning, where students were not accustomed to expressing opinions or asking questions when they encountered unclear explanations.

However, positive changes in the learning process emerged in subsequent meetings. Students who were initially hesitant and passive gradually demonstrated the courage to attempt problems and answer the teacher's questions. Although some answers were not entirely correct, students were able to follow the logical framework required to solve SPLTV problems. This indicates that the Probing-Prompting model effectively trains students to think systematically and enhances their self-confidence in learning mathematics.

Additionally, the strategy of randomly and abruptly calling on students to answer questions ensures that the entire class remains focused and prepared. Since every student has an equal probability of being questioned, they are compelled to concentrate and pay closer attention to explanations and discussions. While this may initially create a tense atmosphere, it can be mitigated if the teacher maintains a friendly demeanor and respects every student's response. If a student provides an incorrect answer, the teacher should guide them toward the correct solution rather than marginalizing them.

These findings align with previous research by Millatush (2019), Swara (2010), and Julianti (2015), all of whom reported that the Probing-Prompting model significantly improves learning outcomes and broadens students' insights. According

to Suherman (2008) and Hamdani (2011), this model triggers a thought process that links students' prior knowledge and experiences with new concepts, allowing them to construct knowledge rather than simply being told the information.

The success of the Probing-Prompting model is due to its requirement for students to play an active role under the teacher's guidance. According to Suherman (2008), this model presents a series of guiding and exploratory questions that trigger a thought process linking new knowledge to what is being studied. Subsequently, students construct concepts, principles, and rules into new knowledge; thus, the information is not merely told to them. Probing-Prompting presents questions that guide and explore student ideas to accelerate the thought process, connecting student knowledge and experience with new material (Hamdani, 2011).

This research consisted of two meetings. In the first meeting, students were still confused by the LKS because they were unaccustomed to searching for information independently. Even high-achieving students preferred working individually and were reluctant to collaborate with others. This was also observed when group representatives were asked to present their discussions; students appeared shy and struggled to convey their results to their peers. Consequently, other students talked amongst themselves and did not respond to the presentation. This was caused by the previous habit of teacher-centered learning, where students were not used to expressing opinions or asking questions.

By the next meeting, changes were observed; students who were initially hesitant could now complete problems, even if not perfectly. This was evident from group presentations where students became active in providing information and explaining the material. Students who were previously shy became brave enough to express their opinions without fear. Probing-Prompting practice is presented through questions that probe knowledge and guide students toward expected developments. Because the Q&A process occurs suddenly with random selection, every student must maintain concentration as they cannot avoid being involved. This ensures students remain focused on learning activities.

While a tense atmosphere may occur, it can be overcome through habituation. To reduce tension, teachers should remain friendly and appreciate every student response. If a student's answer is incorrect, the teacher should guide them toward the correct answer rather than belittling them. This encourages students not to fear answering subsequent questions and to remain active in the process.

However, in this study, two students (KH and MA) did not achieve mastery. The cause was a lack of focus during the teacher's explanation, leading to a poor understanding of the material. One example of a student's error in solving an SPLTV problem (by student KH) is detailed in the following table.

Table 1.
Correct Answers and Student Errors in the Three-Variable Linear Equation System Material

PROBLEM NO. 2

Using the substitution method, determine the solution set for the following three-variable linear

equation system (SPLTV)

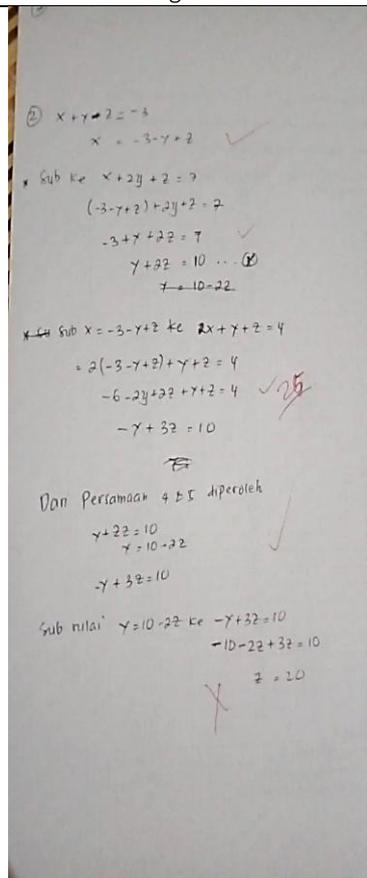
$$\begin{aligned} x + y - z &= -3 \\ x + 2y + z &= 7 \\ 2x + y + z &= 4 \end{aligned}$$

Right Answer

Wrong Answer

$\Rightarrow x + y - z = -3$
 $\Rightarrow x = -3 - y + z$
 ■ Substitute the variable x into the second equation.
 $\Rightarrow x + 2y + z = 7$
 $\Rightarrow (-3 - y + z) + 2y + z = 7$
 $\Rightarrow -3 + y + 2z = 7$
 $\Rightarrow y + 2z = 7 + 3$
 $\Rightarrow y + 2z = 10$

 Equation (3)
 ■ Substitute the variable x into the third equation
 $\Rightarrow 2x + y + z = 4$
 $\Rightarrow 2(-3 - y + z) + y + z = 4$
 $\Rightarrow -6 - 2y + 2z + y + z = 4$
 $\Rightarrow -y + 3z = 4 + 6$
 $\Rightarrow -y + 3z = 10$
 Equation (4)
 ■ Equations (3) and (4) form the SPLDV y and z:
 $y + 2z = 10$
 $-y + 3z = 10$
 ■ Next, solve the SPLDV using the substitution method.
 From the first equation, we obtain



$\Rightarrow y + 2z = 10$
 $\Rightarrow y = 10 - 2z$
 ■ Substitute the variable y into the second equation.
 $\Rightarrow -y + 3z = 10$
 $\Rightarrow -(10 - 2z) + 3z = 10$
 $\Rightarrow -10 + 2z + 3z = 10$
 $\Rightarrow -10 + 5z = 10$
 $\Rightarrow 5z = 10 + 10$
 $\Rightarrow 5z = 20$
 $\Rightarrow z = 4$
 ■ Substitute the value z = 4 into one of the SPLDV, for example $y + 2z = 10$ to obtain
 $\Rightarrow y + 2z = 10$
 $\Rightarrow y + 2(4) = 10$
 $\Rightarrow y + 8 = 10$
 $\Rightarrow y = 10 - 8$
 $\Rightarrow y = 2$
 ■ Next, substitute the values $y = 2$ and $z = 4$ into one of the SPLTVs, for example $x + 2y + z = 7$ to obtain
 $\Rightarrow x + 2y + z = 7$
 $\Rightarrow x + 2(2) + 4 = 7$
 $\Rightarrow x + 4 + 4 = 7$
 $\Rightarrow x + 8 = 7$
 $\Rightarrow x = 7 - 8$
 $\Rightarrow x = -1$
 Thus, we get the value $x = -1$, $y = 2$ and $z = 4$. So, the

solution set for SPLTV above is $\{(-1, 2, 4)\}$.	
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Based on the table, it can be concluded that student KH still encounters difficulties in understanding the material on Three-Variable Linear Equation Systems (SPLTV). This is evident from the response to test item number 2; despite being categorized as a basic problem, KH struggled to comprehend it. From the aforementioned explanation, the author concludes that the difficulties students face in solving SPLTV problems stem from a lack of conceptual understanding and insufficient practice in working through such equations.

The presence of several students who did not achieve mastery due to their inability to solve the problems, as shown above, is attributed to several factors. These include constraints in research time, an inadequate number of meetings, and the fact that Probing-Prompting is a novel learning model for the students. This model differs slightly from the conventional instruction they usually receive, where students typically focus only on completing the exercises provided by the teacher.

Based on the results of the discussion above, it can be concluded that mathematics instruction for Three-Variable Linear Equation Systems using the Probing-Prompting model yielded good learning outcomes for the Grade X-2 students at SMAN 1 Peukan Bada.

IV. CONCLUSION

Based on the research results and the discussion regarding the Probing-Prompting learning model on the topic of Three-Variable Linear Equation Systems (SPLTV) for Grade X-2 students, the calculated mean score was 86,15, which exceeds the Minimum Mastery Criterion (KKM). Furthermore, hypothesis testing indicated that the $t_{observed}$ value is greater than the t_{table} value. Consequently, it can be concluded that the implementation of the Probing-Prompting model in the study of Three-Variable Linear Equation Systems at SMAN 1 Peukan Bada has successfully achieved the learning mastery criteria.

The achievement of learning mastery and student engagement is attributed to the effective and efficient application of this learning model. Moreover, students demonstrated collaborative skills in group assignments, engaging in the exchange of ideas and showing mutual respect for the opinions of their group members.

Mathematics teachers are encouraged to adopt the Probing-Prompting model as an alternative instructional strategy, particularly for topics that require conceptual understanding and systematic reasoning skills, such as Three-Variable Linear Equation Systems. In its implementation, teachers should design structured questions, ranging from simple to complex, to facilitate students in building their understanding progressively. Additionally, teachers are expected to provide guidance and motivation, especially during the initial stages of implementation, as students require time to adapt to a learning environment that demands activity and independence. It is

also essential for teachers to foster a conducive classroom atmosphere to ensure that students do not feel anxious or pressured when randomly selected to answer questions.

Students are expected to play an active role in the Probing-Prompting learning process by confidently expressing opinions, answering questions, and attempting to solve problems independently. Furthermore, students are advised to maintain focus and seriousness throughout the lesson, as every student has an equal opportunity to be called upon. Finally, students should accustom themselves to thinking critically and meticulously, and not fear making mistakes, as the process of questioning and trial is fundamental to enhancing mathematical understanding.

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