Jurnal Inovasi Pendidikan Matematika

Volume 7, Nomor 1, Juli 2026

The Effect of the Gamification Integration Problem Based Learning (PBL) Model on Mathematical Reasoning Ability and Learning Motivation Students of SMP Negeri 9 Gresik

Putri Mustika Puspa Sari[1] , Nur Fauziyah[2] , Syaiful Huda[3]

Pendidikan Matematika, FKIP, Universitas Muhammadiyah Gresik, Jl. Sumatera No. 101 GKB Gresik, Jawa Timur Indonesia 61121; putrimustikapuspasari6@gmail.com[1]
Pendidikan Matematika, FKIP, Universitas Muhammadiyah Gresik, Jl. Sumatera No. 101 GKB Gresik, Jawa Timur Indonesia 61121; nurfauziyah@umg.ac.id[2]
Pendidikan Matematika, FKIP, Universitas Muhammadiyah Gresik, JL. Sumatera NO. 101 GKB Gresik, Jawa Timur Indonesia 61121; syaifulhuda@umg.ac.id[3]

Abstrak

Pembelajaran matematika di SMP masih menghadapi permasalahan berupa rendahnya kemampuan penalaran matematis dan motivasi belajar siswa. Kondisi tersebut menyebabkan siswa kurang aktif dalam memahami dan menyelesaikan permasalahan matematika. Oleh karena itu, diperlukan model pembelajaran yang mampu meningkatkan keterlibatan siswa sekaligus mengembangkan kemampuan berpikir matematis. Salah satu alternatif adalah model Problem Based Learning (PBL) terintegrasi gamifikasi Penelitian ini bertujuan mengetahui perbedaan kemampuan penalaran matematis dan motivasi belajar antara siswa yang mengikuti pembelajaran dengan model Problem Based Learning (PBL) terintegrasi gamifikasi dan siswa yang mengikuti pembelajaran konvensional di SMP Negeri 9 Gresik. Penelitian menggunakan pendekatan kuantitatif dengan metode kuasi eksperimen dan desain Nonequivalent Control Group Design. Sampel terdiri atas kelas eksperimen dan kelas kontrol. Data dikumpulkan melalui tes kemampuan penalaran matematis dan angket motivasi belajar, kemudian dianalisis menggunakan uji Independent Samples t-test dengan bantuan SPSS pada taraf signifikansi 0,05. Hasil penelitian menunjukkan terdapat perbedaan yang signifikan pada kemampuan penalaran matematis (sig. 0,000 < 0,05) dan motivasi belajar (sig. 0,037 < 0,05). Dengan demikian, penerapan model Problem Based Learning (PBL) terintegrasi gamifikasi memberikan pengaruh yang lebih baik terhadap kemampuan penalaran matematis dan motivasi belajar siswa dibandingkan pembelajaran konvensional.
***Kata Kumci**: Problem Based Learning (PBL), gamifikasi, kemampuan penalaran matematis, motivasi belajar.*

Abstract

Mathematics learning in junior high schools still faces problems related to students' low mathematical reasoning ability and learning motivation. These conditions cause students to be less active in understanding and solving mathematical problems. Therefore, a learning model that can increase students' engagement while developing their mathematical thinking skills is needed. One alternative is the integration of the Problem Based Learning (PBL) model with gamification.This study aimed to determine the differences in mathematical reasoning ability and learning motivation between students who were taught using the gamification-integrated Problem Based Learning (PBL) model and those who received conventional learning at SMP Negeri 9 Gresik. This study employed a quantitative approach with a quasi-experimental method using a Nonequivalent Control Group Design. The sample consisted of an experimental class and a control class. Data were collected through a mathematical reasoning test and a learning motivation questionnaire and were analyzed using the Independent Samples t-test with the assistance of SPSS at a significance level of 0.05. The results showed significant differences in mathematical reasoning ability (Sig. = 0.000 < 0.05) and learning motivation (Sig. = 0.037 < 0.05).

Therefore, the implementation of the gamification-integrated Problem Based Learning (PBL) model had a more positive effect on students' mathematical reasoning ability and learning motivation than conventional learning.
Keywords: Problem Based Learning (PBL), gamification, mathematical reasoning ability, learning motivation.

ARTICLE INFORMATION

ISSN : 2733-0597	***Article History***
e-ISSN : 2733-0600	Submitted:
Doi : 10.30587/postulat.v7i1.12102	June 9, 2026
	Revised:
	June 21, 2026
	Publish Online:
	July 22, 2026

INTRODUCTION

The development of education in the modern era demands learning innovations that have the ability to increase student engagement, their motivation, and their learning outcomes. One of the most relevant and rapidly growing innovations is the model *Problem Based Learning* (PBL) which is integrated with gamification elements. The model combines a contextual problem-solving-based approach with gamification elements such as points, challenges, and rewards to encourage students to be more engaged and motivated (Handikaningtyas et al., 2024). *Problem Based Learning* (PBL) is a student-centered learning approach through the presentation of authentic problems related to daily life. Using problem-based learning, students are encouraged to develop the ability to think critically, reason, and solve problems through investigation and collaboration activities, because *Problem Based Learning* (PBL) requires students to conduct inquiry and study independently in understanding and solving the problems given (Hmelo-silver & Barrows, 2006).

Problem Based Learning (PBL) also encourages students to play an active role in the learning process, think creatively, and develop the ability to solve problems given through student-centered learning activities (Rosyidah et al., 2022). Problem-based learning also utilizes contextual problems that are close to students' lives so that they can build an understanding of concepts through the process of investigation and problem-solving (Fauziyah & Husniati, 2023). Meanwhile, Werbach and Hunter define gamification as *"the use of game elements and game design techniques in non-game contexts"*, in other words, refers to the use of game elements and game design techniques in a non-game context (Kevin & Hunter, 2012). In this study, gamification is integrated in the final stage of learning through game-based digital quizzes as a form of learning reinforcement and evaluation.

In mathematics learning, a contextual and interactive approach is very necessary because the characteristics of the material require good reasoning skills and a deep

understanding of concepts. Mathematical reasoning skills are one of the process standards put forward by *National Council of Teachers of Mathematics* (NCTM, 2000), which emphasizes the importance of students' ability to analyze, give reasons, and draw logical conclusions in solving mathematical problems. However, math is often considered a difficult subject so it can lead to low student interest and motivation to learn. Application *Problem Based Learning* (PBL) gives students the opportunity to solve relevant problems in real life. On the other hand, gamification elements at the evaluation stage can help increase student engagement and motivation to learn (Ilmiah, 2022). Studies have also shown that the application of gamification elements in mathematics learning can significantly increase students' motivation to learn, which means that learning that is designed interactively and contextually can provide a more meaningful learning experience(Irnawati et al., 2024; Subagja, 2022).

Despite the various learning innovations that have been implemented, students are still considered to have low mathematical reasoning skills. Research results Khainingsih et al. (2020) shows that students' mathematical reasoning skills are still in the low category, especially in the indicators of making analogies, generalizations, and checking the validity of a statement. In addition, the motivation to learn mathematics is also an important factor that determines how students engage in the learning process. The Theory of Self-Determination put forward by Ryan & Deci (2000), states that the need is met *autonomy*, *competence*, and *relatedness*, affect students' learning motivation. As a result, students will be more motivated to actively participate in the learning process. Both intrinsic and extrinsic motivations play a role in encouraging students to be more active in learning mathematics (Permata Sari & Chadir Tarihoran, 2024). This condition suggests that this learning model can not only improve students' cognitive abilities but can also increase their desire to learn.

Previous research has shown that gamification and Problem Based Learning (PBL) improve math learning. Ambarwati et al. (2022), stating that the *Problem Based learning* (PBL) with the help of integrated gamification teaching materials improves students' ability to solve mathematical problems. Indah et al. (2025) also shows that *Problem Based Learning* (PBL) has a significant impact on improving students' mathematical reasoning skills. Meanwhile, Irnawati et al. (2024) found that the application of gamification elements significantly increased students' motivation to learn. However, most studies only looked at cognitive ability and motivation separately, and did not specifically look at the use of gamification at the evaluation stage in the model *Problem Based Learning* (PBL). The study did so to look at both students' mathematical reasoning abilities and their motivation to study simultaneously.

Based on these problems, this study aims to determine the influence of mathematical reasoning skills and learning motivation between students who participate in learning using the *gamified integrated Problem Based Learning* (PBL) model and students who participate in conventional learning at SMP Negeri 9 Gresik.

RESEARCH METHOD

This study uses a quantitative approach and uses pseudo-experiment methods. The research design used was *Nonequivalent Control Group Design* in the form of *Posttest-Only*. In this design there are two groups, namely the experimental group and the control group. All groups are randomly selected at the pre-created class level. The experimental group received treatment using a *Problem Based Learning* (PBL) model integrated with gamification, while the control group received conventional learning. For the final data of the study, both groups were given a post-test of mathematical reasoning ability and a learning motivation questionnaire. This research involves all grade IX students of SMP Negeri 9 Gresik, which consists of eight parallel classes in the 2025–2026 academic year. So that each class has an equal chance of being selected as a research sample, class drawing is used to select the sample. The results of the draw showed that class IX C was an experimental class that used a gamification-integrated *Problem Based Learning* (PBL) model, and class IX D was a control class that used conventional learning. This research was conducted at SMP Negeri 9 Gresik in the even semester of the 2025/2026 academic year.

In this study, there are test and non-test instruments. The test instrument consists of posttest questions that are used to measure students' mathematical reasoning skills. The tests are structured based on indicators adapted from Hariyanti & Khotimah (2022) which refers to the standard of mathematical reasoning *National Council of Teachers of Mathematics* (NCTM, 2000). The non-test instrument consisted of a learning motivation questionnaire created by the researcher based on the indicators *Self-Determination Theory* submitted by Ryan & Deci (2000), including *autonomy*, *competence*, and *relatedness*. Before being used in research, both instruments were validated by expert lecturers and teachers of mathematics subjects to ensure that they were feasible in terms of content, construction, and language. Specifically, the learning motivation questionnaire was tested first in class IX A outside the research sample to determine the validity and reliability of the instrument.

The research procedure consists of the preparation, implementation, and data analysis stages. In the preparation stage, proposals are drafted, permits are taken care of, instruments are created, and instruments are validated. In the implementation stage, the researcher used *the*

Problem Based Learning (PBL) model integrated with gamification through educaplay quizzes at the end of learning to teach in experimental classes. In the control class, the mathematics teacher uses conventional learning. Both classes were given a posttest of mathematical reasoning skills and a learning motivation questionnaire after all meetings were completed. Then, all the data collected is analyzed at the data analysis stage.

Data analysis was carried out quantitatively using the help of SPSS version 26 to determine the effect of the application of the *gamification integration Problem Based Learning* (PBL) model on students' mathematical reasoning skills and learning motivation. Before hypothesis testing is carried out, the data is tested for the analysis prerequisites using normality and homogeneity tests. Then, hypothesis testing was carried out using *the Independent Sample t-test* using the SPSS version 26 program to determine the difference between the experimental class and the control class in terms of mathematical reasoning ability and student learning motivation.

RESEARCH RESULTS

This research was conducted at SMP Negeri 9 Gresik. Class IX C as the experimental class and class IX D as the control class were selected using *simple random sampling* techniques. *Gamification-integrated Problem Based Learning* (PBL) models are used to teach experimental classes, while conventional learning is used for control classes. Before being used in research, research instruments, learning motivation questionnaires and mathematical reasoning ability tests, have gone through a validation process and reliability tests. Table 1 shows the results of the validation of the mathematical reasoning ability test instrument.

Table 1. Validation Results of Mathematical Reasoning Ability Test Instruments

Aspects Assessed	Average Score	Category
Contents	3,90	Very valid
Construction	4,00	Very valid
Language	3,83	Very valid
Total average	**3,91**	**Very valid**

Based on Table 1, the validation results show that the mathematical reasoning ability test instrument meets the valid criteria so that it is suitable for use in the research. Furthermore, Table 2 shows the results of the validation of the learning motivation questionnaire.

Table 2. Validation Results of Learning Motivation Questionnaire

Aspects Assessed	Average Score	Category
Contents	3,88	Very valid
Construction	4,00	Very valid
Language	4,00	Very valid
Total average	**3,96**	**Very valid**

Based on Table 2, the learning motivation questionnaire prepared based on the indicators of *autonomy*, *competence*, and *relatedness was* declared valid based on the validator's assessment and the results of the empirical validity test. After the instrument was declared valid, the researcher conducted an empirical validity test on the learning motivation questionnaire. Table 3 shows the results of the validity test.

Table 3. Results of the Validity Test of the Questionnaire Instrument

Remarks	Quantity
Number of grains before test	30
Valid Items	25
Invalid item	5
Invalid item number	9,20,26,27,28
Items used	**25**

Empirical validity tests were carried out on 30 learning motivation questionnaires using *the correlation of Product Moment* with SPSS version 26. The test results showed that 25 items were declared valid, while 5 items, namely numbers 9, 20, 26, 27, and 28, were declared invalid because the value of the correlation coefficient was smaller than *the value of the* r-table. Therefore, the five items were eliminated and the questionnaire used in the study consisted of 25 statement items. Furthermore, a reliability test was carried out to find out how consistent the learning motivation questionnaire was. The results are shown in Table 4.

Table 4. Results of Questionnaire Instrument Reliability Test

Reliability Statistics	
Cronbach's Alpha	N of Items
,899	25

The results of the reliability test showed that the learning motivation questionnaire had a Cronbach's Alpha value of 0.899, which suggests that it belongs to a very reliable category. Therefore, it was decided that the learning motivation questionnaire was feasible to be used in the research. After the instrument was declared valid and reliable, a descriptive statistical analysis was carried out to show the mathematical reasoning ability and learning motivation of students in the experimental and control classes. The results of the descriptive analysis are presented in Table 5.

Table 5. Descriptive Statistics of Mathematical Reasoning Ability and Learning Motivation

Variabel	Classes	N	Maximum	Minimum	Mean
Mathematical Reasoning Skills	Eksperimen	30	100	46,66	10,53
	Control	32	80	13,33	6,69
Learning Motivation	Eksperimen	29	88	69	78,83
	Control	29	85	68	76,13

Based on Table 5, the number of respondents on each variable is not the same because data collection is carried out at different times. Data on mathematical reasoning ability was

obtained through the implementation of *posttests*, while learning motivation data was obtained through the distribution of questionnaires after learning was completed. There were 30 students in the experimental class and 32 students in the control class who were present when the posttest was conducted. Meanwhile, at the time of filling out the learning motivation questionnaire, the number of respondents in each class was 29 students because some students were not present. Nevertheless, the data obtained still met the number of samples required for statistical analysis.

Descriptively, students in the experimental class had higher mathematical reasoning skills and learning motivation than the control class. The experimental class obtained an average score of 78.83, while the control class obtained an average score of 76.13. The results show that, descriptively, the application of the integrated gamification *Problem Based Learning* (PBL) model produces better results compared to conventional learning. The prerequisite test, which includes the normality test and the homogeneity test, is performed prior to hypothesis testing using *the Independent Samples t-test*. The purpose of the prerequisite test is to find out whether the research data meet the assumptions required for parametric statistical analysis. Table 6 shows the results of normality testing.

Table 6. Normality Test Results

Variabel	Classes	N	Statistics Shapiro-Wilk	Say.	Remarks
Mathematical Reasoning Skills	Eksperimen	30	0,935	0,065	Normal
	Control	32	0,937	0,063	Normal
Learning Motivation	Eksperimen	29	0,980	0,835	Normal
	Control	29	0,986	0,078	Normal

Based on Table 6, in both the experimental and control classes, the significance values of mathematical reasoning ability and learning motivation were greater than 0.05, according to the results of the normality test using the Shapiro-Wilk test. Therefore, all data have a normal distribution, so it meets one of the assumptions, so that hypothesis testing with independent sample t-test can be performed. Homogeneity tests are used to ensure that the data is distributed normally. This is done after knowing that the variance between the experimental class and the control class is the same. Table 7 shows the results of homogeneity testing.

Table 7. Homogeneity Test Results

Variabel	f	Say.	Remarks
Posttest of Mathematical Reasoning Ability	4,001	0,050	Not homogeneous
Learning Motivation	1,462	0,232	Homogeneous

The results of the homogeneity test are shown in Table 7. The mathematical reasoning ability data obtained a significance value of 0.050, which indicates that the variance of the two groups is not homogeneous. The learning motivation data obtained a significance value of

0.232, which indicates that the homogeneity assumption is met. Although the data on mathematical reasoning ability is not homogeneous, hypothesis testing can still be done using *the Independent Samples t-test* with reference to the line Equal variances not assumed. This allows the analysis to continue at the hypothesis testing stage.

After all prerequisite tests are met and the analysis for mathematical reasoning ability is adjusted to the results of the homogeneity test, hypothesis testing is carried out with *the Independent Samples t-test*. The purpose of this study was to find out if there was a difference in mathematical reasoning skills between students who received gamification-integrated *Problem Based Learning* (PBL) learning and students who received conventional learning. Table 8 shows the test results.

Table 8. Results of the Independent Samples t-test for Mathematical Reasoning Ability

Variance Assumptions	t	df	Sig. (2tailed)
EquaI variances assumed	6,262	60	0,000
EquaI variances not assumed	6,334	55,297	0,000

Table 8, the results of *the Independent Samples t-test* on the *Equal variances not assumed* row show a significance value (2-tailed) of 0.000 < 0.05. Therefore H_0 is rejected and H_1 is accepted. Therefore, students who participate in learning using the *gamified integrated Problem Based Learning* (PBL) model with students who participate in conventional learning have significant differences. Furthermore, the hypothesis was tested on learning motivation data with *the Independent Samples t-test.* The aim was to find out whether the motivation for learning in the experimental class and the control class was different. Table 9 shows the test results.

Table 9. Independent Samples T-Test Test Results for Student Learning Motivation

Variance Assumptions	t	df	Sig. (2-taiIed)
EquaI variances assumed	2,131	56	0,037
EquaI variances not assumed	2,131	55,264	0,038

The significance value (2-tailed) of 0.037 < 0.05 is indicated by the results *of the Independent Samples t-test,* as shown in Table 9. Therefore H_0 is rejected and H_1 is accepted. Therefore, students who participate in learning with the gamification-integrated Problem Based Learning (PBL) model do not have the same learning motivation as students who participate in conventional learning or there are significant differences.

Based on the results of hypothesis testing on both variables, it can be concluded that learning using gamification-integrated *Problem Based Learning* (PBL) models provides significant differences in students' mathematical reasoning ability and learning motivation compared to conventional learning.

DISCUSSIONS

These findings support the theory *National Council of Teachers of Mathematics* (NCTM), emphasizing the importance of mathematical reasoning skills through the activity of making conjectures, compiling proofs, using patterns and relationships, and drawing logical conclusions. In addition, the findings of this study support the theory *Self-Determination* submitted by Ryan & Deci (2000) that meeting students' needs for autonomy, ability, and relevance can increase their desire to learn.

The results of the study show that using a gamified *integrated Problem Based Learning* (PBL) model can result in more active and student-centered learning. The problem-based learning stage encourages students to discover problems, conduct investigations, reason solutions, and infer results, all in an effort to improve their mathematical reasoning abilities.

The results are in line with the opinion Arends (2012), which states that problem-based learning emphasizes students' active involvement in problem-solving so that they can develop exceptional thinking skills. This finding is also supported by research Khurin'in et al. (2024) that found that the application *Problem Based Learning* (PBL) has the ability to improve students' mathematical abilities through the use of problem-solving-based learning strategies that encourage them to develop problem-solving skills. This is also supported by Farhi et al. (2024) which explains that cognitive abilities, including mathematical reasoning skills, are related to the achievement of student learning outcomes.

In addition, the integration of gamification through Educaplay-based quizzes at the end of learning provides a more engaging learning experience, increasing student participation and encouraging them to be more enthusiastic about the learning process, resulting in increased learning motivation. Febriansah et al. (2021) shows that gamification is one of the new learning innovations that uses game elements to increase student engagement in learning. Azwah et al. (2025) Supporting these findings, it said that combining gamification with problem-based learning can make learning more interactive and fun.

The results of this study are in line with the research conducted by Ambarwati et al. (2022) Which suggests that the application of problem-based learning helps students improve their mathematical problem-solving skills better compared to hands-on learning, although the study focuses on problem-solving skills, the findings of this study support the idea that problem-based learning with gamification can improve problem-solving skills.

In addition, the results of this study are in line with the findings of the study Indah et al. (2025), which suggests that problem-based learning models have a significant influence on

students' mathematical reasoning abilities. In addition, the results of this study are also in line with the findings of the research Irnawati et al. (2024)**,** who found that the application of gamification increased students' desire to learn math. Thus, the findings of this study reinforce the findings of previous research that stated that the application of problem-based learning combined with gamification improves students' cognitive and affective qualities. Different from previous research, the study Ambarwati et al. (2022) concentrate on mathematical problem-solving skills, research Indah et al. (2025) only examines mathematical reasoning skills, while research Irnawati et al. (2024) only researching learning motivation.

Meanwhile, this study also integrates *the Problem Based Learning model* with gamification. They tested the impact of the model on two variables at once, namely mathematical reasoning ability and learning motivation. In addition, gamification is applied as a reinforcement at the end of learning through digital quizzes using Educaplay so as to provide a more interactive learning experience. The combination of *the Problem Based Learning* (PBL) model and gamification in this study contributes to improving the cognitive and affective aspects of students simultaneously.

CONCLUSION

The results showed that there was a significant difference in mathematical reasoning skills between students who participated in learning using the gamified *integrated Problem Based Learning* (PBL) model and students who participated in conventional learning. In addition, the learning motivations of the two groups differed significantly. The results showed that the mathematical reasoning ability and learning motivation of grade IX students of SMP Negeri 9 Gresik were influenced by the application of the gamified *integrated Problem Based Learning (*PBL) model.

RECOMMENDATION

Gamification-integrated Problem Based Learning (PBL) models can be used as an alternative to mathematics learning to improve mathematical reasoning skills and increase students' motivation to learn. Teachers are advised to develop learning that integrates problem-solving with gamification activities according to the characteristics of the material and students. To get a more comprehensive picture of how effective the implementation of gamification-integrated *Problem Based Learning* (PBL) models is, researchers are further advised to conduct research that includes more samples, materials, education levels, or other variables.

This study has limitations, namely the difference in the time of implementation and implementation of learning between the experimental class and the control class. The control

class learning was carried out by the subject teacher, while the learning in the experimental class was carried out by the researcher, with the implementation time not being the same between the two classes. These differences have the potential to have an impact on the results of the study.

ACKNOWLEDGMENTS

The author would like to thank Mrs. Nur Fauziyah, S.Pd., M.Pd. as supervisor I and Mr. Syaiful Huda, S.Pd., M.Si. as supervisor II for the guidance, direction, criticism, suggestions, and motivation that have been provided during the process of preparing and completing this research. The author also expressed his gratitude to both parents and families for the prayers, support, and enthusiasm that was always given so that this research could be completed properly. In addition, the author would like to thank all parties who have provided assistance and support, both directly and indirectly, in the implementation of this research.

REFERENCES

Ambarwati, R., Febriana, A., Anggoro, B. S., & Putra, R. W. Y. (2022). The Effectiveness of Problem Based Learning Aided by Gamification Teaching Materials on Students' Mathematical Problem Solving Ability. *Jurnal Pendidikan MIPA*, *23*(3), 1279–1285. https://doi.org/10.23960/jpmipa/v23i3.pp1278-1285

Arends, R. I. (2012). *Learning to Teach*. McGraw-Hill.

Azwah, N., Hidayat, R., & Aini, L. Q. (2025). *Meningkatkan Hasil Belajar Siswa Melalui Model Problem-Based Learning Berbasis Gamifikasi Pada Mata Pelajaran Bahasa Indonesia di SMPN 15 Mataram*. *10*, 625–633.

Farhi, M., Gliksman, Y., & Shalev, L. (2024). Cognitive Control among Primary- and Middle-School Students and Their Associations with Math Achievement. *Education Sciences*, *14*(2). https://doi.org/10.3390/educsci14020159

Fauziyah, N., & Husniati, A. (2023). *Learning Trajectory in Problem-Based Mathematics Learning with Literacy and Numeracy Reinforcement : An Implementation of Lesson Study at Junior High School*. *7*(2), 384–397.

Febriansah, A. T., Syaifuddin, A., & Soepriyanto, Y. (2021). Perkembangan Gamifikasi di Bidang Pendidikan. *Scholaria Jurnal Pendidikan Dan Kebudayaan*, *14*(2), 177–186.

Handikaningtyas, T., Baron, P., Kenya, M., Ramadhan, A., Fajarianto, O., & Nurlia, T. (2024). *Implementation of Problem-Based Learning with Gamification Approach in Improving 21st Century Skills*. *5*(2), 327–334.

Hariyanti, & Khotimah, R. P. (2022). Kemampuan Penalaran Matematis Siswa dalam Menyelesaikan Soal Materi Bangun Ruang Sisi Datar Ditinjau dari Perbedaan Gender di Kelas VIII SMP Negeri 1 Bendosari. *Jurnal Pembelajaran Matematika Inovatif*, *5*(3), 681–692. https://doi.org/10.22460/jpmi.v5i3.681-692

Hmelo-silver, C. E., & Barrows, H. S. (2006). *Goals and Strategies of a Problem-based Learning Facilitator*. *1*(1), 5–22.

Ilmiah, M. (2022). Problem-based Learning dengan Mutimedia Interaktif untuk Mengatasi Rendahnya Motivasi Belajar Matematika. *POSTULAT : Jurnal Pendidikan Matematika*, *3*, 166–176. https://doi.org/10.30587/postulat.v3i2.5044

Indah, D., Safitri, D., Gorontalo, U. N., & Matematis, P. (2025). *PENGARUH MODEL PEMBELAJARAN PROBLEM BASED LEARNING TERHADAP KEMAMPUAN PENALARAN*. *8*(1), 42–50.

Irnawati, D. R., Makmur, A., & Istiyowati, L. S. (2024). Pengaruh Pembelajaran Berbasis Gamifikasi terhadap Motivasi Belajar Matematika Pasca Pandemi Covid-19. *Cetta: Jurnal Ilmu Pendidikan*, *7*(1), 82–88. https://doi.org/10.37329/cetta.v7i1.2997

Kevin, W., & Hunter. (2012). *For The Win: How Game Thinking Can Revolutionize Your Business*. Wharton Digital Press.

Khainingsih et al. (2020). *Jurnal Kependidikan: 6*(2), 266–274.

Khurin'in, Fauziyah, N., & Suryanti, S. (2024). *Penerapan Pembelajaran Problem Based Learning untuk Meningkatkan Literasi Matematis Siswa Kelas X di SMA Muhammadiyah 5 Dukun*. *9*(2), 1035–1043.

NCTM. (2000). *Principles and Standards for School Mathematics*.

Permata Sari, I., & Chadir Tarihoran, A. (2024). Pengaruh Metode Pengajaran dan Motivasi Belajar terhadap Kemampuan Pemahaman Matematika Siswa. *OMEGA: Jurnal Keilmuan Pendidikan Matematika*, *3*(3), 131–139.

Rosyidah, N. F., Fauziyah, N., & Khikmiyah, F. (2022). *PENGEMBANGAN LEMBAR KERJA PESERTA DIDIK MODEL PROBLEM BASED LEARNING MENGGUNAKAN WEB LIVEWORKSHEET UNTUK KELAS VII SMP*.

Ryan, R. M., & Deci, E. L. (2000). *Self-Determination Theory and the Facilitation of Intrinsic Motivation, Social Development, and Well-Being*. *55*(1), 68–78.

Subagja, L. B. (2022). Pengaruh Model Pembelajaran Problem Based Learning (PBL) Berbantuan Aplikasi Berbasis Website Wordwall . Net Dan e -LKPD Wizer . Me Terhadap Motivasi Belajar Siswa. *POSTULAT : Jurnal Pendidikan Matematika*, *3*, 141–150. https://doi.org/10.30587/postulat.v3i2.5042