Attadrib: Jurnal Pendidikan Guru Madrasah Ibtidaiyah
p-ISSN: 2599-3194 | e-ISSN: 2775-8109
Volume 9, Issue. 3, 2026, pp. 576-586

The Effectiveness of Conventional and Digitally Modified Problem-Based Learning (PBL) on Students' Understanding of Disaster Mitigation Concepts

Muhammad Wahyu Nusantara Aji*[1], Ika Listiqowati[2], Widyastuti[3], Hasan[4], Zeffitni[5]
Pascasarjana Universitas Tadulako
e-mail: wahyunusantara20@gmail.com

Submitted: 02-09-2026 Revised : 22-10-2026 Accepted: 11-11-2026

ABSTRACT. This study aimed to analyze students' understanding of disaster mitigation concepts through conventional Problem-Based Learning (PBL) and digital media-based modified PBL, as well as compare the effectiveness of both learning models. This quantitative research employed a quasi-experimental method with a nonequivalent control group design involving 60 eighth-grade students at SMP Negeri 1 Banawa. Class VIII-B served as the experimental group, while class VIII-C served as the control group. Data were collected using a 40-item concept understanding test, observation, interviews, and documentation. Data analysis involved the Mann-Whitney U test, ANCOVA, Two-Way ANOVA, and N-Gain analysis. The results showed that the control group's mean score increased from 47.67 to 71.67, with an N-Gain of 0.46, while the experimental group's mean score increased from 48.58 to 81.83, with an N-Gain of 0.65. The posttest scores revealed a significant difference between the two groups ($U = 149.000$; $p < 0.001$). This difference remained significant after controlling for students' initial abilities ($F = 30.70$; $p < 0.001$; $\eta^2p = 0.350$). Furthermore, the interaction between learning model and measurement time was significant ($F = 25.48$; $p < 0.001$). These findings indicate that digital media-based modified PBL is more effective than conventional PBL in improving students' understanding of disaster mitigation concepts, particularly in the extrapolation indicator.
Keywords: Disaster Mitigation; Concept Understanding; Problem-Based Learning; Digital Media; Social Studies Learning.

https://doi.org/10.54069/attadrib.v9i3.1386

How to Cite Nusantara Aji, M. W., Listiqowati, I., Widyastuti, W., Hasan, H., & Zeffitni, Z. (2026). The Effectiveness of Conventional and Digitally Modified Problem-Based Learning (PBL) on Students' Understanding of Disaster Mitigation Concepts. *Attadrib: Jurnal Pendidikan Guru Madrasah Ibtidaiyah*, *9*(3), 576–586.

INTRODUCTION

Indonesia is a country with a relatively high level of vulnerability to disasters, encompassing both geological and hydrometeorological events. Given these geographical and geological conditions, knowledge regarding disaster mitigation has become an essential component of education (Afirda & Nasution, 2025; Assegaf et al., 2025; Saryono et al., 2026; Septikasari et al., 2024). Through the learning process, students should gain an understanding of the various types of disasters, their underlying causes, potential risks, and the actions that can be taken to reduce their impact (Alam et al., 2026; Amalia, 2026; Mahmud et al., 2024; Salim & Aditya, 2025, 2025). Disaster mitigation education is not merely focused on the acquisition of information; it also aims to equip students with the ability to comprehend their environmental conditions and determine appropriate courses of action when faced with a disaster situation (Andini et al., 2025). Donggala Regency, particularly the Banawa area, is one of the regions in Central Sulawesi that has experienced

natural disasters. The earthquake and tsunami on September 28, 2018, served as a significant event, highlighting the need to strengthen disaster-related knowledge starting from a school age. This experience should be integrated into Social Studies (IPS) instruction so that students can connect the material they learn with the conditions of their surrounding environment (Adeoye, 2024; Asweni et al., 2024; Hakim et al., 2026; Wahyono et al., 2022) Disaster mitigation education in schools is expected to help students understand regional risks, interpret disaster-related information, and recognize measures for risk reduction.

Understanding the concept of disaster mitigation is an ability that cannot be sufficiently developed through rote memorization. Students need to have the ability to translate information, interpret relationships between facts, and extrapolate or estimate a situation based on the information obtained. These three indicators are important because students are not only required to know the meaning of disaster and mitigation, but also understand information on maps, relate geographic conditions to potential risks, and estimate possible impacts. This ability is the basis for students to develop a more meaningful understanding of disaster issues. One learning model that can be used to develop these abilities is Problem Based Learning (PBL) (Anita, 2025, 2025; Nurhalisa et al., 2025; Syahrani & Purwono, 2024; Ulya & Siswanto, 2024). The PBL model places problems as the basis of learning activities. Students are directed to understand problems, organize learning activities, carry out investigations, develop problem solving results, and evaluate the processes that have been carried out (Sivra Tolandang, 2026). (Darwati & Purana, 2021) Explains that PBL provides students with the opportunity to build knowledge through the process of problem solving and active learning. Through these activities, students not only receive information from the teacher, but are also involved in the process of searching, processing and using information. However, implementing PBL requires the support of learning resources that are appropriate to the characteristics of the material. (Amirulloh et al., 2025; Mumtahana et al., 2026; Rohidin et al., 2023; Sitepu et al., 2025; Susanti et al., 2026) Disaster mitigation materials require information that can show regional conditions, risk distribution, disaster events, and the relationship between geographic factors and potential hazards. (Ernawati et al., 2022) The use of printed materials and verbal explanations can still support learning, but has limitations in presenting spatial information and disaster data dynamically. Therefore, the use of digital media can be an alternative to enrich the investigation process in PBL.

Digital media enables students to access various information sources, including videos, digital maps, disaster-related data, and collaborative applications. Mayer (2024) explains that presenting information through both verbal and visual elements can support the learning process, provided it is designed appropriately. In the context of disaster mitigation education, videos can help students visualize disaster events, while digital maps assist them in identifying locations and understanding potential risks. Furthermore, the use of digital media offers students opportunities to synthesize their research findings and communicate their ideas through the creation of learning products. Research on Problem-Based Learning (PBL) and digital media in disaster education has demonstrated the relevance of both approaches. For instance, (Abdullah & Ningrum, 2024) examined the impact of the PBL model on students' critical thinking skills regarding natural disaster mitigation. Similarly, (Surjati & Ni'matullah, 2026) explored the use of Google Earth-assisted PBL in teaching hydrometeorological disaster mitigation. These studies suggest that PBL and the integration of digital technology can effectively support disaster education. Nevertheless, there remains a need for research that directly compares conventional PBL with a modified version of PBL that incorporates digital media—specifically in cases where both groups follow the same PBL stages. Such a comparison is essential to determine whether the use of digital media provides an additional contribution to students' conceptual understanding. Moreover, conducting research in areas with a history of disasters, such as Donggala Regency, is particularly relevant, as the learning material can be contextualized based on local environmental conditions.

This study was conducted at SMP Negeri 1 Banawa, comparing two groups of eighth-grade students. The experimental group participated in a modified, digital media-based Problem-Based Learning (PBL) approach, while the control group followed a conventional PBL model. Both groups utilized the same five stages of PBL but were provided with different learning resources and media. The research focused on the understanding of disaster mitigation concepts, assessed through indicators of translation, interpretation, and extrapolation. The study aimed to analyze the effectiveness of both instructional models and to determine the differences in the improvement of disaster mitigation concept understanding between students who experienced conventional PBL and those who experienced the modified, digital media-based PBL

METHOD

This study employs a quantitative approach using a quasi-experimental research method. The design utilized is a nonequivalent control group design, which involves two pre-existing groups: an experimental group and a control group. Both groups were administered a pretest prior to instruction and a posttest following the intervention to assess changes in their understanding of disaster mitigation concepts. The research was conducted at SMP Negeri 1 Banawa, Donggala Regency, Central Sulawesi Province. The subjects consisted of 60 eighth-grade students divided into two classes. Class VIII-B served as the experimental group (30 students) and received instruction through a modified Problem-Based Learning (PBL) approach incorporating digital media, while Class VIII-C served as the control group (30 students) and received instruction through conventional PBL. The classes were selected based on their existing composition within the school; therefore, no individual randomization of students was performed.

The primary research instrument was a 40-item multiple-choice test designed to assess conceptual understanding. The instrument was developed based on three indicators of conceptual understanding: translation, interpretation, and extrapolation. The translation indicator pertains to a student's ability to restate information in a different form. The interpretation indicator relates to the ability to comprehend and explain the meaning of information, as well as the relationships between facts. Meanwhile, the extrapolation indicator concerns the ability to estimate consequences or future states based on the information already understood. The content validity of the instrument was analyzed using Aiken's V index, yielding a value of 1.00. The instrument also underwent a pilot test prior to its use in data collection. All 40 items were determined to be valid based on the testing results reported in the thesis. In addition to the test, the study employed observation sheets to monitor the implementation of instruction, along with interviews and documentation, to serve as supporting data for describing how instruction was carried out in both groups.

The instructional intervention was carried out over three sessions. Both groups followed the five stages of Problem-Based Learning (PBL): (1) orienting students to the problem; (2) organizing students for study; (3) guiding individual and group investigations; (4) developing and presenting work; and (5) analyzing and evaluating the problem-solving process. This consistent structure ensured that the comparison between the two groups remained focused on the differences in the media and learning resources provided. In the experimental group, the PBL approach was modified through the integration of digital media. The resources and applications utilized included documentary videos from the BMKG (Meteorology, Climatology, and Geophysics Agency) and BNPB (National Board for Disaster Management), Mentimeter, Google Classroom, Google Docs, inaRISK Personal, the Indonesian Disaster Information Data (DIBI) from BNPB, SiPongi+, Google Earth, Google My Maps, Canva, Padlet, Google Forms, Quizizz, and Wheel of Names. These tools were employed to facilitate the presentation of problems, information gathering, investigation of disaster-related data, group collaboration, preparation of findings, presentations, and the evaluation of the learning process. Meanwhile, the control group engaged in a conventional PBL approach, utilizing printed photographs of disaster events, news clippings, books, printed maps or atlases, student worksheets, large-format paper (plano paper), oral presentations, question-

and-answer sessions, "3-2-1" exit tickets, and written reflections. Both groups received the same instructional content and followed the same PBL stages; the distinction lay solely in the use of digital media and learning resources to support their investigative activities.

Research data were analyzed using both descriptive and inferential methods. Descriptive analysis was employed to determine the mean pretest and posttest scores for each group. Normality was assessed using the Shapiro–Wilk test, while the homogeneity of variances was examined using Levene's test. The equivalence of initial ability levels was analyzed using an independent-samples t-test. Differences in posttest scores were analyzed using the Mann–Whitney U test, as the posttest data for the control group did not meet the assumption of normality. Furthermore, ANCOVA was used to determine the effect of the instructional model, with pretest scores included as a covariate. A two-way ANOVA was conducted to examine the interaction between the instructional model and the time of measurement. Improvements in conceptual understanding were also analyzed using the normalized gain (N-Gain).

RESULT AND DISCUSSION

Result

The pretest results indicate that the initial level of understanding regarding disaster mitigation concepts was relatively similar between the two groups. The experimental group achieved an average score of 48.58, while the control group had an average of 47.67—a difference of 0.91 points. An independent-samples t-test yielded a t-value of 0.527 with a significance level of $p = 0.600$, demonstrating that there was no significant difference in the initial ability between the experimental and control groups. Following the instructional intervention, both groups showed an improvement in their scores. The experimental group, which participated in a modified, digital media-based Problem-Based Learning (PBL) approach, attained an average posttest score of 81.83. Meanwhile, the control group, which followed a conventional PBL approach, achieved an average score of 71.67. The average improvement for the experimental group reached 33.25 points, whereas the control group showed an increase of 24.00 points.

Table 1. Comparison of pretest and posttest scores for both groups

Group	Number of students	Pretest average	Posttest average
PBL termodifikasi berbasis media digital	30	48,58	81,83
PBL Konvensional	30	47,67	71,67

The comparison indicates that both learning models can improve the understanding of disaster mitigation concepts. However, the improvement observed in the experimental group is greater than that in the control group. These results provide a preliminary indication that the use of digital media to support Problem-Based Learning (PBL) activities can help students achieve a better grasp of the concepts. Regarding mastery, the experimental group reached a mastery rate of 96.67%, while the control group reached 66.67%. In the experimental group, 66.67% of students fell into the "good" category, and 33.33% fell into the "fair" category. Meanwhile, in the control group, 13.33% of students were in the "good" category, and 86.67% were in the "fair" category.

Statistical testing was conducted to determine whether the difference in values between the two groups was significant. The normality test results indicated that the posttest data for the control group were not normally distributed; therefore, the difference in posttest scores was analyzed using the Mann–Whitney U test. The Mann–Whitney U test yielded a U value of 149.000, $Z = -4.473$, and $p < 0.001$, with an effect size of $r = 0.58$. These results indicate a significant difference in the understanding of disaster mitigation concepts between students who participated in a modified, digital media-based Problem-Based Learning (PBL) approach and those who followed a conventional PBL approach. Further analysis was conducted using ANCOVA, with pretest scores serving as a covariate. The results yielded an F-value of $F(1,57) = 30.703$ ($p < 0.001$), with a partial eta squared of 0.350. This indicates that the instructional model has a significant effect on conceptual understanding, even after controlling for students' prior ability. A two-way ANOVA also revealed a significant interaction between the instructional model and the time of measurement, with an F-

value of $F(1,58) = 25.477$ ($p < 0.001$) and a partial eta squared of 0.305. These findings demonstrate that the pattern of score improvement from the pretest to the posttest differs between the experimental group and the control group.

N-Gain analysis is used to determine the level of improvement in students' conceptual understanding following instruction. The analysis results indicate that the experimental group achieved an average N-Gain of 0.65 (or 65.01%), while the control group achieved an average N-Gain of 0.46 (or 46.09%). Both groups fall into the medium category; however, the N-Gain value for the experimental group is higher than that of the control group.

Table 2. Categories of improvement in conceptual understanding based on N-Gain

N-Gain Category	Experimental Group	Control Group
Tall	30,00 %	10,00%
Currently	70,00%	76,67%
Average N-Gain	0,65	0,46
Average category	Currently	Currently

These results indicate that the experimental group had a larger proportion of students in the high-improvement category compared to the control group. In the experimental group, no students fell into the low-improvement category, whereas 13.33% of students in the control group were in the low-improvement category. The Mann–Whitney U test for N-Gain differences yielded a U value of 132.500, with $p < 0.001$ and an effect size of $r = 0.61$. These findings demonstrate that the improvement in conceptual understanding between the two groups differs significantly.

Conceptual understanding in this study was analyzed based on three indicators: translation, interpretation, and extrapolation. The N-Gain results indicate that the experimental group achieved higher scores across all indicators compared to the control group.

Table 3. N-Gain based on indicators of conceptual understanding

Indicator	Experimental group	Control group
Translation	0,64	0,45
Penafsiran	0.60	0,52
Extrapolation	0,70	0,39

The highest N-Gain score in the experimental group was observed for the extrapolation indicator, at 0.70. Meanwhile, the control group achieved its highest score for the interpretation indicator, at 0.52. The most significant difference between the two groups was also found in the extrapolation indicator. These results indicate that a modified, digital media-based Problem-Based Learning (PBL) approach offers the greatest relative advantage in supporting students' ability to estimate consequences based on disaster-related information.

The observation results indicate that the implementation of instruction in both the experimental and control groups reached 100% over the course of three sessions. Both groups carried out the stages of Problem-Based Learning (PBL) in accordance with the planned instructional activities. Interview findings support the quantitative results, suggesting that the use of digital media provides a more diverse learning experience. Students were given the opportunity to access videos, maps, and disaster-related information through various digital sources. The use of such media helped students connect the learning material with regional conditions and disaster-related information discovered during the inquiry process. Nevertheless, the implementation of digital media-based instruction also faced several challenges, primarily concerning internet connectivity, the availability of devices, and variations in students' technological proficiency. These conditions necessitate guidance from the teacher to ensure that the use of digital media continues to support the achievement of learning objectives.

Discussion

Effectiveness of conventional PBL on the understanding of disaster mitigation concepts

The research results indicate that conventional Problem-Based Learning (PBL) can improve students' understanding of disaster mitigation concepts. The average score of the control group increased from 47.67 in the pretest to 71.67 in the posttest, with an N-Gain of 0.46, which falls into the medium category. This improvement demonstrates that problem-based learning provides students with opportunities to develop their understanding through activities such as discussion, investigation, and the formulation of solutions.

Conventional Problem-Based Learning (PBL) is implemented through five learning stages, ranging from orientation to the problem to the evaluation of the problem-solving process. The use of printed photographs, news clippings, books, printed maps, atlases, and worksheets provides students with sources of information to understand the subject of disaster mitigation. Through these activities, students are able to identify types of disasters, comprehend available information, and connect the material to the issues being discussed within their groups. These findings align with the explanation provided by Hmelo-Silver (2004), which states that PBL offers students the opportunity to construct knowledge through problem-solving. Learning is not merely centered on the delivery of information by the teacher; rather, it engages students in a process of inquiry and the development of understanding. The conventional PBL approach in this study demonstrates that the use of printed learning resources and discussion activities can effectively support an improved understanding of disaster mitigation concepts.

However, the results for the control group indicate that the improvement in conceptual understanding did not reach the same level as that of the experimental group. The mean posttest score for the control group was 71.67, which is lower than the 81.83 achieved by the experimental group. This difference suggests that, while conventional Problem-Based Learning (PBL) can enhance conceptual understanding, the support provided by media and information resources used during the inquiry process may be a contributing factor to the disparity in learning outcomes.

Effectiveness of a modified, digital media-based Problem-Based Learning (PBL) approach for understanding disaster mitigation concepts

The experimental group, which engaged in a modified, digital media-based Problem-Based Learning (PBL) approach, saw their average score increase from 48.58 to 81.83, with an N-Gain of 0.65. The mastery rate for this group reached 96.67%. These results indicate that digital media-supported PBL leads to a higher level of conceptual understanding compared to conventional PBL within the context of this study. In this research, digital media served not merely as a supplement to instruction but was integrated directly into the stages of the PBL process. Documentary videos were used to illustrate disaster events and orient students toward the problems at hand. Google Classroom and Google Docs facilitated the organization of activities and group work, while tools such as inaRISK Personal, DIBI BNPB, SiPongi+, and Google Earth served as sources of information during the inquiry phase.

During the development and presentation stages, students were given the opportunity to organize information and communicate their ideas using platforms like Canva, Padlet, and Google My Maps. Google Forms and Quizizz were also utilized to support evaluation. This integration enabled students to access information through various forms of representation, process data, and present their solutions to the problems. (Mayer, 2024) explains that the use of verbal and visual elements in instruction can support information processing, provided they are structured appropriately. In the context of disaster mitigation education, information presented through videos, maps, and digital data helps students form a more concrete understanding of the issues being studied. However, the value of these media lies not just in their visual presentation, but in the learning activities that guide students to comprehend, connect, and apply the information. These findings are also consistent with the work of (Fiorella, 2023), who highlights the importance of generative activities in learning. To build a solid understanding, students must engage in organizing,

explaining, and integrating information. In this study, the inquiry process—conducted via digital sources—and the subsequent development of solutions provided students with the opportunity to engage in such activities.

Differences in the effectiveness of conventional PBL versus digital media-based modified PBL

The research findings indicate that a modified, digital media-based Problem-Based Learning (PBL) approach yields higher achievement levels compared to conventional PBL. This is evidenced by differences in post-test averages, score improvements, mastery percentages, and N-Gain values. A Mann–Whitney U test revealed a significant difference in post-test results, while an ANCOVA analysis demonstrated that the impact of the instructional model remained significant even after controlling for students' prior ability. These findings are significant because both groups in the study followed the same PBL stages; the primary difference in the intervention lay in the media support and learning resources utilized during the instructional process. The experimental group had access to digital resources and interactive maps, whereas the control group relied on printed materials and conventional learning resources.

The use of digital media allows students to access information regarding disasters in a more diverse range of formats. Such information can support inquiry-based learning and help students connect disaster-related issues with specific regional conditions (Agustyarini et al., 2026; Anggraeni et al., 2025; Barnett-Itzhaki et al., 2023; Kuncorowati et al., 2025; Sulaeman et al., 2025). While printed materials still play a role in instruction, they are limited in their ability to present spatial information and dynamic data compared to the digital resources employed by the experimental group. These results align with the work of Abdullah and Ningrum (2024) on the application of PBL in the context of natural disaster mitigation, as well as the research of Bashori and Khotimah (2024) on the use of Google Earth for teaching hydrometeorological disaster mitigation. This study provides further evidence by comparing two groups that both implemented PBL but utilized different forms of media support.

Differences in improvement across the indicators of translation, interpretation, and extrapolation

The analysis based on specific indicators shows that the experimental group achieved higher N-Gain scores in the areas of translation, interpretation, and extrapolation. The most significant difference, however, was observed in the extrapolation indicator, where the experimental group attained an N-Gain of 0.70, compared to 0.39 for the control group. The translation indicator relates to students' ability to restate information they have acquired. The use of videos, images, and digital resources helps students identify information regarding types of disasters, regional conditions, and mitigation concepts. For this indicator, the experimental group achieved an N-Gain of 0.64, which is higher than the 0.45 recorded by the control group. Regarding the interpretation indicator, the experimental group achieved an N-Gain of 0.60, while the control group reached 0.52—a relatively smaller margin between the two groups. This suggests that activities such as discussions, reading information, and explaining the relationships between facts—which are part of conventional Problem-Based Learning (PBL)—can also help students develop their interpretation skills.

A more substantial difference was found in the extrapolation indicator. This skill requires students to estimate consequences or future scenarios based on information they have already understood. The use of digital maps and disaster-related information sources allows students to connect locations, potential hazards, and possible impacts. Students go beyond merely recognizing information; they use it to assess risks and formulate mitigation ideas. The superior performance in the extrapolation indicator demonstrates that integrating digital media into PBL makes a significant contribution when the learning process requires students to use information to anticipate situations. Consequently, the selection of instructional media should be aligned with the specific objectives and

indicators one aims to achieve. Digital media is most effective when used to support students in conducting investigations, interpreting data, and drawing conclusions based on evidence.

Implications of research for social studies instruction

The research findings imply that social studies instruction on the topic of disaster mitigation can be developed through the implementation of Problem-Based Learning (PBL) supported by digital media. Teachers can maintain the core stages of the PBL model while selecting digital media that aligns with the specific requirements of the subject matter and the capabilities of their students. The use of videos, digital maps, and disaster-related data can serve as an effective means to enrich investigative activities and help students better understand their environmental context. In practice, teachers must ensure that digital media is used in a purposeful and directed manner. Students require guidance on how to access information sources, interpret data, read maps, and connect the gathered information to the specific problems under study. Teacher supervision remains essential to ensure that the use of technology does not distract students from the intended learning objectives.

Challenges such as internet connectivity issues, the availability of devices, and varying levels of digital literacy must also be taken into account. Schools can prepare offline (non-digital) learning materials as an alternative, organize students into groups to share the use of available devices, and provide additional support to students who are not yet familiar with digital applications. In this way, the integration of digital media can be implemented more equitably and in a manner suited to the specific conditions of each school.

CONCLUSION

The findings demonstrate that both conventional problem-based learning (pbl) and digital media-based modified pbl contributed to improving students' understanding of disaster mitigation concepts. However, the improvement was greater among students who participated in digital media-based modified pbl. The average score in the experimental group increased from 48.58 to 81.83, with an n-gain of 0.65, while the control group increased from 47.67 to 71.67, with an n-gain of 0.46. Both n-gain values were classified as moderate. A notable finding was observed in the extrapolation indicator, where the experimental group achieved an n-gain of 0.70 compared with 0.39 in the control group. This indicates that integrating digital media into pbl particularly supported students' ability to estimate the possible consequences of disasters based on relevant information. The difference between the groups was also statistically significant, including after controlling for students' initial abilities.

The scientific contribution of this study lies in providing empirical evidence that the integration of digital media can strengthen the implementation of pbl in teaching disaster mitigation concepts. Both groups followed the same five stages of pbl, but the experimental group was supported by digital learning resources, including videos, digital maps, and disaster-related information. Therefore, the findings extend the discussion of pbl by showing that differences in learning resources can contribute to different levels of students' conceptual understanding, particularly in extrapolation. Digital media does not replace the essential stages of pbl; rather, it provides additional resources that help students access information, visualize disaster-related conditions, and develop a better understanding of potential risks. These findings support the use of technology-integrated learning as a complementary approach to contextual and problem-oriented social studies instruction.

Nevertheless, this study has several limitations that should be considered when interpreting the findings. First, the quasi-experimental design involved two existing classes at only one school, with 60 eighth-grade students, so the findings cannot be generalized to all school contexts. Second, the experimental and control groups were taught by different teachers, which may have introduced differences in teaching styles. Third, the intervention was conducted over a relatively short period, limiting the ability to assess students' long-term retention of the concepts. In addition, the use of the same questions in the pretest and posttest may have created a testing effect. Future research

should involve more schools and students from diverse geographical and educational backgrounds. Further studies should also consider using the same teacher or stronger procedures to control teacher-related differences, extending the intervention period, and using different assessment instruments. In particular, future research should examine long-term retention and students' practical disaster preparedness through activities such as evacuation simulations, rather than relying solely on conceptual understanding tests.

ACKNOWLEDGMENT

The author expresses gratitude to the principal, the social studies teacher, and the eighth-grade students of SMP Negeri 1 Banawa for their support and for providing the opportunity to conduct this research. Thanks are also extended to the academic supervisor and all those who assisted in the research process and the preparation of this article.

REFERENCECES

Abdullah, I., & Ningrum, E. (2024). The Influence of Problem Based Learning Models on Students' Critical Thinking Ability on Natural Disaster Mitigation Material. *Jurnal Ilmu Pendidikan (JIP) STKIP Kusuma Negara*, *15*(2), 159–169. https://doi.org/10.37640/jip.v15i2.1906

Adeoye, M. A. (2024). The Fruit of Deception: Untangling the Mystery of Adam's Choice in Genesis 3. *Interdisciplinary Journal of Social Sciences*, *1*(2), 79–93. https://doi.org/10.59373/ijoss.v1i2.73

Afirda, N., & Nasution, N. R. (2025). Integration of Da'wah Communication and Disaster Mitigation Through Disaster Monitoring. *Communicator: Journal of Communication*, *2*(2), 128–141. https://doi.org/10.59373/comm.v2i2.133

Agustyarini, Y., Ilmi, K., & Nurhayati, U. (2026). The Effect of RME Instruction on Fourth-Grade Madrasah Ibtidaiyah Students' Learning Outcomes in Plane Geometry. *Journal of Education and Learning Innovation*, *3*(2), 103–111. https://doi.org/10.59373/jelin.v3i2.369

Alam, D. W. S., Hilmi, M., & Thabrani, A. M. (2026). Integration of Religious Moderation and Ecological Education from a Social Ecology Perspective. *Attaqwa: Jurnal Ilmu Pendidikan Islam*, *22*(2), 179–195. https://doi.org/10.54069/attaqwa.v22i2.1158

Amalia, E. R. (2026). Religious Pluralism in Indonesia's National Curriculum: A Critical Review of Interfaith Religious Education. *Attaqwa: Jurnal Ilmu Pendidikan Islam*, *22*(2), 162–178. https://doi.org/10.54069/attaqwa.v22i2.1169

Amirulloh, M. I., Habiburrohman, H., & El-Yunusi, M. Y. M. (2025). Penerapan Problem Based Learning: Pendekatan Inovatif untuk Peningkatan Hasil Belajar di Kelas. *Ngaos: Jurnal Pendidikan Dan Pembelajaran*, *3*(1), 1–11. https://doi.org/10.59373/ngaos.v3i1.40

Andini, N. F., Putra, R. W., Aulia, I. R., & Enjellia, G. M. (2025). *Integrasi Elemen Pengurangan Risiko Bencana Dalam Pendidikan Geografi : Studi Pada Wilayah Sumatera Barat, Indonesia*. *1*(1).

Anggraeni, F., Salahudin, A., & Rohmah, S. K. (2025). Pembelajaran Matematika Aktif dan Menyenangkan: Implementasi Media Kartu Domino untuk Meningkatkan Hasil Belajar Siswa. *Journal of Education and Learning Innovation*, *2*(2), 112–123. https://doi.org/10.59373/jelin.v2i2.117

Anita, Y. (2025). *Tingkat Pemahaman Literasi Mitigasi Bencana Siswa Pada Pembelajaran*.

Assegaf, A. R., Khaulasari, H., Thohir, M., Ali, A., & Pangastuti, R. (2025). The Effectiveness of Peaceful Education Learning Strategies for Students at Emergency Madrasas Following Natural Disasters in Sidoarjo. *Jurnal Pendidikan Agama Islam*, *22*(1), 57–80. https://doi.org/10.14421/jpai.v22i1.8369

Asweni, D. F. N., Wabiser, Y. D., & Amsad, L. N. (2024). Analysis of the Needs for Developing Papua Context-Based Literacy Teaching Materials for ANBK Preparation: A Literature Review. *Interdisciplinary Journal of Social Sciences*, *1*(2), 87–94. https://doi.org/10.59373/ijoss.v1i2.86

Barnett-Itzhaki, Z., Beimel, D., & Tsoury, A. (2023). Using a Variety of Interactive Learning Methods to Improve Learning Effectiveness: Insights from AI Models Based on Teaching Surveys. *Online Learning*, *27*(3). https://doi.org/10.24059/olj.v27i3.3575

Darwati, I. M., & Purana, I. M. (2021). Problem Based Learning (PBL): Suatu Model Pembelajaran Untuk Mengembangkan Cara Berpikir Kritis Peserta Didik. *Widya Accarya*, *12*(1), 61–69. https://doi.org/10.46650/wa.12.1.1056.61-69

Ernawati, Y., Marianti, A., & Saptono, S. (2022). *The Improvement of Student's Critical Thinking Skills on Motion System Material through Using Digital Book based on Problem Based Learning*.

Fiorella, L. (2023). Making Sense of Generative Learning. *Educational Psychology Review*, *35*(2), 50. https://doi.org/10.1007/s10648-023-09769-7

Hakim, F., Syam, N., Ch, M., & Ibrahim, A. M. (2026). Intelligence in Islamic Education: Knowledge Integration or Ethical Alienation. *Attaqwa: Jurnal Ilmu Pendidikan Islam*, *22*(1), 111–127. https://doi.org/10.54069/attaqwa.v22i1.1149

Kuncorowati, P. W., Handayani, I. G. A. K. R., & Subekti, R. (2025). A learning model for law enforcement based on the justice value of Pancasila for equitable spatial planning. *Cakrawala Pendidikan*, *44*(1), 125–134. https://doi.org/10.21831/cp.v44i1.75957

Mahmud, S., Musfirah, A. R., Marlina, C. N., Fitria, S., Bujangga, H., Pranajaya, S. A., & Alfiyanto, A. (2024). Integrating Howard Gardner's Multiple Intelligences in Islamic Education: A Systematic Review of Indonesian Practices. *Jurnal Ilmiah Peuradeun*, *12*(3), 1017–1050. https://doi.org/10.26811/peuradeun.v12i3.1215

Mayer, R. E. (2024). The Past, Present, and Future of the Cognitive Theory of Multimedia Learning. *Educational Psychology Review*, *36*(1), 8. https://doi.org/10.1007/s10648-023-09842-1

Mumtahana, L., Rosyidah, C. N., Kausar, S., Khamim, N., & Syamsi, M. (2026). Teachers' Efforts to Implement Problem-Based Learning in Order to Improve Students' Collaboration and Communication Skills. *At-Tadzkir: Islamic Education Journal*, *5*(1), 101–113. https://doi.org/10.59373/attadzkir.v5i1.181

Nurhalisa, N., Rizal, R., Aqil, M., Lagandesa, Y. R., & Fasli, M. (2025). Pengaruh Model Problem Based Learning (PBL) dengan berbantuan Media Wordwall terhadap Hasil Belajar Siswa pada Mata Pelajaran Bahasa Indonesia. *Attadrib: Jurnal Pendidikan Guru Madrasah Ibtidaiyah*, *8*(1), 151–159. https://doi.org/10.54069/attadrib.v8i1.867

Rohidin, R., Syafi'ie, M., Heryansyah, D., Hadi, S., & Ali, M. (2023). Exclusive policy in guaranteeing freedom of religion and belief: A study on the existence of sharia-based local regulations in Indonesia and its problems. *Cogent Social Sciences*, *9*(1), 2202939. https://doi.org/10.1080/23311886.2023.2202939

Salim, M. A., & Aditya, R. B. (2025). Integration of Artificial Intelligence in Islamic Education: Trends, Methods, and Challenges in the Digital Era. *Journal of Modern Islamic Studies and Civilization*, *3*(01), 74–89. https://doi.org/10.59653/jmisc.v3i01.1368

Saryono, S., Nurkamto, J., Hidayatullah, M. F., & Komarudin, K. (2026). Teaching for preparedness: Indonesian physical education teachers' roles in the disaster education. *Jurnal Cakrawala Pendidikan*, *45*(1). https://doi.org/10.21831/cp.v45i1.86259

Septikasari, Z., Retnawati, H., Wilujeng, I., Shaw, R., & Handaka, I. B. (2024). Needs assessment: Strategy of integration disaster education at elementary schools in disaster prone areas. *Journal of Education and Learning (EduLearn)*, *18*(1), 244–252. https://doi.org/10.11591/edulearn.v18i1.20921

Sitepu, J. M., Laedi, S. H., Azizah, A., Asriani, A., & Sitepu, M. S. (2025). Implementation of Problem-Based Learning (PBL) Learning Model to Improve Learning Motivation of Class V Students. *Attadrib: Jurnal Pendidikan Guru Madrasah Ibtidaiyah*, *8*(2), 377–383. https://doi.org/10.54069/attadrib.v8i2.935

Sivra Tolandang. (2026). *Penerapan Model Problem Based Learning untuk Meningkatkan Hasil Belajar Matematika Siswa Kelas V SD Inpres Lemoh. Volume 5 Nomor 4 Tahun 2026*.

Sulaeman, S., Ahmad, A., & Ridwan, I. (2025). Integrating Fiqh al-Bi'ah into Project-Based Learning to Enhance Environmental Character in Islamic Higher Education. *Tafkir: Interdisciplinary Journal of Islamic Education*, *6*(4), 1009–1025. https://doi.org/10.31538/tijie.v6i4.2238

Surjati, E., & Ni'matullah, O. F. (2026). *Integrasi Google Earth dengan Model Pembelajaran Berbasis Proyek untuk Meningkatkan Literasi Spasial*.

Susanti, E., Isa, Y., & Pebriantika, L. (2026). Integrating Web-Based Interactive Multimedia and Problem-Based Learning to Support Social Studies Instruction in Junior High Schools. *Indonesian Technology and Education Journal*, 77–88. https://doi.org/10.61255/itej.v4i1.1057

Syahrani, S., & Purwono, A. (2024). Pengaruh Model Pembelajaran PBL Berbasis Computational Thingking terhadap Hasil Belajar Siswa pada Mata Pelajaran Bahasa Indonesia. *Academicus: Journal of Teaching and Learning*, *3*(2), 99–108. https://doi.org/10.59373/academicus.v3i2.64

Ulya, N. D., & Siswanto, J. (2024). Upaya Meningkatkan Hasil Belajar Matematika Melalui PBL Pada Peserta Didik Kelas 1 Sekolah Dasar. *Attadrib: Jurnal Pendidikan Guru Madrasah Ibtidaiyah*, *7*(2), 170–181. https://doi.org/10.54069/attadrib.v7i2.780

Wahyono, U., Kade, A., & Untara, K. A. A. (2022). The Implementation of Local Context Modules as an Effort for Disaster Risk Reduction (An Empirical Study in Disaster-Affected Schools). *Jurnal Pendidikan IPA Indonesia*, *11*(3), 363–370. https://doi.org/10.15294/jpii.v11i3.37399