JARME Journal of Authentic Research on Mathematics Education
Volume 8, No. 1, January 2026
https://doi.org/ 10.37058/jarme.v3i1.16041 e-ISSN 2655-7762

EFFECTIVENESS OF THE PROBING PROMPTING MODEL ASSISTED BY KAHOOT GAMIFICATION ON STUDENTS' MATHEMATICAL CONCEPTUAL UNDERSTANDING

Widya Dwiyanti[1]*, Ucu Koswara[2], Annisa Suci Nuraeni[3], Darto[4]
[1, 2, 3]Universitas Sebelas April, Jl. Angkrek Situ No.19 Sumedang, Jawa Barat, 45323, Indonesia.
[4] Universitas Islam Negeri Sultan Syarif Kasim Riau, indonesia
* Corresponding Author: widdwiyanti@unsap.ac.id

ARTICLE INFO

Article history
Received: 2025-06-23
Revised: 2026-01-12
Accepted: 2026-01-17

Keywords
Gamifikasi Kahoot, Kemampuan pemahaman konsep matematis, Probing Prompting, Sikap siswa

Kahoot Gamification, Mathematical conceptual understanding, Probing Prompting, Student attitude

ABSTRACT

Kemampuan pemahaman konsep matematis yang terbatas dan rendahnya keterlibatan siswa di kelas sering menghambat siswa SMP dalam mentransformasikan masalah kontekstual ke dalam representasi matematika formal. Penelitian ini bertujuan untuk mengkaji efektivitas model pembelajaran Probing Prompting berbantuan gamifikasi Kahoot dalam meningkatkan kemampuan pemahaman konsep matematis siswa serta menelaah sikap siswa terhadap penerapannya. Penelitian ini menggunakan pendekatan kuantitatif dengan metode eksperimen semu melalui desain nonequivalent control group. Subjek penelitian melibatkan dua kelas VII, yaitu 23 siswa pada kelas eksperimen dan 27 siswa pada kelas kontrol. Pengumpulan data dilakukan menggunakan tes uraian kemampuan pemahaman konsep matematis dan angket sikap siswa. Hasil uji independent samples t-test menunjukkan adanya perbedaan peningkatan yang signifikan antara kedua kelompok. Kelas eksperimen memperoleh nilai N-Gain sebesar 0,66 (kategori sedang), lebih tinggi dibandingkan kelas kontrol yang memperoleh nilai 0,28 (kategori rendah). Selain itu, siswa menunjukkan sikap positif terhadap integrasi Kahoot dengan skor rata-rata 3,16. Temuan ini menegaskan pentingnya integrasi strategi bertanya terstruktur dengan dukungan afektif dalam memperkuat pemahaman konsep matematis siswa. Secara pedagogis, penelitian ini menunjukkan bahwa penggabungan model Probing Prompting dengan gamifikasi Kahoot berpotensi mendorong partisipasi aktif dan pembelajaran matematika yang lebih bermakna.

Limited mathematical conceptual understanding and low classroom engagement often hinder junior secondary students from translating contextual problems into formal mathematical representations. This study aimed to examine the effectiveness of the Probing Prompting learning model assisted by Kahoot gamification in enhancing students' mathematical conceptual understanding and to explore students' attitudes toward its implementation. A quasi-experimental design with a nonequivalent control group was employed, involving two seventh-grade classes consisting of 23 students in the experimental group and 27 students in the control group. Data were collected using an essay-type test of mathematical conceptual understanding and a student attitude questionnaire. The results of the independent samples t-test revealed a significant difference between the two groups. The experimental group achieved a normalized gain (N-Gain) score of 0.66 (moderate category), which was higher than that of the control group (0.28, low category). In addition, students *demonstrated positive attitudes toward the integration of Kahoot, with a mean score of 3.16. These findings highlight the theoretical importance of integrating structured questioning strategies with affective learning support. Pedagogically, the study suggests that combining Probing Prompting with gamification can foster active participation and meaningful learning in mathematics classrooms.*

How to Cite:

Dwiyanti, W., Koswara, U., & Nuraeni, A. S. (2026). Effectiveness of the Probing Prompting Model Assisted by Kahoot Gamification on Students' Mathematical Conceptual Understanding. ***Journal of Authentic Research on Mathematics Education, 8***(1), 52-61. https://doi.org/10.37058/jarme.v3i1.16041

1. INTRODUCTION

Mathematical conceptual understanding constitutes a fundamental foundation for students in solving complex problems, extending beyond the mere memorization of procedural steps. This competence requires students to reconstruct mathematical concepts across multiple representations and to apply them meaningfully in unfamiliar situations (Febriantika, 2019). A strong level of conceptual understanding enables learners to develop mathematical reasoning, engage meaningfully in problem solving, and establish coherent connections among symbolic, graphical, and contextual representation (Al-Mutawah et al., 2019; Lindsey et al., 2023; Taqwa & Rahim, 2022). Consequently, mathematical conceptual understanding occupies a central position in students' mathematical proficiency, as it serves as a foundation for the development of higher-order mathematical abilities.

Despite its central role in mathematical learning, numerous studies indicate that students' conceptual understanding remains insufficiently developed. Difficulties in translating mathematical symbols into meaningful conceptual structures are frequently reported. In many cases, students are able to follow procedures but struggle to explain the underlying relationships between symbols, operations, and conceptual meanings. As a result, mathematical symbols are often perceived merely as manipulative rules rather than as representations of interconnected concepts, leading to fragmented understanding and superficial learning outcomes (Anwar et al., 2024; Dila & Zanthy, 2020; Ismail & Hakim, 2023).

Evidence from preliminary observations conducted in a junior secondary school in Sumedang, Indonesia, further supports this concern. Students' limited conceptual development was closely associated with a rigid classroom climate that constrained active participation and discouraged exploratory thinking. Under such conditions, students tended to avoid engagement in mathematical discussions, thereby reducing opportunities for conceptual reconstruction (Ismail & Zulkarnaen, 2023). These findings suggest that improving conceptual understanding cannot rely solely on repetitive procedural practice but requires learning environments that support both cognitive engagement and students' affective readiness to participate.

In response to these challenges, the Probing Prompting learning model offers a pedagogical approach grounded in structured, sequential questioning designed to guide students' thinking processes. Through carefully formulated probing and prompting questions, students are encouraged to activate prior knowledge, clarify misconceptions, and progressively construct deeper conceptual understanding (Hanifa et al., 2023; Putri et al., 2019). Empirical studies further indicate that this model contributes positively to students' conceptual development by supporting systematic reasoning and reflective thinking during classroom interactions (Rohman et al., 2025).

Nevertheless, the effectiveness of Probing Prompting is highly dependent on students' willingness to participate actively in classroom dialogue. When students experience anxiety, fear of making mistakes, or discomfort in expressing ideas, the potential of questioning-based instruction may not be fully realized (Alyawati *et al*., 2020). Psychological pressure during discussion activities has been shown to inhibit students' engagement, thereby limiting the impact of probing questions on conceptual learning (Zai & Dwikristanto, 2023). These conditions highlight the importance of creating a supportive learning atmosphere that reduces affective barriers and encourages meaningful participation.

Gamification through digital platforms such as Kahoot presents a promising avenue to address affective challenges in Probing Prompting. By incorporating game-like elements, immediate feedback, and interactive competition, Kahoot has been reported to enhance classroom dynamics, increase student motivation, and foster positive learning attitudes (Licorish *et al*., 2018). Importantly, the pedagogical value of Kahoot lies not merely in its technological features but in its capacity to create a learning environment that supports active engagement and emotional comfort during instructional activities (Wang & Tahir, 2020).

Although Probing Prompting and Kahoot gamification have each been widely examined in educational research, they are predominantly studied as separate instructional approaches. Empirical investigations examining how structured questioning within Probing Prompting interacts with gamified learning environments to support conceptual understanding remain limited (DeJarnette et al., 2020; Rohman et al., 2025; Zhang & Yu, 2021). Moreover, studies that simultaneously address both cognitive outcomes and students' affective responses within such integrated designs are still scarce. Accordingly, this study addresses this research gap by examining the effectiveness of the Probing Prompting learning model assisted by Kahoot gamification in enhancing students' mathematical conceptual understanding. Specifically, the study aims to compare the improvement in conceptual understanding between students who receive Probing Prompting assisted by Kahoot and those who experience conventional instruction, as well as to explore students' attitudes toward the implementation of the integrated learning model.

2. METHOD

2.1. RESEARCH DESIGN

This study employed a quantitative approach using a quasi-experimental method with a nonequivalent control group design. The design was selected to examine the effectiveness of the Probing Prompting learning model assisted by Kahoot gamification in improving students' mathematical conceptual understanding. The use of a quasi-experimental design was necessitated by practical constraints that prevented random assignment of participants. Two intact classes were assigned as the experimental and control groups, both of which were administered a pretest and a posttest.

2.2. Participants

The study was conducted at SMP Negeri 2 Cimalaka during the second semester of the 2024/2025 academic year. The population comprised all seventh-grade students, totaling 177 students distributed across six classes. A purposive sampling technique was employed based on recommendations from the mathematics teacher and institutional considerations. Two intact classes, VII-E and VII-F, were selected on the basis of their relatively homogeneous levels of classroom participation, making them representative for comparing the effectiveness of the instructional model on students' conceptual understanding and attitudes. Class VII-E, consisting of 23 students, was assigned as the experimental group and received instruction using the Probing Prompting learning model assisted by Kahoot gamification, while class VII-F, consisting of 27 students, served as the control group and was taught using conventional instructional methods.

2.3. Instruments

Data were collected using test and non-test techniques. The primary instrument was a mathematical conceptual understanding test consisting of five open-ended items on the topic of one-variable linear inequalities. The test was designed to measure five indicators of conceptual understanding: (1) restating a concept; (2) classifying objects based on specific properties; (3) providing examples and non-examples; (4) representing concepts in multiple mathematical forms; and (5) applying concepts in problem-solving situations (Febriantika, 2019). The test was administered twice, as a pretest and a posttest.

In addition, a non-test instrument in the form of a Likert-scale questionnaire consisting of 20 statements was used to assess students' attitudes toward the learning process. The attitude questionnaire was developed based on six indicators adapted from Lestari and Yudhanegara (2017), including students' acceptance of learning stimuli, responsiveness during instruction, levels of comfort and enjoyment, seriousness in participation, appreciation of the learning process, and responsibility in completing learning tasks. Prior to implementation, all instruments were subjected to content validity evaluation through expert judgment.

2.4. Procedure

Prior to the implementation, both groups completed a pretest to assess their initial level of mathematical conceptual understanding. The experimental group participated in learning activities using the Probing Prompting model integrated with Kahoot gamification. Structured and sequential questions were employed to guide students' thinking and to encourage active participation through interactive digital quizzes. The control group received conventional instruction emphasizing teacher explanations and routine exercises. At the end of the instructional period, both groups completed a posttest, and the experimental group responded to the attitude questionnaire.

2.5. Data Analysis

Data analysis was conducted using descriptive and inferential statistical techniques with the assistance of SPSS version 25.0. Descriptive statistics were used to summarize students' pretest and posttest scores. The improvement in students' mathematical conceptual understanding was analyzed using the normalized gain (N-Gain) score. The use of N-Gain was considered appropriate given the quasi-experimental design of the study, which allowed for potential differences in students' initial abilities across groups. By normalizing individual gains relative to each student's maximum possible improvement, the N-Gain analysis enabled proportional comparison of learning improvement and reduced bias arising from pretest score differences.

Prior to hypothesis testing, the assumptions of normality and homogeneity were examined. Data normality was tested using the Shapiro–Wilk test due to the sample size being fewer than 50 students, while homogeneity of variance was assessed using Levene's test. After the assumptions were satisfied, an independent samples t-test was conducted at a significance level of 0.05 to compare the improvement in conceptual understanding between the experimental and control groups.

In addition to significance testing, effect size was calculated using Cohen's d to determine the magnitude of the treatment effect. Data obtained from the attitude questionnaire were analyzed descriptively by calculating the mean total score to categorize students' attitudes toward the learning model as positive or negative.

3. RESULTS AND DISCUSSION

3.1. RESULTS

The research data were obtained from the mathematical conceptual understanding test administered as a pretest and posttest in both the experimental and control groups. Descriptive statistics summarizing the mean scores and normalized gain (N-Gain) for both groups are presented in Table 1.

Table 1. Description of Students' Mathematical Conceptual Understanding

Group/Class	N	Mean			Standard Deviation (SD)		Improvement Category
		Pretest	Posttest	N-Gain	Pretest	Posttest	
Experiment	23	9.96	32.13	0.66	4.005	6.539	Moderate
Control	27	14.89	23.59	0.28	4.619	7.180	Low

Table 1 shows clear differences in the improvement of students' mathematical conceptual understanding between the two groups. Overall, the experimental group demonstrated a higher level of improvement compared to the control group, as indicated by a higher mean N-Gain score. Meanwhile, the standard deviations of the pretest and posttest scores suggest that the variability of students' conceptual understanding remained relatively stable across both groups.

To further illustrate the effectiveness of the treatment, the distribution of students across N-Gain categories is visualized in Figure 1.

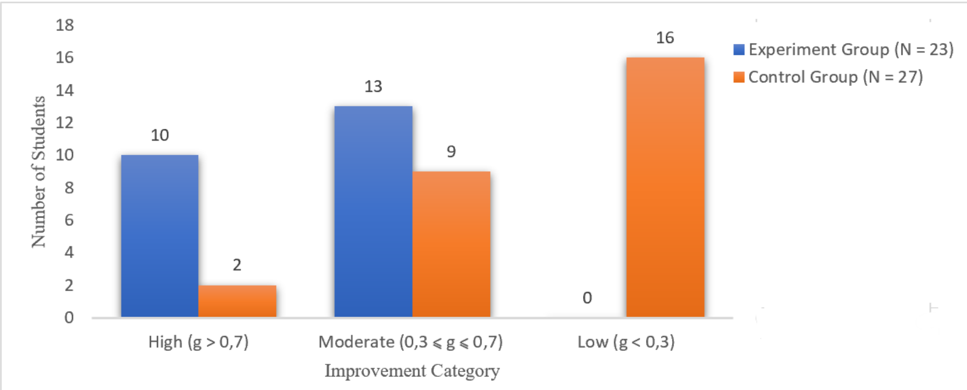

Figure 1. Distribution of Improvement Categories of Mathematical Conceptual Understanding

As shown in Figure 1, most students in the experimental group were distributed within the moderate and high improvement categories, with no students remaining in the low category. In contrast, the control group showed an opposite pattern, in which the majority of students (16 students) remained in the low improvement category, and only two students achieved the high improvement category. This pattern indicates that the improvement observed in the experimental group was not only higher but also more evenly distributed across students.

To examine whether the observed differences in improvement were statistically significant, a series of inferential statistical tests was conducted. The prerequisite tests indicated that the data from both groups were normally distributed (Shapiro–Wilk significance values > 0.05) and exhibited homogeneous variances (Levene's test significance value = 0.952 > 0.05). Accordingly, hypothesis testing was carried out using a parametric independent samples t-test at a significance level of 0.05. The summary of the t-test results is presented in Table 2.

Table 2. Results of the Independent Sample t-test

Variable	Mean Difference	df	Sig. (2-tailed)	Sig. level (α)	Conclusion
N-Gain	8.538	48	0.000	0.05	H_0 rejected (Significant)

As shown in Table 2, the significance value (Sig. 2-tailed) for the N-Gain comparison was 0.000, which is lower than the significance threshold of 0.05. This result indicates a statistically significant difference in the improvement of mathematical conceptual understanding between the experimental and control groups.

To complement the significance testing, effect size was calculated using Cohen's d. Based on the posttest scores, the effect size value was d = 1.24, which falls into the very large category, indicating a strong effect of the treatment on students' conceptual understanding. In addition, the effect size calculated from the pretest scores yielded a value of d = −1.14, reflecting differences in students' initial levels of mathematical conceptual understanding prior to the implementation of the instructional intervention.

Beyond cognitive outcomes, this study also examined students' affective responses toward the implementation of the Probing Prompting learning model assisted by Kahoot gamification. Students' attitudes were measured using a Likert-scale questionnaire comprising six main indicators. A summary of the questionnaire analysis is presented in Table 3.

Table 3. Summary of Students' Attitude Questionnaire Results by Indicator

No	Attitude Indicator	Mean Score	Category
1	Acceptance of Learning Stimuli	3.23	Positive
2	Enjoyment of Learning	3.17	Positive
3	Response to Learning Stimuli	3.04	Positive
4	Learning Engagement	3.19	Positive
5	Appreciation of Learning Stimuli	3.19	Positive
6	Responsibility for Learning Task	3.20	Positive
	Overall Mean	3.17	Positive

As shown in Table 3, students' overall attitudes toward the learning model were categorized as positive, with an average score of 3.16. The indicator acceptance of learning stimuli obtained the highest mean score (3.23), while response to learning stimuli recorded the lowest mean score (3.04). Nevertheless, all indicators remained within the positive category, indicating a consistent pattern of favorable student attitudes toward the implementation of the Probing Prompting model assisted by Kahoot gamification.

3.2. Discussion

The findings of this study indicate that the Probing Prompting learning model plays a significant role in strengthening students' processes of mathematical conceptual reconstruction. The use of structured, sequential questions encouraged students to activate prior knowledge, identify misconceptions, and re-examine the conceptual structures underlying the mathematical content being learned. This mechanism aligns with the view that reflective processes are central to the development of deeper conceptual understanding, as students are required to revisit, evaluate, and reorganize their initial ideas during problem solving (Dwiyanti & Sholihat, 2023).

The results are also consistent with the findings of Zhang and Yu (2021), who reported that systematically arranged questioning strategies can enhance the quality of students' reasoning by guiding them toward conceptual elaboration and verification of their initial understanding. In this sense, the improvement in conceptual understanding observed in the experimental group cannot be attributed merely to increased practice with problem-solving tasks, but rather to the presence of a structured reasoning process facilitated by probing and prompting questions that required students to analyze, reflect, and justify their thinking.

The integration of Kahoot gamification within the Probing Prompting model provided additional support by enhancing students' emotional engagement during the learning process. Gamification elements such as immediate feedback, attractive visual displays, and a light competitive atmosphere helped sustain students' attention and encouraged more active participation in responding to questions. This finding is in line with Licorish et al. (2018), who argued that gamified learning environments can increase student attention and participation through emotional engagement mechanisms. Moreover, the use of Kahoot contributed to creating a more enjoyable and less intimidating learning environment, which is particularly important when students are confronted with challenging, sequential questions. Wang and Tahir (2020) emphasized that positive and interactive learning environments can reduce cognitive anxiety, thereby increasing students' readiness to engage more deeply with conceptual reasoning. Within the context of mathematics learning, this affective support becomes especially relevant, as it helps students maintain focus and persistence when dealing with cognitively demanding tasks. Similar conclusions were drawn by Dewimarni (2022), who highlighted that interactive media and gamification elements can enhance students' motivation and comfort, leading to more stable and sustained participation in learning activities.

The synergy between the cognitive demands imposed by the Probing Prompting model and the affective support provided by Kahoot offers a more comprehensive explanation for the effectiveness of the instructional approach implemented in the experimental group. When students are emotionally engaged through gamified activities, they appear to be better prepared to respond to reflective questions that require conceptual elaboration. Conversely, successful conceptual understanding achieved through Probing Prompting reinforces students' confidence and positive attitudes toward the learning process. This bidirectional interaction between cognitive and affective dimensions creates mutually reinforcing learning conditions, resulting in higher and more evenly distributed gains in conceptual understanding.

From an affective perspective, the questionnaire results indicate that students demonstrated positive attitudes toward the implementation of the Probing Prompting model assisted by Kahoot. Positive attitudes are an important factor, as they reflect students' emotional readiness to engage in learning activities that require sustained attention and cognitive effort. Previous studies have shown that emotional engagement plays a critical role in enhancing attention quality and participation in question-based learning environments (Alpaslan & Ulubey, 2021). Positive emotions such as enjoyment and interest can facilitate cognitive, affective, and behavioral engagement during the learning process. Therefore, the favorable attitudes identified in this study can be understood as an affective foundation that supports the successful implementation of Probing Prompting and gamification in strengthening students' mathematical conceptual understanding.

From a theoretical standpoint, this study contributes to the literature on question-based learning by demonstrating that the effectiveness of the Probing Prompting model is not determined solely by the cognitive structure and quality of the questions posed, but also by the affective context in which the questioning process takes place. Gamification functions as an affective support that stabilizes students' reflective thinking during classroom dialogue. These findings extend existing research by emphasizing that deeper conceptual reconstruction can be achieved when instructional design simultaneously considers both cognitive and affective dimensions of learning. Accordingly, the integration of Probing Prompting and Kahoot can be understood as a learning configuration that activates these two dimensions in parallel to support students' mathematical conceptual understanding.

4. CONCLUSION

Based on the results of the data analysis, it can be concluded that the implementation of the Probing Prompting learning model assisted by Kahoot gamification led to a greater improvement in students' mathematical conceptual understanding compared to conventional instruction. These findings suggest that the use of structured, sequential questioning, when supported by a more positive and participatory learning environment, can facilitate students' cognitive engagement more effectively.

From a theoretical perspective, the findings reinforce the view that the effectiveness of question-based instruction does not depend solely on the cognitive structure of the questions, but is also influenced by the accompanying affective context. Kahoot gamification serves as affective support that helps stabilize students' reflective thinking processes during questioning activities. In this regard, the integration of Probing Prompting and Kahoot may be conceptualized as an instructional configuration that simultaneously activates cognitive and affective dimensions in supporting students' mathematical conceptual understanding.

In addition, the results of the attitude questionnaire indicate that students responded positively to the implementation of the Probing Prompting model assisted by Kahoot gamification. This positive response suggests that the approach is not only effective in enhancing conceptual understanding, but also well received from an affective standpoint. These findings imply that mathematics instructional designs that integrate structured questioning strategies with affective support mechanisms have the potential to create more meaningful and sustainable learning experiences.

Several limitations of the study should be considered when interpreting the findings. First, the study employed a quasi-experimental design without random assignment of participants. As a result, differences in students' initial characteristics may have influenced the learning outcomes, despite the application of statistical controls. Second, the study was conducted within a single school context and at one educational level, which limits the generalizability of the findings to broader populations.

Furthermore, the study focused primarily on measuring improvements in mathematical conceptual understanding and students' attitudinal responses. Therefore, it did not explore in depth the cognitive and affective mechanisms occurring during the learning process. The interactions among the quality of Probing Prompting questions, students' emotional dynamics, and the specific features of Kahoot gamification were not examined at the process level. Based on these limitations, future research is recommended to further investigate the integration of Probing Prompting and gamification. Such studies may employ approaches that allow for deeper exploration of learning mechanisms, including mixed-methods designs or experimental studies with tighter controls. Future studies may also examine variations in question design, levels of gamification complexity, and students' affective characteristics. This line of inquiry may help clarify the conditions under which technology-assisted questioning strategies most effectively support students' mathematical conceptual understanding.

REFERENSI

Al-Mutawah, M. A., Thomas, R., Eid, A., Mahmoud, E. Y., & Fateel, M. J. (2019). Conceptual understanding, procedural knowledge and problem-solving skills in mathematics: High school graduates work analysis and standpoints. *International journal of education and practice*, *7*(3), 258-273. https://doi.org/10.18488/journal.61.2019.73.258.273.

Alpaslan, M. M., & Ulubey, Ö. (2021). Examining the relations between emotions, motivation, classroom engagement and achievement in mathematics. *International Journal of Research in Education and Science*, *7*(4), 1042-4057. https://doi.org/10.46328/ijres.1953.

Alyawati, D., Susanti, E., Sari, N., & Sukmaningthias, N. (2020). Probing prompting in symbolization. *Journal of Physics: Conference Series*, 1480(1), 012048. https://doi.org/10.1088/1742-6596/1480/1/012048.

Anwar, I. N., Muhtadi, D., & Sukirwan, S. Kesulitan siswa pada asesmen kompetensi minimum materi segiempat dan segitiga. *Journal on Mathematics Education Research (J-MER)*, *5*(1), 18-32. https://doi.org/10.17509/j-mer.v5i1.75586.

DeJarnette, A. F., Wilke, E., & Hord, C. (2020). Categorizing mathematics teachers' questioning: The demands and contributions of teachers' questions. *International Journal of Educational Research*, 104, 101690. https://doi.org/10.1016/j.ijer.2020.101690.

Dewimarni, S., Ulhusna, M., & Marhayati, L. (2022). Penerapan aplikasi Kahoot pada mata pelajaran Matematika untuk meningkatkan motivasi dan minat belajar siswa dikelas VII SMP Negeri 38 Padang. *J-ABDI: Jurnal Pengabdian kepada Masyarakat*, *1*(8), 1935-1940. https://doi.org/10.53625/jabdi.v1i8.1024.

Dila, O. R., & Zanthy, L. S. (2020). Identifikasi kesulitan siswa dalam menyelesaikan soal aritmatika sosial. *Teorema: Teori dan Riset Matematika*, *5*(1), 17-26. https://doi.org/10.25157/teorema.v5i1.3036.

Dwiyanti, W., & Sholihat, M. N. A. (2023). Kebutuhan akan kognisi dan efikasi diri matematis terhadap kecenderungan berpikir reflektif. *Plusminus: Jurnal Pendidikan Matematika*, *3*(3), 359-370. https://doi.org/10.31980/plusminus.v3i3.1501.

Febriantika, A. A. (2019). Kemampuan pemahaman konsep matematis ditinjau dari kompetensi keahlian. *AlphaMath: Journal of Mathematics Education*, *5*(2), 1-8. https://doi.org/10.30595/alphamath.v5i2.7329.

Hanifa, U., Suhendra, S., & Jauhari, M. F. (2023). Probing-prompting learning: Its effect on improving conceptual understanding in mathematics. *Kalamatika: Jurnal Pendidikan Matematika*, *8*(2), 205-218. https://doi.org/10.22236/KALAMATIKA.vol8no2.2023pp207-220.

Ismail, H. S., & Zulkarnaen, R. (2023). Korelasi antara kemampuan pemahaman konsep matematis dengan kecemasan matematis. *Jurnal Educatio FKIP UNMA*, *9*(4), 1857-1862. https://doi.org/10.31949/educatio.v9i4.6122.

Ismail, N. M. D., & Hakim, D. L. (2023). Kemampuan pemecahan masalah matematis siswa SMK dalam menyelesaikan permasalahan materi sistem persamaan linier tiga variabeL (SPLTV). *JP3M (Jurnal Penelitian Pendidikan dan Pengajaran Matematika)*, *9*(1), 40-49. https://doi.org/10.37058/jp3m.v7i1.4674.

Lestari, K. E., dan Yudhanegara, M. R. (2017). *Penelitian pendidikan matematika* (ed. 2). Bandung: PT. Refika Aditama.

Licorish, S. A., Owen, H. E., Daniel, B., & George, J. L. (2018). Students' perception of Kahoot!'s influence on teaching and learning. *Research and Practice in Technology Enhanced Learning*, *13*(1), 1-23. https://doi.org/10.1186/s41039-018-0078-8.

Lindsey, B. A., Stetzer, M. R., Speirs, J. C., Ferm Jr, W. N., & Van Hulten, A. (2023). Investigating student ability to follow reasoning chains: The role of conceptual understanding. *Physical Review Physics Education Research*, *19*(1), 010128. https://doi.org/10.1103/PhysRevPhysEducRes.19.010128

Putri, W. E., Darto, D., & Rahmi, D. (2019). Pengaruh penerapan model pembelajaran probing prompting terhadap kemampuan pemahaman konsep matematis berdasarkan keaktifan belajar siswa SMP. *Juring (Journal for Research in Mathematics Learning)*, *2*(4), 357-362.

Rohman, R. L., Susantini, E., Raharjo, R., Makhtar, M. M. Z., & Satriawan, M. (2025). The effectiveness of probing prompting models for critical thinking development in indonesian science education: A systematic literature review. *Jurnal Pendidikan MIPA*, *26*(3), 1428-1444. https://doi.org/10.23960/jpmipa.v26i3.pp1428-1444.

Taqwa, M. R. A., & Rahim, H. F. (2022). Students' conceptual understanding on vector topic in visual and mathematical representation: a comparative study. *Journal of Physics: Conference Series*, 2309(1), 012060. https://doi.org/10.1088/1742-6596/2309/1/012060.

Wang, A. I., & Tahir, R. (2020). The effect of using Kahoot! for learning–A literature review. *Computers & Education*, *149*, 103818. https://doi.org/10.1016/j.compedu.2020.103818.

Zai, G. P. S., & Dwikristanto, Y. P. (2023). Mengembangkan kemampuan berpikir kritis siswa dengan metode pembelajaran probing prompting. *KAIROS: Jurnal Ilmiah*, *3*(2), 1-17.

Zhang, Q., & Yu, Z. (2021). A literature review on the influence of Kahoot! On learning outcomes, interaction, and collaboration. *Education and Information Technologies*, *26*(4), 4507-4535. https://doi.org/10.1007/s10639-021-10459-6.

Zhang, Q., & Yu, Z. (2021). A literature review on the influence of Kahoot! On learning outcomes, interaction, and collaboration. *Education and Information Technologies*, *26*(4), 4507-4535. https://doi.org/10.1007/s10639-021-10459-6.