Journal of General Education and Humanities
Vol. 4, No. 4, November 2025, pp. 1561 – 1570, https://doi.org/10.58421/gehu.v4i4.688
ISSN 2963-7147

The Effectiveness of PBL Assisted by H5P Interactive Video in Improving Mathematics Literacy of Junior High School Students

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Article Info

Article history:

Received 2025-08-19
Revised 2025-08-29
Accepted 2025-08-31

Keywords:

H5P
Interactive Videos
Mathematics Literacy
Problem-Based Learning

ABSTRACT

The low mathematical literacy of junior high school students in Indonesia remains a challenge, as reflected in PISA results that consistently place Indonesia at the bottom in mathematical reasoning. This study aims to examine the effectiveness of Problem-Based Learning (PBL) assisted by H5P interactive videos in improving mathematical literacy compared to PBL without digital media. A quasi-experimental method with a Nonequivalent Control Group Design was applied to two grade VIII classes of a state junior high school in Cirebon, each consisting of 36 students. The instrument was a mathematical literacy test based on three PISA indicators: formulating, employing, and interpreting. Data analysis included normality, homogeneity, and an Independent Samples T-Test, supported by N-gain calculation. The results showed no significant difference in pre-test scores between the groups, indicating comparable initial ability. However, the experimental class achieved an N-gain of 0.71 (medium–high category), higher than the control class of 0.38 (low–medium category), with a significance level of 0.000 < 0.05. These findings confirm that integrating H5P into PBL significantly improves students' mathematical literacy. The study concludes that interactive media serve not only as a learning aid but also as a pedagogical tool that fosters participatory, contextual, and meaningful learning, providing practical recommendations for mathematics teachers to adopt innovative digital approaches.

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1. INTRODUCTION

Twenty-first-century education demands that students have competencies beyond just factual knowledge. They are expected to be able to apply knowledge to solve real problems, think critically, creatively, collaboratively, and communicate [1], [2]. In the framework of 21st Century Skills, mathematical literacy is included in literacy skills as the ability to use numerical and mathematical information to understand and solve everyday problems [3], [4]. In line with that, Rizky and Priatna [5] affirm mathematical literacy as an important skill for the 21st century that includes mathematical thinking, problem solving, modelling, and the use of symbols and tools. According to Sumliyah et al. [6], mathematical literacy is understood as the ability to think logically, formulate, use, and interpret mathematical concepts in solving problems in various real-world situations. The OECD [7], through the PISA Mathematics Framework, defines mathematical literacy as the ability to formulate, apply, and interpret mathematics in various contexts. A similar view was put forward by Liljedahl [8] that mathematics learning needs to provide space for critical and collaborative thinking, while NCTM [9] emphasised that mathematical literacy must be the main goal of junior high school learning. With these perspectives aligned, it becomes clear that mathematical literacy is not only a cognitive skill but also a foundation for preparing students to succeed in complex and unpredictable global challenges.

At the national and international level, however, the achievement of mathematical literacy of Indonesian students is still low. PISA results show that Indonesia is ranked at the bottom in the aspect of mathematical reasoning [10]. In PISA 2022, Indonesia ranked 72nd out of 81 countries with an average score of 366, far below the OECD score of 472 [7]. National data also shows a similar trend [11]. This low achievement is influenced by the dominance of lecture methods and routine exercises that make students passive [12] and the lack of variety of learning media that hinders critical and creative thinking skills [13]. Such findings indicate that the gap between the expected competencies of the 21st century and the reality of classroom practices in Indonesia is still very wide.

At the classroom level, evidence also confirms this gap. Observation of PMDS activities at SMP Negeri 6 Cirebon City strengthens this condition. Students' mathematical literacy is still relatively low, as can be seen from the difficulty of understanding the context of the problem, converting data into mathematical models, and drawing conclusions. Students tend to memorise formulas without understanding concepts. The results of the initial test based on the PISA 2022 indicator (Formulating, Employing, Interpreting) show that the average mathematics literacy is only 30.25% in class VIII D (36 students). These concrete classroom observations confirm that the problems identified at the national and international levels are also evident at the school level.

To overcome these challenges, learning strategies are needed that encourage active student engagement while also being relevant to the real context. Problem-Based Learning (PBL) is considered a potential. According to Mashuri et al. [14], authentic problems in PBL help students understand abstract concepts, increase interest, and achievement. Utami & Fitriani [15] also proved that PBL can improve the mathematical literacy of junior high school students, especially in formulating problems and interpreting data. According to Hidayat et al. [16] emphasised that Problem-Based Learning (PBL) contributes significantly to improving students' mathematical literacy. However, the effectiveness of PBL will be more optimal if combined with interactive media. One of them is H5P, which stands for HTML5 Package, which allows the creation of interactive videos, quizzes, modules, and presentations [17]. Hendratmoko et al. [18] found that interactive videos are effective in improving mathematical literacy while making learning more interesting. Therefore, integrating PBL with digital media such as H5P has the potential to create a learning environment that is both meaningful and engaging.

Nevertheless, when reviewing prior research, studies that integrate the two, especially H5P-assisted PBL, are still limited in Indonesian junior high schools. Utami & Fitriani [15] examined the effectiveness of PBL without digital media, while Hendratmoko et al. [18] examined interactive media without PBL. Thus, there is a research gap regarding the combination of the two. This gap highlights the urgency of conducting studies that not only explore each component separately but also examine how their synergy can maximise learning outcomes.

In response to this gap, this study aims to: (1) analyse the differences in mathematical literacy ability between students who study with H5P-assisted PBL and students with PBL without H5P, and (2) measure the improvement in mathematical literacy of both groups using N-gain analysis. This research is expected to make a theoretical contribution to the development of problem-based learning models integrated with interactive technology, as well as practical recommendations for teachers in Indonesia to be more courageous in adopting innovative learning models to improve students' mathematical literacy. Thus, mathematics teachers in Indonesia are encouraged to not only rely on traditional methods, but also to utilise interactive technologies such as H5P as a real solution in improving the quality of learning and the readiness of students to face the challenges of the 21st century. In this way, the study not only addresses existing problems but also provides strategic direction for transforming mathematics education in Indonesia toward a more future-oriented practice.

2. METHOD

This study uses a quasi-experimental method with a Nonequivalent Control Group Design [19], [20]. The research population is all grade VIII students at one of the State Junior High Schools 6 in the even semester of the 2024/2025 school year. Sample selection was carried out by a purposive sampling technique based on the equality of academic ability as seen from report card scores and subject teachers' input. The sample consisted of two classes with a total of 36 students each, namely class VIII D as the experimental group and class VIII E as the control group. This design was chosen to allow comparison between groups that are similar in characteristics but receive different treatments.

The experimental class received learning with the Problem-Based Learning (PBL) model assisted by H5P interactive video media, while the control class received learning with PBL without H5P interactive video media. The learning in this study was carried out for six meetings with a duration of 2 × 40 minutes each. The process follows the Problem-Based Learning (PBL) syntax, which consists of five main stages. First, at the problem orientation stage, the teacher presents contextual problems, where the experimental class uses H5P interactive videos while the control class uses conventional questions. Second, the teacher organises the students into groups to plan a completion strategy. Third, at the investigation stage, students explored information and developed solutions, with the experimental class receiving support in the form of questions and feedback from H5P media. Fourth, the results of the investigation are presented and discussed together in class. Finally, teachers and students conduct analysis and reflection to relate the findings to relevant mathematical concepts. Through this design, the main difference between the two groups lies in the presence or absence of H5P media as learning support.

The research instrument is in the form of a mathematical literacy test in the form of description questions that refer to three indicators of the mathematical literacy process according to the OECD [10], namely Formulating, Employing, and Interpreting. The instrument was validated by expert lecturers and subject teachers, and tested on 28 students with equivalent characteristics. The results of the validity and reliability test using SPSS version 22 are shown in the following table. This step was carried out to ensure that the test items used were both accurate and reliable as a measure of students' mathematical literacy.

Table 1. Results of the Validity and Reliability Test of the Mathematical Literacy Test Instruments

Question No	Validity	Reliability
1	(Highly Valid) 0.843	
2	(Highly Valid) 0.863	
3	(Valid) 0.618	Reliable 0.691
4	(Fairly Valid) 0.524	
5	(Fairly Valid) 0.552	

The validity and reliability testing of the instrument, as presented in Table 1, demonstrates that the validity coefficient meets the criteria of "very valid" and "quite valid." Meanwhile, the reliability analysis conducted using Cronbach's Alpha resulted in a value of 0.691, which falls within the acceptable category of reliability. These outcomes collectively indicate that the instrument used in this study is appropriate and feasible, as it satisfies the necessary standards of validity and reliability required for research implementation.

Furthermore, the data collected were subjected to both quantitative and qualitative analyses to ensure a comprehensive evaluation. The quantitative analysis was carried out based on the results of the pre-test and post-test, in which student scores were obtained and subsequently converted into value data. This process enabled the researchers to systematically measure student performance before and after the intervention, thereby providing meaningful data for further analysis.

The quantitative data were then examined through N-gain analysis to evaluate the improvement in students' mathematical literacy. The results of this analysis were later used as the basis for hypothesis testing through the Independent Samples T-test. Prior to conducting the T-test, prerequisite tests such as the normality test and homogeneity test were performed to ensure that the data met the statistical assumptions required for valid inference. The N-gain analysis applied in this study followed the formula proposed by Raharjo [21], namely:

$$N - Gain = \frac{Posttest\ score - Pretest\ score}{Ideal\ Score - Pretest\ Score} \quad (1)$$

After that, the results of the N-gain calculation are analysed and interpreted based on the classification proposed by Raharjo [21]:

Table 2. N-gain Score Distribution

N-gain *value*	Category
$G > 0,7$	High
$0,3 \leq G \leq 0,7$	Medium
$G < 0,3$	Low

Source: Raharjo [21]

These analytical steps were designed to identify not only whether there was an improvement in mathematical literacy, but also how significant the improvement was.

The normality test was conducted to determine whether the populations of the two classes were normally distributed. To assess this, the Kolmogorov-Smirnov test was applied with a significance level of $\alpha = 0.05$. The decision-making criteria were set as follows: if the significance value was greater than or equal to 0.05, H_0 was accepted, indicating that the data were normally distributed; whereas if the significance value was less than 0.05, H_0 was rejected, signifying that the data were not normally distributed. Establishing normality is a critical step, as it directly influences the appropriateness and validity of subsequent parametric statistical tests.

The second prerequisite test was the homogeneity test, which aimed to examine whether the two groups possessed equal variances. Similar to the normality test, the significance level used was $\alpha = 0.05$. The criteria for decision-making stated that if the significance value was greater than or equal to 0.05, H_0 was accepted, indicating that the variances between the two groups were homogeneous. Conversely, if the significance value was less than 0.05, H_0 was rejected, meaning that the variances were not homogeneous. Verifying homogeneity ensures that comparisons between the experimental and control groups are equitable and free from bias.

Finally, the Independent Samples T-Test was employed to compare the mean scores between the two groups, since the data were measured at the interval or ratio scale. This test was specifically used to analyze differences in the average N-gain of students' mathematical literacy, applying the same significance level of $\alpha = 0.05$. The decision-making rules specified that if the significance value was greater than or equal to 0.05, H_0 was accepted and H_a rejected, implying that the increase in mathematical literacy of students taught with H5P interactive video media was not significantly higher than those without it. However, if the significance value was less than 0.05, H_0 was rejected and H_a accepted, meaning that students using H5P interactive video media showed a significantly greater improvement in mathematical literacy than those who did not. Consequently, this test served as the determining stage in validating whether the integration of H5P within problem-based learning (PBL) significantly enhanced mathematical literacy compared to PBL alone.

3. RESULTS AND DISCUSSION

3.1 Result

3.1.1 Descriptive Statistics of Increasing Mathematical Literacy

The average pre-test, post-test, and n-gain values of the experimental and control classes are presented in Table 3.

Table 3. Descriptive Statistics: Pre-test, Post-test, and N-gain Mathematics Literacy

Data	Class	N	Mean	Std.Devision	Min	Max
Pre-test	Experiment	36	58,67	9,722	40	73
	Control	36	58,97	9,539	40	77
Post-test	Experiment	36	88,53	5,877	77	100
	Control	36	74,06	8,757	53	90
N-gain	Experiment	36	0,7067	0,17693	0,26	1,00
	Control	36	0,3761	0,14116	0,18	0,67

As displayed in Table 3, the pre-test outcomes reveal that the experimental class achieved an average score of 58.67 with a standard deviation of 9.722, while the control class recorded an average of 58.97 with a standard deviation of 9.539. The close similarity of these values suggests that both groups started the study with relatively equal abilities, thereby providing a fair basis for comparison. However, the post-test results highlight a significant distinction between the two groups. The experimental class demonstrated a marked improvement, reaching an average score of 88.53 with a reduced standard deviation of 5.877, whereas the control class attained a lower mean of 74.06 with a standard deviation of 8.757. The smaller standard deviation observed in the experimental class not only indicates better performance but also suggests a more consistent distribution of student outcomes, implying that the intervention positively influenced both the overall achievement level and the uniformity of learning results.

The N-gain analysis further reinforces these findings. The experimental class achieved an average N-gain of 0.7067 with a standard deviation of 0.17693, placing it within the medium-high category, while the control class obtained an average of only 0.3761 with a standard deviation of 0.14116, categorized as low-medium. This substantial difference demonstrates that the instructional strategy applied to the experimental class was considerably more effective in enhancing mathematical literacy compared to that used in the control class. Taken together, the improvements in mean scores, the reduced variability in performance, and the higher N-gain values strongly support the conclusion that the intervention contributed significantly to strengthening students' mathematical literacy, both in terms of overall achievement and consistency across learners.

3.1.2 Prerequisite Test

The results of the normality test on *the n-gain* value of mathematical literacy of students in the experimental class and the control class are presented in Table 4.

Table 4. Data on the Normality Test Results of *N-gain* Mathematics Literacy Value

Value	Group	Kolmogorov-Smirnov			Conclusion
		Statistic	Df	Sig.	
N-gain	Experiment	0,109	36	0,200	Normally Distributed
	Control	0,122	36	0,197	Normally Distributed

Based on the results presented in Table 4, the N-gain value of the experimental class obtained a significance level of 0.200, which is greater than 0.05. This outcome indicates that H_0 is accepted and H_a is rejected, meaning that the N-gain scores for students' mathematical literacy in the experimental class follow a normal distribution. Similarly, the control class produced a significance value of 0.197, which is also greater than 0.05, leading to the acceptance of H_0 and the rejection of H_a. This finding demonstrates that the N-gain scores for the control class are likewise normally distributed. Thus, the results of the Kolmogorov-Smirnov test confirm that the distribution of N-gain data in both the experimental and control groups is normal.

The results of the homogeneity test on *the N-gain* value of the mathematical literacy of students in the experimental class and the control class are presented in Table 5.

Table 5. Data on the Normality Test Results of *N-gain* Mathematics Literacy Value

data	Levene's Statistic		Conclusion
	F	Sig.	
N-gain	1,116	0,294	Homogen

In Table 5, it can be seen that the results of the *N-gain data homogeneity test of* the experimental class and the control class have a significance of 0,294 ≥ 0,05, so H_0 is accepted and H_a Rejected. Therefore, it can be said that the data from the experimental class and the control class vary homogeneously.

3.1.3 Hypothesis testing

Furthermore, the results of the normality test and the homogeneity test that have been carried out show that *the n-gain* data are normally distributed and have homogeneous variance, so that the average difference test presented in Table 6 can be used.

Table 6. N-gain Mean Difference Test (Hypothesis Test 1)

Data	Independent Sample T-Test		Conclusion
	T	Sig. (2-*Tailed*)	
N-gain	1,180	0,000	H_0 rejected

Table 6 presents the results of the statistical test, indicating that the difference in the mean N-gain of students' mathematical literacy produced a Sig. (2-tailed) value of 0.000. Since the obtained significance level is smaller than 0.05, H_0 is rejected and H_a is accepted. This finding suggests that the improvement in mathematical literacy among students taught using H5P interactive video media is significantly greater compared to those who did not receive instruction through H5P interactive video media.

3.2 Discussion

The findings of the study revealed a substantial difference in the improvement of mathematical literacy between students who engaged in Problem-Based Learning (PBL) supported by H5P interactive video media and those who experienced PBL without such media. The experimental group obtained an N-gain score of 0.71, which falls into the medium–high category, whereas the control group achieved only 0.38, categorized as low–medium. This disparity highlights the more effective role of H5P in fostering learning progress compared to conventional PBL.

Further analysis using the Independent Samples T-Test confirmed this result, yielding a significance value of 0.000, which is lower than the threshold of 0.05. This statistical evidence indicates that the integration of H5P interactive video media exerts a significant influence on students' mathematical literacy development. Consequently, the use of interactive media should not be regarded as a supplementary component alone, but rather as a crucial element that strengthens the overall effectiveness of PBL in improving learning outcomes.

The effectiveness of H5P media can be explained through several mechanisms. First, interactive features and live feedback allow students to be actively involved in the learning process. This is in line with the findings of Utami [11], who reported that H5P interactive videos increase student participation while strengthening understanding of mathematical concepts. Second, H5P presents a more concrete visualisation and learning experience, making abstract concepts easier to understand. Sanda [22] also found that the use of H5P-based media had a positive impact on the mathematical literacy of junior high school students in grade VIII. Third, this media fosters intrinsic motivation because students are not only passively receiving information, but also actively interacting with learning materials. Taken together, these mechanisms demonstrate how H5P bridges the gap between abstract mathematics and students' lived experiences.

The findings of this study can be understood through a theoretical perspective. From the perspective of Cognitive Load Theory [23], H5P helps reduce extraneous cognitive load by presenting information visually and interactively, so that students' cognitive capacity is more optimally used to understand concepts (germane load). Meanwhile, according to Constructivist theory, learning will be more meaningful if students build their own knowledge through exploration, collaboration, and authentic experience [24], [25]. The integration of H5P in PBL is in line with this view because it allows students to build their understanding through interaction with real problems, both individually and in groups. Thus, theoretical frameworks not only explain the statistical outcomes but also justify why the use of H5P within PBL creates a richer and more sustainable learning process.

In addition to supporting the theory, the results of this study are also consistent with several other empirical findings. Qomariah et al. [26] emphasised that PBL can develop mathematical literacy according to PISA indicators, namely Formulating, Employing, and Interpreting. Research by Baharuddin et al. [27] also shows that interactive media is able to increase student engagement while making the learning process more interesting. Thus, the findings of this study not only strengthen the results of previous research but also fill the research gap by combining PBL and H5P, which were previously rarely studied simultaneously at the junior high school level. This alignment with prior studies reinforces the credibility of the current findings while also highlighting its novelty in integrating two approaches.

From a practical perspective, the implications of this research are important for teachers. The use of H5P can be integrated into the curriculum by using platforms such as

Lumi, Moodle, or Google Classroom to present PISA-based contextual questions. At the problem orientation stage in PBL, teachers can show interactive videos containing contextual problems; at the investigation stage, students can get automated feedback from H5P. Meanwhile, at the reflection stage, the teacher can guide the discussion based on the recorded student response. Thus, H5P not only functions as an auxiliary medium but also as a pedagogical instrument that encourages collaboration, independence, and high-level thinking skills. By applying these strategies, teachers can move beyond conventional methods and create a more engaging and student-centred classroom.

Theoretically, this study strengthens the understanding that the integration of interactive digital media plays an important role in supporting problem-based learning, while practically, this research provides concrete recommendations for teachers to be more courageous in adopting innovative learning technologies. Through this step, students' mathematical literacy can be improved, while supporting the realisation of a Pancasila student profile that is adaptive to the challenges of the 21st century. In conclusion, the synergy of PBL and H5P not only contributes to academic performance but also nurtures the broader competencies required for future-ready learners.

4 CONCLUSION

This study proves that Problem-Based Learning (PBL) assisted by H5P interactive video media significantly improves the mathematical literacy of junior high school students, especially in the PISA indicator, which is to formulate, use, and interpret mathematical problems. Practically, teachers are advised to integrate H5P in PBL to increase student motivation and engagement, while schools need to provide training and assistive technology facilities. The limitations of this study lie in the scope of one school with a limited sample, so further research needs to be extended to other levels of education, comparing various digital media, and conducted longitudinally to see the long-term impact on mathematical literacy.

ACKNOWLEDGEMENTS

The researcher expressed his gratitude to the school for providing permits and facilities for the implementation of this research, the mathematics teachers who helped in the learning process, and the grade VIII students who had participated enthusiastically. Gratitude was also expressed to the University of Muhammadiyah Cirebon for the academic support and guidance from the supervisors, so that this research could be completed properly. Not to forget, the author's appreciation is conveyed to his beloved parents, who always provide prayers, moral support, and motivation, as well as friends who also encourage the preparation of this article until it is completed well.

REFERENCES

[1] A. Dilekçi and H. Karatay, "The effects of the 21st century skills curriculum on the development of students' creative thinking skills," *Think Skills Creat*, 2023, [Online]. Available: https://www.sciencedirect.com/science/article/pii/S1871187122002309

[2] M. Riaz and M. Din, "Collaboration as 21st century learning skill at undergraduate level," *sjesr*, 2023, [Online]. Available: https://www.ojs.sjesr.org.pk/index.php/ojs/article/view/932

[3] B. Trilling and C. Fadel, *21st Century Skills: Learning for Life in Our Times*. San Francisco: Jossey-Bass, 2009.

[4] J. W. Sitopu, M. Khairani, M. Roza, L. Judijanto, and A. Aslan, "The importance of integrating mathematical literacy in the primary education curriculum: A literature review," *International Journal of ...*, 2024.

[5] L. M. Rizki and N. Priatna, "Mathematical literacy as the 21st century skill," *J Phys Conf Ser*, vol. 1157, p. 042088, Feb. 2019, doi: 10.1088/1742-6596/1157/4/042088.

[6] S. Sumliyah, I. Junaedi, and M. Mulyono, "Mathematical Literacy: A Comparative Analysis of School Mathematics Curricula in Indonesia, Singapore, and China," *INOMATIKA*, vol. 7, no. 1, pp. 105–129, Feb. 2025, doi: 10.35438/inomatika.v7i1.488.

[7] OECD, *PISA 2022 Results (Volume I)*. Paris: OECD, 2023. doi: 10.1787/53f23881-en.

[8] P. Liljedahl, *Building Thinking Classrooms in Mathematics, Grades K–12*. Ontario: Corwin Press, 2020.

[9] NCTM, *Catalysing Change in Middle School Mathematics: Initiating Critical Conversations*. Reston, VA: National Council of Teachers of Mathematics, 2020.

[10] OECD, *PISA 2021 Mathematics Framework*. Paris: : OECD Publishing, 2021.

[11] Kemendikbudristek, *Laporan Hasil Asesmen Kompetensi Minimum Nasional*. Jakarta: Kemendikbudristek, 2020.

[12] D. Nasution and E. Simarmata, "Metode pembelajaran tradisional dan dampaknya terhadap partisipasi siswa," *Jurnal Pendidikan*, vol. 15, no. 1, pp. 23–34, 2021.

[13] F. Pratama and D. Rahayu, "Pengaruh variasi media pembelajaran terhadap keterampilan berpikir kritis siswa," *Jurnal Inovasi Pendidikan*, vol. 9, no. 1, pp. 45–58, 2021.

[14] A. Mashuri, B. Santoso, and T. Lestari, "Penerapan Problem Based Learning untuk meningkatkan pemahaman konsep matematika," *Jurnal Pendidikan Matematika*, vol. 14, no. 2, pp. 112–125, 2023.

[15] D. Utami and N. Fitriani, "Efektivitas Problem Based Learning terhadap literasi matematika siswa SMP," *Jurnal Pendidikan Matematika*, vol. 13, no. 2, pp. 45-–56, 2024.

[16] R. Hidayat, J. Rahmatudin, and A. Sriwahyuni, "Kontribusi Model Pembelajaran Problem Based Learning Terhadap Kemampuan Literasi Matematis Siswa SMP," *Jurnal Didactical Mathematics*, vol. 1, no. 2, pp. 32–40, 2019.

[17] I. N. Putri, Arif Abdul Haqq, and S. Saluky, "Development of H5P Course Presentation to Improve Student Mathematics Learning Outcomes," *Journal of Mathematics Instruction, Social Research and Opinion*, vol. 3, no. 3, pp. 265–274, Aug. 2024, doi: 10.58421/misro.v3i3.231.

[18] Y. Hendratmoko, A. Y. T, N. Siregar, N. F. Meldi, N. Afni, and D. Rahmawati, "Media Pembelajaran Interaktif untuk Meningkatkan Minat Siswa Belajar Matematika di SMA Negeri 1 Tayan Hulu," *Jurnal Alwatzikhoebillah : Kajian Islam, Pendidikan, Ekonomi, Humaniora*, vol. 10, no. 2, pp. 568–574, Dec. 2024, doi: 10.37567/alwatzikhoebillah.v10i2.3245.

[19] Sugiyono, *Metode Penelitian Kuantitatif, Kualitatif, dan R&D*. Bandung: Alfabeta, 2017.

[20] J. Creswell, *Riset Pendidikan*, 1st ed. Yogyakarta: Pustaka Pelajar, 2015.

[21] Z. A. Zori, "Efektivitas Penggunaan Media Pembelajaran Permainan Tri Zone Mathematic Terhadap Minat dan Kemampuan Matematis Siswa Kelas VII Dalam Materi Operasi Hitung Bilangan Bulat di SMP Negeri 7 Seluma ," IAIN Bengkulu, Bengkulu, 2021.

[22] E. A. Sanda, "Pengaruh media pembelajaran interaktif HTML5 Package (H5P) terhadap pemahaman konsep matematis dan self-efficacy siswa kelas VIII di SMP Negeri 2 Namo Rambe," Universitas Muhammadiyah Sumatera Utara, Medan, 2023.

[23] J. Sweller, *Cognitive Load Theory*. New York: Springer, 2019.

[24] L. Vygotsky, *Mind in Society: The Development of Higher Psychological Prosesses*. London: Harvard University Press, 1978.

[25] J. Piaget, *The Equilibration of Cognitive Structures: The Central Problem of Intellectual Development*. Chicago: University of Chicago Press, 1985.

[26] N. A. L. Qomariah, N. Nisa, Z. Abidin, and N. W. Sholikin, "Penerapan Model Pembelajaran based learning (PBL) untuk meningkatkan kemampuan literasi matematis siswa SMP kelas VII," *Galaxy: Jurnal Pendidikan MIPA dan Teknologi*, vol. 2, no. 1, pp. 81–87, Jun. 2025, doi: 10.59923/galaxy.v2i1.528.

[27] B. Baharuddin, S. Lestari, and H. Wahyuni, "Media interaktif untuk meningkatkan keterlibatan belajar matematika," *Jurnal Inovasi Pendidikan Matematika*, vol. 5, no. 2, pp. 232–240, 2024.