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# Developing Disaster Mitigation and Metacognitive Knowledge of Elementary School Students through Problem Based Learning

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## Abstract

This study examines the development of disaster mitigation knowledge among elementary school students by categorizing students based on their metacognitive abilities. This study uses a treatment from the problem-based learning method in social studies learning with the theme of disaster mitigation. The purpose of this study is to identify differences in disaster mitigation knowledge between students who use the PBL method with high metacognition and students who use the PBL method with low metacognition. The research type used a quantitative method, with the research subjects being fifth-grade students at SDN 2 Sedayulawas Lamongan. The research instruments used pre-test and post-test questions on disaster mitigation knowledge, a metacognitive questionnaire, and teaching modules using the PBL method. The expected target of this research is the development of disaster mitigation knowledge and metacognitive skills among elementary school students. The results of the study showed that the PBL learning method influenced disaster mitigation knowledge with a Wilcoxon test significance of 0.000 and an average metacognitive score of 194.95, with 11 students having high metacognitive skills and 12 students having low metacognitive skills.

**Keywords:** PBL; Knowledge of Natural Disaster Mitigation; Metacognition; Elementary School Students

## Abstrak

Penelitian ini mengkaji tentang pengembangan pengetahuan mitigasi bencana siswa sekolah dasar dengan merngkatagorikan siswa berdasarakan kemampuan mertakognitifnya. Pernerlitan ini mernggunakan treratmernt dari mertoder problem baserd learning dalam pemberlajaran IPS dergan terma mitigasi berncana. Tujuan dari pernerlitan ini adalah untuk merngiderntifikasi perrberdaan perngertahuan mitigasi berncana antara siswa yang mernggunakan mertoder PBL dergan mertakognitif tinggi dan siswa yang mernggunakan mertoder PBL dergan mertakognitif rerndah. Jernis pernerlitan mernggunakan mertoder kuantitatif, subyerk pernerlitan yaitu siswa kelas 5 SDN 2 Serdayulawas Lamongan. Instrumern pernerlitan mernggunakan soal prer terst dan post terst perngertahuan mitigasi berncana, angkert mertakognitif dan modul ajar dergan mertoder PBL. Targert yang diharapakan pada pernerlitan ini adalah perngembangan perngertahuan mitigasi berncana dan mertakognitif siswa serkolah dasar. Hasil pernerlitan mertoder pemberlajaran PBL mernperngaruhi perngertahuan mitigasi berncana dergan signifikansi uji Wilcoxon serbersar 0,000 dan rata-rata mertakognitif siswa serbersar 194,95 dergan katergori 11 siswa mernpunyai mertakognitif tinggi dan 12 siswa mernpunyai mertakognitif rerndah.

**Kata Kunci:** PBL; Pengetahuan Mltigasi Bencana Alam; Metakogniti; Siswa Sekolah Dasar

## INTRODUCTION

Knowledge of natural disaster mitigation must be immediately taught to students who live in disaster-prone areas to reduce children's difficulties with disasters caused by limited understanding and lack of preparation to face disasters (Fidiana Kurniawati & Akderr Triyoga, 2024). Increasing knowledge of natural disaster mitigation can be done by providing understanding to students who live in areas prone to natural disasters regarding various types of disasters, the causes of disasters, how to understand the occurrence of disasters, and how to save oneself when natural disasters occur through learning in the classroom using appropriate and interesting learning techniques so that students can apply them (Nabila & Wahab Abdi, 2024). Planned mitigation requires students to develop problem-solving skills to address situations frequently encountered during natural disasters (Ferrbrianto et al., 2019).

Learning through the Problem-Based Learning (PBL) method can encourage students to explore their previous knowledge, enabling them to expand their knowledge and build stronger self-confidence, which can then be applied to enhance students' understanding of natural disaster mitigation (Putri et al., 2024). This approach also allows students to acquire important concepts and knowledge from the learning topic (Ayunda et al., 2023). Research findings show that knowledge of natural disaster mitigation supported by role-playing methods can improve students' knowledge of natural disaster mitigation (Widyarini & Handawati, 2024).

Students with strong metacognitive skills tend to be better able to manage and control their learning process. Students can identify difficulties in understanding the material, choose appropriate strategies to overcome these difficulties, and evaluate the effectiveness of the strategies used. This helps students become more effective and independent learners. (Perrtiwi et al., 2022) Meanwhile, metacognitive skills include the

ability to plan, monitor, and evaluate the learning process. (Zamzami & Zamzami, 2025)

Research conducted by Siti Khairani demonstrated that the use of the PBL model is effective in improving students' critical thinking skills (Khairani et al., 2020). Furthermore, Mardani's research demonstrated that the PBL model is also effective in improving student motivation and learning outcomes (N.K. Mardani et al., 2021). The high frequency of natural disasters in Indonesia has not been matched by an adequate understanding of mitigation among elementary school students, necessitating contextual and applicable learning innovations

Previous research has shown that the Problem-Based Learning (PBL) model is effective in improving student knowledge, critical thinking skills, motivation, and learning outcomes, including in the context of natural disaster mitigation. However, weaknesses in previous research lie in the limited integration of more contextual methods such as role-playing and the suboptimal implementation at the elementary school level.

Therefore, the purpose of this research is to develop and integrate the PBL model with a role-playing approach to strengthen students' understanding of disaster mitigation in a more active and meaningful way. The purpose of this research is to improve elementary school students' knowledge, skills, and awareness of natural disaster mitigation through the application of an innovative and participatory learning model.

## RESEARCH METHODS

The research method uses a quantitative method. This study uses a preliminary research design of the One Group pre-test post-test type. The research procedures are 1) problem formulation, 2) literature review, 3) creation of research instruments, 4) determining the subjects, population and sampler of the study, 5) data collection, 6) data analysis (Paner et al., 2022). The research subjects were 27 fifth-grade students of SDN 2 Serdayulawas Lamongan. The data collection instruments are 1) the social studies

learning module that has been validated by learning experts, 2) observation sheets and learning interviews, 3) pre-test and post-test questions on planned mitigation knowledge that have passed non-sample tests and are tested for validity, 4) MAI metacognitive questionnaires that have been validated. The expected results of this study are 1) producing planned mitigation knowledge, 2) learning innovation using the PBL method, 3) student metacognitive classification. Targeted achievement indicators are 1) well-developed planned mitigation knowledge, 2) PBL method innovation in learning. Data analysis techniques use normality tests, Wilcoxon tests and paired sampler t-tests. The Problem-Based Learning (PBL) learning model for developing knowledge of natural disaster mitigation is implemented in several structured stages over 4-6 meetings (each meeting lasting 70 minutes). Learning begins with a problem orientation, where the teacher presents real-life disaster cases such as floods, landslides, or forest fires through videos or images to stimulate students' curiosity. Next, students are divided into small groups to identify problems, ask questions, and explore prior knowledge regarding the causes and impacts of disasters. In the investigation stage, students seek information from various sources such as books, student worksheets, or the internet to find appropriate mitigation solutions. The results of the discussion are then compiled into posters, concept maps, or simple presentations presented to the class. Examples of activities include analyzing the causes of flooding in the surrounding environment, creating simple evacuation plans, and simulating actions to be taken before, during, and after a disaster occurs.

## RESULTS AND DISCUSSION

### Results

The first finding shows that the learning module developed for this study conforms to the syntax of the Problem-Based Learning (PBL) learning model. This learning model has been validated by experts. The following are the validation results of the learning module.

**Table 1.** PBL Learning Module Validation Results.

Aspect Evaluation	Presentation
Writing Format Assessment Indicators	80%
Content Assessment Indicators	77%
Language and Writing Assessment Indicators	80%

From Table 1 above, it can be concluded that the learning module with the Problem Based Learning (PBL) model is feasible and can be used in learning. The reliability test of the pre-test and post-test questions is presented in Tables 2, 3, and 4.

**Table 2.** Results of the Reliability Test of the Pre-Test Mitigation Plan Questions

Cronbach's Alpha	N of Items
0.758	16

**Table 3.** Results of the Post-Test Reliability Test

Cronbach's Alpha	N of Items
0.763	16

**Table 4.** Mertacognitive Angkert Reliability Test Results

Cronbach's Alpha	N of Items
0,945	52

Based on Table 2, the results of the multiple-choice pre-test reliability test showed a Cronbach's alpha value of 0.758. Meanwhile, in Table 3, the post-test essay questions had a Cronbach's alpha value of 0.763. Table 4 showed a Cronbach's alpha value of 0.945. These values indicate that the questions and questionnaires used had a very high level of reliability. This means that the questions can be trusted for use in collecting data. In addition, students' knowledge of natural disaster mitigation also increased. During the pre-test, the average value obtained was 40.1. After the learning, the average score on the post-test increased to 71.2. This shows that most students experienced a significant increase in their knowledge of natural disaster mitigation. The results of the cognitive-student questionnaire in social studies learning

using PBL obtained an average cognitive-student score of 194.95, with 11 students categorized as having high cognitive-student scores and 12 students categorized as having low cognitive-student scores. The data can be seen through the following table 5.

**Table 5.** Results of Students' Mitigation and Metacognitive Knowledge

Student No	Pre test Mitigation	PostTest Mitigation	Metakognitive	Metacognitive Category
1	28	48	115	Low
2	60	70	210	High
3	46	78	231	High
4	43	85	189	Low
5	23	70	200	High
6	55	80	172	Low
7	35	52	230	High
8	45	77	204	High
9	36	82	178	Low
10	40	48	196	High
11	45	83	186	Low
12	40	85	187	Low
13	43	70	183	Low
14	36	80	175	Low
15	42	85	210	High
16	52	85	184	Low
17	43	73	189	Low
18	33	83	197	High
19	27	32	180	Low
20	33	42	179	Low
21	36	90	227	High
22	42	73	219	High
23	40	68	243	High

Next are the normality results presented in Table 6.

**Table 6.** Normality Test Results

	Test of Normality					
	Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pretest	0.119	23	0.200	0.974	23	0.788
Posttest	0.208	23	0.011	0.853	23	0.003

a. Lilliefors Significance Correction

In Table 6, the results of the normality test show that the pre-test data has a significance value of  $0.788 > 0.05$ . This means that the pre-test data is normally distributed. However, the post-test data has a significance value of  $0.003 < 0.05$ , so the post-test data is considered not normally distributed. Thus, overall, the data in this study is considered not normally distributed. Therefore, the Wilcoxon test is used to test the hypothesis. The results of the Wilcoxon test are shown in Table 7. From the results, it is known that the Z value is -4.198 with a significance value of 0.000. Because the significance value is smaller than 0.05, it can be concluded that there is a significant influence of the Problem Based Learning learning model on students' knowledge of natural disaster mitigation.

**Table 7.** Wilcoxon Test Results

Test Statistics <sup>a</sup>	
Posttest - Posttest	
Z	-4.198 <sup>b</sup>
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test; b. Based on negative ranks

The learning process in this study was designed to improve students' understanding of natural disaster mitigation through the application of the Problem-Based Learning (PBL) model. The learning process utilized the cognitive domains of analysis (C4) and evaluation (C5), aiming to enable students to identify types of disasters, analyze their causes and impacts, and evaluate and select appropriate mitigation measures. This domain aligns with the needs of mitigation learning, which requires students not only to understand the theory but also to understand the actions that must be taken in the face of natural disasters (Ratnawati et al., 2023; Yuniar et al., 2022).

In addition, cause-and-effect analysis is conducted during the learning process to help students understand the relationship between disaster-causing factors and their impacts, enabling them to think critically and systematically. School contextual factors such as environmental conditions, student experience

with disasters, and the availability of infrastructure also play a role. influence the success of implementing the PBL model in learning. Therefore, teachers need to adapt learning scenarios to school characteristics and student backgrounds to make learning more relevant and meaningful. This study has limitations, including the relatively short implementation time, which does not fully reflect long-term changes in student knowledge. Furthermore, limited access to learning resources and variations in student abilities are also factors that can influence the research results. The practical implications of this study indicate that implementing the PBL model can be an effective alternative learning strategy to improve disaster mitigation knowledge while simultaneously training students' critical thinking and decision-making skills in real-life situations. (Surtikawati et al., 2022)

The increase in knowledge of natural disaster mitigation is also significantly influenced by the learning method used. The PBL model is considered effective because it presents real-life problems related to students' lives, particularly in the context of natural disasters that frequently occur in the surrounding environment. This model makes students more active in gathering information, discussing, and formulating solutions to the problems presented. Thus, students' knowledge of disaster mitigation becomes deeper, more relevant, and easier to apply in everyday life (Nirwana et al., 2024; SALSABILA & MUQOWIM, 2024). Furthermore, learning with the PBL model also makes the learning atmosphere more enjoyable and meaningful, thus helping students to better understand and remember important steps in dealing with natural disasters. Through the implementation of the PBL model in science subjects, students not only learn theoretically, but also experience a real and contextual learning process (Izzania et al., 2020; N.K. Mardani et al., 2021; Widyarini & Handawati, 2024).

The effectiveness of a learning model can be measured by how much influence it has on improving students' understanding and

engagement in the learning process. In this context, the Problem-Based Learning (PBL) model shows high effectiveness in improving students' knowledge regarding natural disaster mitigation. Based on research results, the application of the PBL model encourages students to be more active in exploring information, understanding concepts, and applying the knowledge obtained through solving real problems that are relevant to their daily lives (Nirwana et al., 2024; Yuniar et al., 2022). Throughout the learning process, students showed high enthusiasm and active involvement in observing, discussing, and answering questions related to disaster mitigation. They seemed more interested in following the lesson because the material was presented through real problems relevant to everyday life. This shows that the use of the PBL model supported by contextual learning media is very helpful in increasing students' knowledge about natural disaster mitigation (Salsabila & Muqowim, 2024; Widyarini & Handawati, 2024).

Knowledge of natural disaster mitigation must be immediately taught to students who live in disaster-prone areas to reduce children's vulnerability to disasters caused by limited understanding and lack of preparation to face disasters. Increasing knowledge of natural disaster mitigation can be done by providing understanding to students who live in disaster-prone areas about various types of disasters, the causes of disasters, how to prevent disasters, and how to save themselves when natural disasters occur through classroom learning using appropriate and interesting learning techniques so that students can apply them to their daily lives. Mitigation planning requires students to have problem-solving skills to overcome situations they are experiencing when natural disasters occur. This is in accordance with the development of the times in learning in the 21st century where students are required to have problem-solving skills. In the 21st century, learning does not only rely on knowledge but also skills. 21st-century educational skills include critical thinking skills, problem-solving skills, metacognition, communication, collaboration,

and innovation. (Indra Himayatul Asri, 2023) This reflects that students are not only able to understand the material, but also can connect it to the planned situations that may occur in their environment. The PBL model provides space for students to understand various types of planning, analyze the causes and impacts, and determine appropriate and relevant mitigation steps (Ratnawati et al., 2023; SALSABILA & MUQOWIM, 2024). Furthermore, this is proven by the results of the Wilcoxon test which shows a significance value of  $0.000 < 0.05$ . This means there is a significant correlation between the implementation of the PBL model and improving students' knowledge of natural disaster mitigation (Nirwana et al., 2024; Yuniar et al., 2022).

Learning is no longer solely teacher-centered, but rather directs students to be more active in understanding the types of disasters, their causes, impacts, and mitigation steps that must be taken. With a contextual approach relevant to everyday life, students become more aware of the importance of disaster preparedness and are able to design actions to be taken before, during, and after a disaster occurs (Mahulaer, 2024; Widyarini & Handawati, 2024).

## CONCLUSION AND SUGGESTIONS

### Conclusion

The integration of the Problem-Based Learning (PBL) model has proven effective in improving elementary school students' knowledge of natural disaster mitigation. This model encourages active student engagement through problem identification, information exploration, and problem-solving within real-world contexts relevant to their lives. The study showed a significant increase in post-test scores, indicating that PBL positively impacts student understanding. Furthermore, this approach contributes to the development of more contextual and real-life pedagogical strategies, enabling students to become more aware, responsive, and prepared to face disaster situations.

### Suggestions

It is recommended that further research be conducted over a longer period of time and involving a wider sample to obtain a more comprehensive picture of the effectiveness of PBL in various school contexts. Furthermore, future research could examine the influence of PBL on other aspects such as critical thinking skills, collaboration, and disaster preparedness attitudes. In curriculum development, the PBL model can be systematically integrated into science and natural sciences learning by adapting disaster mitigation materials that are contextual and relevant to the students' environment. Teachers also need to be trained to design and implement problem-based learning optimally. Thus, the application of PBL not only increases knowledge but also shapes students' character to be adaptive and responsive to disaster risks.

## REFERENCES

- Ayunda, S. N., Lufri, L., & Alberida, H. (2023). Pengaruh Model Pembelajaran Problem Based Learning (PBL) Berbantuan LKPD terhadap Kemampuan Berpikir Kritis Peserta Didik. *Journal on Education*, 5(2), 5000–5015. <https://doi.org/10.31004/joe.v5i2.1232>
- Febrianto, E., Hidayati, Y., Puspitahadi, W., Ipa, P., Keguruan, F., Trunojoyo, U., Febrianto, E., Febrianto, E., Jurnal, J., Pendidikan, P., & No, V. (2019). *MODEL SAINS TERPADU BERBASIS MITIGASI BENCANA*. 4(2), 89–95.
- Fidiana Kurniawati, & Akde Triyoga. (2024). Optimalisasi Pemberdayaan Anak Usia Sekolah Dalam Mitigasi Bencana. *Indonesian Health Literacy Journal*, 1(3), 115–121. <https://doi.org/10.70574/04hf7c37>
- Indra Himayatul Asri, I. W. L. I. G. P. S. (2023). Kompetensi Abad 21 Sebagai Bekal Menghadapi Tantangan Masa Depan. *Kappa Journal Program Studi Pendidikan Fisika FMIPA Universitas Hamzanwadi*, 7(1). <http://e-journal.hamzanwadi.ac.id/index.php/kpj/index>
- Izzania, R. D. S. M., Winarni, E. W., & Agusdianita, N. (2020). Pengaruh Penggunaan Model

- Problem Based Learning pada Materi Siaga Bencana terhadap Kemampuan Literasi Sains Siswa Kelas IV SD Negeri Kota Bengkulu. *Juridikdas Jurnal Riset Pendidikan Dasar*, 3(3), 381–390.
- Khairani, S., Suyanti, R. D., & Saragi, D. (2020). The Influence of Problem Based Learning (PBL) Model Collaborative and Learning Motivation Based on Students' Critical Thinking Ability Science Subjects in Class V State Elementary School 105390 Island Image. *Budapest International Research and Critics in Linguistics and Education (BirLE) Journal*, 3(3), 1581–1590. <https://doi.org/10.33258/birle.v3i3.1247>
- Mahulae, P. S. (2024). Implementation of problem based learning model to improve students' understanding of reforestation and disaster mitigation. *Cendikia : Media Jurnal Ilmiah Pendidikan*, 14(4), 406–411. <https://doi.org/10.35335/cendikia.v14i4.4917>
- Nabila, N., & Wahab Abdi, A. (2024). Sosialisasi Kebencanaan Sebagai Peningkatan Pengetahuan Mitigasi Bencana Siswa Smp Negeri 16 Banda Aceh. *Jurnal Pendidikan Geosfer*, IX, 132–145. <https://doi.org/10.24815/jpg.v9i1.28681>
- Nirwana, S., Azizah, M., & Hartati, H. (2024). Analisis Penerapan Problem Based Learning berbantu Quizizz pada Pembelajaran IPAS Kelas V Sekolah Dasar. *Jurnal Inovasi, Evaluasi Dan Pengembangan Pembelajaran (JIEPP)*, 4(1), 155–164. <https://doi.org/10.54371/jiepp.v4i1.396>
- N.K. Mardani, N.B. Atmadja, & I.N.Suastika. (2021). Pengaruh Model Pembelajaran Problem Based Learning (Pbl) Terhadap Motivasi Dan Hasil Belajar Ips. *Jurnal Pendidikan IPS Indonesia*, 5(1), 55–65. <https://doi.org/10.23887/pips.v5i1.272>
- Pane, I., Hadju, V. A., Maghfiroh, L., & Hairil, A. (2022). Desain Penelitian Mixed Method. In N. Saputra (Ed.), *Desain Penelitian Mixed Method* (1st ed., Vol. 1). Yayasan Penerbit Muhammad Zaini Anggota IKAPI (026/DIA/2021).
- Pertiwi, P. D., Pujiastuti, H., & Fathurohman, M. (2022). Implementasi Pendekatan Metakognitif dalam Pembelajaran Matematika: Systematic Literature Review. *EDUKATIF : JURNAL ILMU PENDIDIKAN*, 4(6), 7904–7918. <https://doi.org/10.31004/edukatif.v4i6.4285>
- Putri, W., Leuwol, F. S., & Lasaiba, M. A. (2024). Peningkatan Pemahaman Mitigasi Bencana Peserta Didik Melalui PBL. 3, 85–98. <https://doi.org/10.30598/geoforumvol3iss2pp85-98>
- Ratnawati, E., Setyasih, I., & Sandy, A. T. (2023). Tingkat pengetahuan mitigasi bencana dalam menghadapi ancaman banjir siswa kelas XII IPS SMA Negeri di Kota Samarinda. *Geography Science Education Journal (GEOSEE)*, 4(2), 73–80.
- SALSABILA, Y. R., & MUQOWIM, M. (2024). Korelasi Antara Teori Belajar Konstruktivisme Lev Vygotsky Dengan Model Pembelajaran Problem Based Learning (Pbl). *LEARNING : Jurnal Inovasi Penelitian Pendidikan Dan Pembelajaran*, 4(3), 813–827. <https://doi.org/10.51878/learning.v4i3.3185>
- Surtikawati, E., Desstyia, A., Fathoni, A., & Pendidikan, M. (2022). Efektivitas Model Pembelajaran Problem Based Learning (Pbl) Dalam Meningkatkan Hasil Belajar Tematik Di Kelas Vi Sd N 2 Girimarto. *ELSE (Elementary School Education Journal) Jurnal Pendidikan Dan Pembelajaran Sekolah Dasar*, 6.
- Widyarini, S., & Handawati, R. (2024). Peningkatan Pengetahuan Mitigasi Bencana Banjir dengan Bermain Peran pada Siswa SDN Bidaracina 05 Kelurahan Bidara Cina. 12(2), 218–226.
- Yuniar, R., Nurhasanah, A., Rahman Hakim, Z., & Asih Vivi Yandari, I. (2022). Peran Guru Dalam Pelaksanaan Model Pbl (Problem Based Learning) Sebagai Penguatan Keterampilan Berpikir Kritis. *Pendas : Jurnal Ilmiah Pendidikan Dasar*, 7(2), 1134–1150. <https://doi.org/10.23969/jp.v7i2.6408>
- Zamzami, M. A., & Zamzami, M. R. A. (2025). Peran Strategi Metakognitif Dalam Meningkatkan

Pemahaman Materi Pembelajaran Pada Siswa Sekolah Dasar. *Primary Education Journals (Jurnal Ke-SD-An)*, 5(1), 415–421. <https://doi.org/10.36636/primed.v5i1.6747>