

Effectiveness of Using LSE (Landslide Education) Mobile Digital Platform to Measure Knowledge of Senior High School Students

Alifa Ambar Sari¹, Juhadi^{2*}, Heri Tjahjono³, Dewi Liesnoor Setyowati⁴, Pradika Adi Wijayanto⁵

^{1,2,3,4,5}Universitas Negeri Semarang, Indonesia

*e-mail: juhadigeo@mail.unnes.ac.id

ABSTRACT

Smartphone-based media that is increasingly sophisticated has the potential to be used in learning to be effective. This study aims to measure the effectiveness of the LSE (Landslide Education) application to increase knowledge about landslide disasters among high school students. This quantitative descriptive study uses a pre-experimental design with a one-shot case study model. The research subjects used a purposive sample of 141 students from grades XII F 7- XII F of SMA Negeri 12 Semarang. Data collection used post-test data test techniques, while non-test techniques were through observation, questionnaires, and documentation. Based on the results of the study, the average knowledge of the parameters of landslide disaster, knowledge of the distribution of landslide-prone areas in Semarang City, knowledge through education, local wisdom, and use of technology is 87. Hence, it is very good, while the average result of the student perception questionnaire using the LSE (Landslide Education) application is 83, so it is included in the good category. Based on these results, using the LSE (Landslide Education) application effectively increases Senior High School 12 Semarang disaster knowledge.

Keywords:

Mobile Applications; Disaster Mitigation; Landslides; Landslide Education.

ABSTRAK

Media berbasis smartphone yang semakin canggih memiliki potensi untuk digunakan dalam pembelajaran agar efektif. Penelitian ini bertujuan untuk mengukur efektivitas aplikasi LSE (Landslide Education) untuk meningkatkan pengetahuan tentang bencana tanah longsor pada siswa SMA. Penelitian ini merupakan penelitian deskriptif kuantitatif dengan

menggunakan rancangan pre-eksperimental dengan model studi kasus one-shot. Subjek penelitian menggunakan sampel purposive sebanyak 141 siswa dari kelas XII F 7- XII F SMA Negeri 12 Semarang. Pengumpulan data menggunakan teknik tes data post-test, sedangkan teknik non-tes melalui observasi, angket, dan dokumentasi. berdasarkan hasil penelitian, rata-rata pengetahuan dari parameter pengetahuan bencana tanah longsor, pengetahuan tentang sebaran daerah rawan tanah longsor di Kota Semarang, Pengetahuan melalui edukasi, kearifan lokal, dan pemanfaatan teknologi adalah 87 sehingga sangat baik sedangkan rata-rata hasil angket persepsi siswa menggunakan aplikasi LSE (Landslide Education) adalah 83 sehingga termasuk dalam kategori baik. Berdasarkan hasil tersebut, penggunaan aplikasi LSE (Landslide Education) efektif dalam meningkatkan pengetahuan kebencanaan di SMA Negeri 12 Semarang.

Kata kunci:

Aplikasi Mobile; Mitigasi Bencana; Tanah longsor; Pendidikan Longsor.

1. Introduction

Education is a fundamental factor in determining a country's future. Education is a weapon humans use to improve the quality of human resources in national development. The quality of human resources can be assessed from the plan and implementation of education used nationally in schools (Rizaldi, 2021), education also requires mature learning planning (Abdulayeva, 2024; Farhang, Hashemi, & Ghorianfar, 2023), learning planning will make the results effective and efficient (Marinho et al., 2024; Serbes & Albay, 2017; Souza, Ivanir, Sousa, & Silva, 2024). Based on this, it is very important that learning is planned as much as possible so that it is optimal and in accordance with the objectives. Learning objectives need to be emphasized and designed to be successful according to the objectives. Learning objectives are a place for students to demonstrate behavior or competencies that change as a result of involvement in activities, and activities must support learning objectives (Andriani, Fadly, & Khawa, 2021). Tujuan pembelajaran harus relevan dan terukur (Harden, 2002), there is alignment of goals, learning activities, and assessments to form student competencies (Hristov, Nakov, & Miočinović, 2023; Sewagegn, 2020). The conclusion is that learning objectives need alignment between objectives and activities and require assessment so that student competencies can be seen.

Disaster mitigation education must be included in the school curriculum to prepare a disaster-resilient Indonesian society. This is reinforced by (Kastolani & Mainaki, 2018) the fact that disaster education is important for students. Besides that, it needs to start from elementary school (Suarmika, Arnyana, Suastra, & Margunayasa, 2022), disaster education can increase mitigation knowledge (Indra, Adiandari, Herlambang, & Kartika, 2023). A potential subject in disaster education in Indonesia is geography. Geography learning is a factor that can support the quality of education in Indonesia. Geography education that can be used as a supporting factor is in the material of natural

disaster mitigation. This is supported by (Kurniawan, Saipiatuddin, & Hidayat, 2025) Geography is the main subject for integrating disaster risk reduction education in schools. Geography is a core subject for the integration of disaster risk reduction education in schools (Gong, Duan, & Guo, 2021), Disaster education strengthens understanding of risk and mitigation planning based on location and topography. (John, Gustavo, & Rakuasa, 2023).

The government has regulated disaster education, which is included in the curriculum. Natural disaster mitigation is a material taught in class XII in senior high school (Rizaldi, 2022). The importance of disaster issues in Indonesia encourages the provision of disaster mitigation learning into the education system. Based on this, in addition to emphasizing improving students' quality, education's objectives are regulated so that each subject has general and specific objectives as provisions for life in responding to present and future challenges. Geography education has unique characteristics in its approach so that students understand and apply it in one of the scientific studies related to disasters. Government regulations reinforce the importance of disaster-related learning. (Permendikbud, 2016) These regulations based on Minister of Education and Culture Regulation Number 24 of 2016, at the senior high school level, disaster mitigation material is included as material in the geography subject, namely basic competency 3.7 (analyzing types and mitigation of natural disasters through education, local wisdom, and utilization of modern technology) (Wiluyana, Sanjoto, & Sidiq, 2024). However, in its implementation, there are still some obstacles. The program for organizing disaster-safe education units is listed in Minister of Education and Culture Regulation Number 33 of 2019. This program, namely the Disaster Safe Education Unit Program or abbreviated as the SPAB Program, is an effort to prevent and overcome disasters in educational units (Permendikbud, 2019) based on these regulations, it is expected that disaster education will be emphasized and organized at the school level with relevant programs as support, so that it is not only integrated into learning materials to be more optimal. Disaster preparedness is very important in disaster risk reduction efforts. This effort is supported by disaster mitigation knowledge and skills to realize disaster awareness (Ayub, Kosim, Gunada, & Utari, 2021).

Semarang City is an area prone to disasters, including landslides. Geologically, Semarang City has two topographies, namely lowlands and high hills. The lowlands of Semarang City are better known as the city center, while the high hills are known as the upper city. Landslides most often occur in high hills or the upper part of the city because the land is wavy and hilly with a landslide slope of up to 15-45% (Tjahjono, Trihatmoko, Hanafi, & Findayani, 2022). Based on the landslide hazard map from the Central Java Regional Disaster Management Agency, one of the areas with a high level of vulnerability is Gunungpati, Semarang (Abu Bakar & Mohamad, 2023). Highlands with unstable soil conditions dominate Mount Pati and are prone to landslides. This landslide disaster greatly affects the running of the education system. Landslide disasters are unavoidable, but that does not mean that steps cannot be taken to reduce the dangers of the disaster.

Efforts to control the impact of landslide disasters in the senior high school environment are important because senior high schools are the producers of the nation's next generation, which affects the nation's sustainability and future. Students living in areas prone to landslide disasters must receive

landslide disaster preparedness education. According Shi et al. (2023), as a country that is very prone to landslides, Indonesia must realize the importance of dealing with landslide disasters, starting from how to mitigate landslide disasters, and this requires the involvement of schools in introducing landslide disaster mitigation education. Implementing education on landslide disaster preparedness in senior high school needs to be done early on to provide in-depth knowledge and readiness for actions that need to be taken before, during, and after a disaster occurs. Thus, there is the ability to think and act effectively when a disaster occurs (Turan & Oral, 2023). Based on research Assidiqi, Juhadi, & Banowati (2023) with the title "Efforts to Increase Disaster Knowledge through the LANDIE (Landslide Disaster Education) Application Prototype," that landslide disaster learning through applications is suitable for use as a medium in disaster training, and the LANDIE application is declared effective in increasing knowledge about landslide disasters.

Providing intensive landslide disaster preparedness education by including it in the subject schedule can increase students' knowledge regarding the importance of landslide disaster preparedness by using effective media that is easy for students to carry. For example, an Android application that contains information about landslide disaster mitigation. Learning media that uses audiovisuals, especially animation, is more effective in increasing students' knowledge than providing learning materials using visual or audio media alone (Opabola et al., 2023). This study aims to measure the effectiveness of the LSE Mobile application to increase knowledge about landslide disasters among senior high school students Senior High School 12 Semarang is located in Gunung Pati District, a landslide-prone area in Semarang.

The author's observations on students in grades XII F 7 to XII F 10 at Senior High School 12 Semarang through students filling out a Google form with 10 questions about how landslide disasters are taught in schools, and getting information that the teaching materials used by geography teachers are textbooks from the government. Although no students have ever been victims of landslides, disaster-related knowledge must still be provided. Because every human being experiences mobility, with early knowledge through senior high school, students are expected to be able to carry out mitigation wherever they are. The design of the LSE Mobile (Landslide Education) application is expected to be effective for landslide disaster mitigation. The objectives of this study are 1) To discover knowledge about landslide disasters; 2) To design the application; 3) To test the acceptability of the application to students; 4) To analyze the effectiveness of implementing mitigation learning. This study hopes to increase knowledge about landslide disasters in the community.

2. Methods

2.1 Research Design

This study uses a pre-experimental research design with a one-shot case study research design model. This design provides one-time treatment to the research subjects, then a post-test on implementing the LSE Mobile application. This research design does not use a control group as a comparison. This study uses a quantitative descriptive approach.

2.2 Population and sample

The population in this study was 141 students of class XII F 7 and XII F 10 of Senior High School 12, Semarang. These students receive geography subjects and disaster material from classes XI to XII. These students live in Gunungpati District, Semarang. The type of sampling used purposive sample. Samples were taken by looking at 1) classes that received geography lessons; 2) able to operate smartphones well; and 3) samples from classes that had received disaster material from class XI. The total number of research samples was 141 students.

2.3 Data collection

Data collection uses data test techniques, post tests knowing knowledge about landslide disaster, observation to find out students' learning activities & questionnaires perception of LSE usage for students, and documentation.

2.4 Data Analysis

Data analysis techniques use average, median, minimum score, maximum score, and observations to determine students' learning activities, questionnaire perception using percentage descriptions, and then interpreted using the specified criteria table arranged based on percentage. Media experts and geography teachers validated the developed media. Based on the validation results, it was declared suitable for use.

3. Results and Discussion

3.1 Knowing Knowledge About Landslide Disaster

The results of students' knowledge scores in answering all questions from the three materials can be seen in Table 1 below.

Table 1. Student Knowledge Score Data

Descriptive Analysis	Material 1	Material 2	Material 3
Average	72	94	95
Median	70	60	60
Minimum Score	30	60	60
Maximum Score	100	80	80

From Table 1, it can be seen that the average knowledge of students about landslide disasters in material 1 with a score of 72, in material 2 obtained a score of 94, and in material 3 obtained a score of 95. This happens because students are increasingly familiar with how the application works, so that students in answering questions on materials two and three have prepared a strategy to answer well. Some make small notes, some memorize the material, and some press the pause button when answering questions to avoid the second count, which results in repeating the answer from the beginning. Students' psychomotor abilities are also increasingly trained by realizing how the application works.

3.2 Application design draft

3.2.1 Needs Analysis

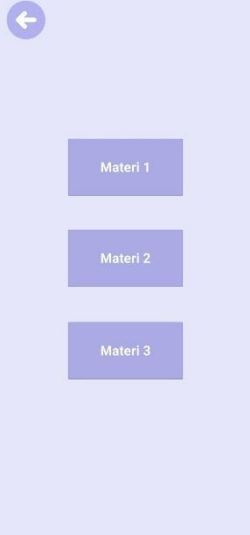
The first step taken is decomposition. The problem is that students are in Gunung Pati District, a landslide-prone area. The main problem is broken down into several parts: 1) awareness of the area where they live that is prone to landslides; 2) how to mitigate; and 3) local wisdom developing in the community. The second step is pattern recognition. All samples agree that disaster learning is carried out through application media (Herman et al., 2023)

The third step is abstraction. The implementation of learning assisted by applications that are compiled based on needs analysis. This application is based on 1) being easy to understand, access, and operate by students; and 2) educating. The fourth step is the algorithm. Designing the features used 1) introduction of disasters, causative factors, characteristics, and effects of landslides; 2) landslide vulnerability distribution maps; 3) knowledge of mitigation and its implementation; 4) addition of landslide disaster mitigation knowledge with local wisdom in Indonesia.

3.2.2 Design Plan

Based on the needs analysis, the application design is then prepared with the help of programming languages such as HTML, JavaScript, PHP, and C#. The following is the LSE Mobile application design presented in Table 2:

Table 2. LSE Mobile Application Design Plan

Feature	Screen
Distribution of materials	

Landslide knowledge, mitigation, and local wisdom knowledge



Practice questions from the material



Source: Research Data Processing 2024

3.3 Application Acceptability to Students

Student acceptance questionnaire with the LSE (Landslide Education) Mobile application via Google Form, and the results are in Table 3:

Table 3. Application Acceptability Questionnaire

No	Question	Answer
----	----------	--------

1	This LSE mobile motivated me to study landslide disaster material	Agree: 55.6% Strongly agree: 44.4%
2	For me, landslide disasters are important to know about.	Agree: 41.1% Strongly agree: 58.9%
3	I prefer disaster material explained in this way	Agree: 57.8% Strongly agree: 30% Disagree: 11.1% Strongly disagree: 1.1%
4	The contents of the LSE mobile are interesting to read	Agree: 61.1% Strongly agree: 36.7% Disagree: 2.2%
5	This LSE mobile has an attractive layout and is easy to read.	Agree: 61.1% Strongly agree: 34.4% Disagree: 4.4%
6	This LSE mobile helped me answer questions that I had been asking myself.	Agree: 71.1% Strongly agree: 23.3% Disagree: 5.6%
7	This landslide disaster material is related to everyday life.	Agree: 63.3% Strongly agree: 34.4% Disagree: 2.2%
8	This LSE mobile is presented according to my ability level.	Agree: 67.8% Strongly agree: 31.1% Disagree: 1.1%
9	This LSE mobile is my facility to find out about landslides	Agree: 64.4% Strongly agree: 33.3% Disagree: 2.2%
10	This LSE mobile will be one of my learning resources, and I will propose it to the government.	Agree: 63.3% Strongly agree: 26.7% Disagree: 8.9% Strongly disagree: 1.1%

The following is a classification of student acceptance level analysis.

Score	Classification
80-100	Very Accepting
66-79	Accept
56-65	Just Accept
40-55	Do not accept
0 - 39	Very Unacceptable

From the table above, all questions are cumulated using a Likert scale:

$$\boxed{TPn}$$

Information:

T: Total Number of Respondents Who Chose

Pn: Likert Score Number Choice

$$141 (44.4\% + 58.9\% + 30\% + 36.7\% + 34.4\% + 23.3\% + 34.4\% + 31.1\% + 33.3\% + 26.7\%) + (55.6\% + 41.1\% + 57.8\% + 61.1\% + 61.1\% + 71.1\% + 63.3\% + 67.8\% + 64.4\% + 63.3\%) + (11.1\% + 2.2\% + 4.4\% + 5.6\% + 2.2\% + 8.9\%) + (1.1\% + 1.1\%) \times$$

$$\begin{aligned} &= 141 (35\% + 60\% + 5\% + 0\%) \times \\ &= 83 \end{aligned}$$

From the results of the questionnaire assessment of student acceptance of the presence of the LSE Mobile application, calculated using the Likert scale formula, the result was 83, so the level of student acceptance of the presence of the LSE Mobile application is very acceptable.

3.4 Effectiveness of Implementation of Mitigation Learning on Landslide Disasters

Final knowledge about pre-disaster, during, and post-disaster, as well as local wisdom in disaster mitigation, is good, while knowledge about disaster recognition is good. More details are presented in Table 4.

Table 4. Results of The Questionnaire on The Effectiveness of Students' Knowledge About Landslide Disasters

Parameter	Average
Landslide disaster knowledge	72
Knowledge of the distribution of landslide-prone areas in Semarang City	94
Knowledge through education, local wisdom, and the use of technology	95
Average of all parameters	87

Source: Research Data Processing 2024

The educational experience gained by the research sample during training also provided awareness of the importance of useful knowledge in the future because the context and content presented influenced the process of delivering information that led to learning outcomes.



Picture 1. Implementation of learning

3.5 Discussion

The development of applications in disaster education is specifically designed to facilitate students in landslide disaster material with content that is adjusted to the environmental conditions around Semarang. Disaster education is an early prevention effort, expected to minimize material and non-material losses when disasters occur. This development is relevant based on (Aliperti & Cruz, 2020; Syukron, Madugalla, Shahin, & Grundy, 2024; Tan et al., 2020), that disaster apps are broadly classified into two categories: general-purpose apps and built for purpose apps. Creating a specialized application can be beneficial as users can focus on learning about landslide disaster materials, while developers can include relevant and creative content to achieve the intended goals. The development of mobile applications that focus on disaster preparedness plays an important role for students. According to (Hayati, Wirda, Mauvidar, & Darliani, 2024; Rany, Kuswanto, & Abdillah, 2020), knowledge of disaster preparedness and mitigation plays a role in reducing high risks due to the impact of disasters, so it needs to be taught early on. According to (Gargiulo, Russo, Gugg, Amoroso, & Capuano, 2025), disaster preparedness applications play an important role in educating young people in disaster preparedness, including being able to increase community knowledge and protective behavior significantly. Knowing the importance of the explanation above underlies the development of the LSE (Landslide Education) application.

The application is designed according to the analysis of student needs so that it is easy to use anywhere and anytime, and according to the right smartphone specifications, it is not difficult for those with minimal specifications. LSE Mobile (Landslide Education) Mobile Application. This application contains reading materials, images, and videos to convey material about landslide disasters, from the definition of landslide disasters, characteristics of landslide-prone areas, pre-landslide disaster mitigation, and other material related to landslide disasters. In addition to the material, this application is equipped with practice questions to measure student knowledge. It also provides evaluations for students as a form of appreciation for their learning. The combination of multimedia that is combined has the potential to improve students' knowledge, attitudes and skills based on (Osei-Kyei, Tam, Ma, & Mashiri, 2021) in addition to utilizing interactive features, gamification, and interesting presentation of materials so that users can more easily understand and remember important information related to disasters (Matsuno, Fukanuma, & Tsuruoka, 2021; Matsuno & Matsuura, 2023).

The development of LSE (Landslide Education) is a mobile-based application that can potentially provide benefits to students, including increasing aspects of knowledge in disaster preparedness in the form of understanding landslides and being able to analyze landslide phenomena based on a geographic approach, namely: spatial, environmental and territorial, of course natural and human aspects will determine the disaster. Spatial: Able to map landslide-prone areas, environmental: Understand the interaction between physical conditions (slope, rainfall) and human activities, regional: Examine the distribution of risks and adaptation strategies of local communities. Therefore, students not only understand what landslides mean, but can also analyze the causal factors and mitigation steps based on a geographical perspective. This is supported by (Pitchay, Farida Ridzuan,

Azni Haslizan Ab Halim, & Najwa Hayaati Mohd Alwi, 2024; Winarni, Purwandari, & Wachidi, 2021) The use of Android mobile applications increases students' disaster preparedness knowledge. Attitude aspect, students with the knowledge they have will be the basis for thinking and making decisions that have a basis, so that in each decision it is reflected in the students' attitude in responding to landslides, and what they will do, it is proven that the use of android mobile applications can improve students' preparedness attitudes (Estri, Marti, & Rahayu, 2021; Kim & Cho, 2017; Oktarina, Nurhusna, & Saputra, 2019). Skills aspect, students can practice taking disaster mitigation actions starting from pre-disaster, during disasters, and post-disasters, so that they are useful when experiencing them in the field. (Karakitsios et al., 2020; Rahmawati, Labibah, & Kuswanto, 2020; Shilei et al., 2020) Confirmed that the use of Android mobile applications can improve skills.

These advantages prove that LSE (Landslide Education), an Android mobile application, can be optimally beneficial even though it is limited to knowledge and knowing students' perceptions of using it. In the process of increasing students' knowledge in disaster preparedness, it can be concluded that it is effective based on the results of data analysis, with an average value of 72 in material 1, 94 in material 2, and material 3 of 95. This effectiveness is supported in the implementation. This proves that using LSE (Landslide Education) increases knowledge of landslide disaster preparedness. The correlation between knowledge and disaster preparedness. This relationship is closely related in that when knowledge is high, there is a greater potential for preparedness in facing disasters to be more organized, with a foundation for thinking and acting based on experiences previously gained through both theoretical and practical learning. This aligns with (Safriani, Wibowo, Hadiyati, & Hafida, 2022), who stated that knowledge fosters psychological adaptation and more rational and timely response strategies. (Syaifulloh, Soekamto, Wagistina, & Hari Utomo, 2023) Also, increasing knowledge directly enhances students' mental readiness and response to real threats. Moreover, disaster preparedness knowledge is obtained in the educational process, including the potential for senior high schools. Structured disaster education and training through school curriculum or special training can consistently improve preparedness knowledge and skills, which ultimately strengthens the ability of individuals and groups to respond to disasters (Mariam et al., 2021; White-Lewis, Beach, & Zegers, 2021).

This knowledge will be better and optimal. Success will be more optimal using direct interaction with students with existing natural disaster simulations, so that knowledge in preparedness can be implemented. Students use the application through activities, reading materials, watching learning videos, and answering practice questions to increase their knowledge. The questionnaire results on the effectiveness of students' knowledge about landslide disasters. Knowledge of landslide disasters, the distribution of landslide-prone areas in Semarang City, Knowledge through education, local wisdom, and utilization of technology. Based on the indicators above, the average score is 87, which is effective. This application is motivating because the content is in accordance with everyday facts, the content of LSE (Landslide Education) mobile is interesting to read, equipped with an attractive appearance, and interesting quizzes, so that it can be one of the innovative learning

resources to complement the learning carried out by teachers. Based on the facts above, LSE (Landslide Education) is useful for increasing knowledge and is in demand by students.

4. Conclusion

Based on the study results, it can be concluded that students' knowledge of landslide disasters is relatively good, with a greater emphasis on understanding mitigation implementation rather than mastering definitions. The LSE Mobile application developed is considered feasible for use and is well-received by students as a practical learning medium for disaster education, particularly in landslide mitigation. The application has proven effective in enhancing high school students' understanding of mitigation efforts, although its implementation still faces several challenges. The limitations of this study lie in the application's development, which is still restricted to certain Android versions and includes only features such as reading materials, videos, and quizzes. In addition, the application testing was conducted on a limited scale, suggesting the need for broader trials and the development of more interactive and relevant features so that the application can make a more optimal contribution to landslide disaster preparedness.

5. References

- Abdulayeva, A. (2024). The Role of Lesson Planning and Design in The Learning Process. *Bulletin of Dulaty University*, 14(2), 67–74. <https://doi.org/10.55956/XHPI2655>.
- Abu Bakar, M. Z. bin, & Mohamad, Z. F. binti. (2023). Local government capacity for earthquake disaster risk reduction in Malaysia: Case studies in Bentong and Selayang areas. *International Journal of Disaster Risk Reduction*, 97, 103987. <https://doi.org/10.1016/J.IJDRR.2023.103987>.
- Aliperti, G., & Cruz, A. M. (2020). Promoting built-for-disaster-purpose mobile applications: An interdisciplinary literature review to increase their penetration rate among tourists. *Journal of Hospitality and Tourism Management*, 44, 193–210. <https://doi.org/10.1016/J.JHTM.2020.06.006>.
- Andriani, Z. Z. D., Fadly, A. M. H., & Khawa, D. (2021). Pembelajaran Bahasa Inggris Untuk Anak-Anak Di Pondok Pesantren Kanak-Kanak Bayur Desa Barurejo Kecamatan Siliragung Kabupaten Banyuwangi. *LOYALITAS: Jurnal Pengabdian Kepada Masyarakat*, 4(1), 85–96. <https://doi.org/10.30739/LOYAL.V4I1.913>.
- Assidiqi, M. N. F., Juhadi, J., & Banowati, E. (2023). Upaya Peningkatan Pengetahuan Bencana melalui Prototipe Aplikasi LANDIE (Landslide Disaster Education). *JAMBURA GEO EDUCATION JOURNAL*, 4(2), 167–178. <https://doi.org/10.34312/JGEJ.V4I2.21320>.
- Ayub, S., Kosim, K., Gunada, I. W., & Utari, L. P. (2021). Model Pembelajaran Mitigasi Bencana Tanah Longsor Di Sekolah Dasar Lereng Gunung Rinjani. *ORBITA: Jurnal Pendidikan Dan Ilmu Fisika*, 7(2), 406–414. <https://doi.org/10.31764/ORBITA.V7I2.4936>.
- Estri, A. K., Marti, E., & Rahayu, M. H. (2021). The Effectiveness Of Android-Based Educational Game Toward High School Students' Preparedness In Facing Merapi Eruption. *The Malaysian Journal of Nursing (MJN)*, 12(4), 72–76. <https://doi.org/10.31674/MJN.2021.V12I04.010>.
- Farhang, A. P. Q., Hashemi, A. P. S. S. A., & Ghorianfar, A. P. S. M. (2023). Lesson Plan and Its Importance in Teaching Process. *International Journal of Current Science Research and Review*, 06(08). <https://doi.org/10.47191/IJCSRR/V6-I8-57>.
- Gargiulo, M. V., Russo, R., Gugg, G., Amoroso, O., & Capuano, P. (2025). Standardising risk

- perception assessment: The CORE APP training and competition evaluation protocol. *International Journal of Disaster Risk Reduction*, 116, 105071. <https://doi.org/10.1016/J.IJDRR.2024.105071>.
- Gong, Q., Duan, Y., & Guo, F. (2021). Disaster Risk Reduction Education in School Geography Curriculum: Review and Outlook from a Perspective of China. *Sustainability 2021*, Vol. 13, Page 3963, 13(7), 3963. <https://doi.org/10.3390/SU13073963>.
- Harden, R. M. (2002). Learning outcomes and instructional objectives: Is there a difference? *Medical Teacher*, 24(2), 151–155. <https://doi.org/10.1080/0142159022020687;Wgroup:String:Publication>.
- Hayati, H., Wirda, W., Mauvidar, E., & Darliani, A. (2024). Pengaruh Pengetahuan Bencana terhadap Kesiapsiagaan Siswa SMP Nurul Islah dalam Menghadapi Tsunami di Kota Banda Aceh. *Jurnal Penelitian Inovatif*, 4(4), 2165–2172. <https://doi.org/10.54082/JUPIN.705>.
- Herman, A., Direja, S., Nopi Herdiani, T., Stikes, T., Mandiri, S., Bengkulu, I., & Artikel, H. (2023). Pengembangan Aplikasi Berbasis Android Sebagai Media Edukasi Kesiapsiagaan Bencana Gempa Bumi dan Tsunami. *Digital Transformation Technology*, 3(2), 724–734. <https://doi.org/10.47709/DIGITECH.V3I2.3313>.
- Hristov, S., Nakov, D., & Miočinović, J. (2023). Constructive Alignment Between Objectives, Teaching And Learning Activities, Student Competencies And Assessment Methods In Higher Education. *Journal of Agriculture and Plant Sciences*, 21(2), 21–36. <https://doi.org/10.46763/JAPS23212021H>.
- Indra, P. I. G., Adiandari, A. M., Herlambang, P. G. D., & Kartika, M. (2023). Strengthening Community Disaster Education for Disaster Mitigation. *Journal of Communication in Scientific Inquiry (JCSI)*, 5(2), 127–133. <https://doi.org/10.58915/JCSI.V5I2.1099>.
- John, G., Gustavo, P., & Rakuasa, H. (2023). Disaster Education and the Role of Geographers: A Step Toward a Disaster Resilient Ambon City: A Review. *Journal of Education Method and Learning Strategy*, 1(03), 183–192. <https://doi.org/10.59653/JEMLS.V1I03.238>.
- Karakitsios, S., Busker, R., Tjärnhage, T., Armand, P., Dybwad, M., Nielsen, M. F., ... Sarigiannis, D. (2020). Challenges on detection, identification and monitoring of indoor airborne chemical-biological agents. *Safety Science*, 129, 104789. <https://doi.org/10.1016/J.SSCI.2020.104789>.
- Kastolani, W., & Mainaki, R. (2018). Does Educational Disaster Mitigation Need To Be Introduced In School? *SHS Web of Conferences*, 42, 00063. EDP Sciences. <https://doi.org/10.1051/SHSCONF/20184200063>.
- Kim, S. J., & Cho, H. (2017). The Effect of Smartphone-Delivered Emergency Preparedness Education on Coping Knowledge Among Fifth- and Sixth-Grade Elementary Schoolchildren in South Korea. *The Journal of School Nursing*, 33(6), 434–445. <https://doi.org/10.1177/1059840516680267>.
- Kurniawan, N., Saipiatuddin, & Hidayat, A. N. (2025). Integrating disaster education into geography curriculum: Strengthening school-based preparedness. *Journal of Environment and Geography Education*, 2(1). <https://doi.org/10.61511/JEGEO.V2I1.2025.1696>.
- Mariam, I., Budhiana, J., Permana, I., Dewi, R., Rahmanishati, W., Noviyanti, L., ... Tinggi Ilmu Kesehatan Sukabumi, S. (2021). Knowledge, Attitudes, Disaster Training and Self Efficacy on Disaster Preparedness. *Research Horizon*, 1(5), 179–188. <https://doi.org/10.54518/RH.1.5.2021.179-188>.
- Marinho, M. C., Luiz Da Silva, W., Souza De Oliveira, A., Coelho, T., Andresa, W., Da Silva, V., ... Gomes, F. (2024). A Importância Do Planejamento Educacional Individual Na Educação Inclusiva. *ARACÊ*, 6(3), 5750–5762. <https://doi.org/10.56238/AREV6N3-088>.
- Matsuno, Y., Fukanuma, F., & Tsuruoka, S. (2021). Development of Flood Disaster Prevention

- Simulation Smartphone Application Using Gamification. *Springer Optimization and Its Applications*, 169, 147–159. https://doi.org/10.1007/978-3-030-64973-9_9.
- Matsuno, Y., & Matsuura, M. (2023). Development and Evaluation of a Shelter Simulator Using Gamification. *IFIP Advances in Information and Communication Technology*, 672 LNBIP, 327–340. https://doi.org/10.1007/978-3-031-34207-3_21.
- Oktarina, Y., Nurhusna, N., & Saputra, M. A. A. (2019). Implementation of Blended Learning Through Smartphone-Based Applications in Disaster in Nursing Courses. *Indonesian Nursing Journal Of Education And Clinic (INJEC)*, 3(2), 113–120. <https://doi.org/10.24990/INJEC.V3I2.208>.
- Opabola, E. A., Galasso, C., Rossetto, T., Meilianda, E., Idris, Y., & Nurdin, S. (2023). Investing in disaster preparedness and effective recovery of school physical infrastructure. *International Journal of Disaster Risk Reduction*, 90, 103623. <https://doi.org/10.1016/J.IJDRR.2023.103623>.
- Osei-Kyei, R., Tam, V., Ma, M., & Mashiri, F. (2021). Critical review of the threats affecting the building of critical infrastructure resilience. *International Journal of Disaster Risk Reduction*, 60, 102316. <https://doi.org/10.1016/J.IJDRR.2021.102316>.
- Permendikbud. *Regulation of the Minister of Education and Culture Number 24 of 2016 concerning Core Competencies and Basic Competencies of Subjects in the 2013 Curriculum in Primary and Secondary Education.*, Pub. L. No. 24, 1 (2016). Indonesia: Ministry of Education and Culture.
- Permendikbud. *Concerning the Implementation of the Disaster-Safe Education Unit Program.*, Pub. L. No. 33 (2019). Ministry of Education and Culture.
- Pitchay, S. A., Farida Ridzuan, Azni Haslizan Ab Halim, & Najwa Hayaati Mohd Alwi. (2024). Disasterprep: Gamified Mobile Edutainment For Future Disaster Preparedness And Resilience. *ASEAN Journal of Teaching & Learning in Higher Education*, 16(2). <https://doi.org/10.1016/J.IJDRR.2024.104379>.
- Rahmawati, L., Labibah, U. N., & Kuswanto, H. (2020). The implementation of android-based physics learning media integrated with landslide disaster education to improve critical thinking ability and disaster preparedness. *Journal of Physics: Conference Series*, 1440(1), 012042. <https://doi.org/10.1088/1742-6596/1440/1/012042>.
- Rany, T. D., Kuswanto, H., & Abdillah, A. J. (2020). Development of physics-based learning media for android integrated with earthquake disaster education. *Journal of Physics: Conference Series*, 1440(1), 012029. <https://doi.org/10.1088/1742-6596/1440/1/012029>.
- Rizaldi, D. (2021). Analysis of Disaster Mitigation Education in Geography Subjects in Grade XI of Senior High School in Indonesia. *Proceedings of the National and International Seminar of Dharmawangsa University*, 1–6. Dharmawangsa University.
- Rizaldi, D. (2022). *Geoeduid Website Learning Media for Geography Learning in High School*. Universitas Negeri Semarang.
- Safriani, E. W., Wibowo, Y. A., Hadiyati, S., & Hafida, N. (2022). The Influence of Preparedness on the Adaptive Capacity of Junior High School Students in Dealing With a Landslide Disaster, Banjarnegara, Indonesia. *Proceedings of the International Conference of Learning on Advance Education (ICOLAE 2021)*, 662, 1107–1115. <https://doi.org/10.2991/ASSEHR.K.220503.122>.
- Serbes, M., & Albay, M. (2017). Importance of Career Planning and Development in Education. *International Journal of Social Sciences & Educational Studies*, 4(2), 149–154. <https://doi.org/10.23918/IJSSES.V4I2SIP149>.
- Sewagegn, A. A. (2020). Learning Objective and Assessment Linkage: Its Contribution to Meaningful Student Learning. *Universal Journal of Educational Research*, 8(11), 5044–5052. <https://doi.org/10.13189/UJER.2020.081104>.
- Shi, L., Gao, D., Wang, X., Lin, J., Chen, D., Li, T., ... Wang, D. (2023). Community resilience

- enhances epidemic prevention: Moderating role of residents' participation in community-based epidemic prevention. *International Journal of Disaster Risk Reduction*, 97, 104040. <https://doi.org/10.1016/J.IJDRR.2023.104040>.
- Shilei, Z., Yue, S., Tinglin, H., Ya, C., Xiao, Y., Zizhen, Z., ... Xiao, L. (2020). Reservoir water stratification and mixing affects microbial community structure and functional community composition in a stratified drinking reservoir. *Journal of Environmental Management*, 267, 110456. <https://doi.org/10.1016/J.JENVMAN.2020.110456>.
- Souza, A. A. De, Ivanir, D. C. A., Sousa, L. M. da S., & Silva, J. M. Da. (2024). The Indispensability Of The Educational Planning Process. *Revista Gênero e Interdisciplinaridade*, 5(01), 170–182. <https://doi.org/10.51249/gei.v5i01.1862>.
- Suarmika, P. E., Arnyana, I. B. P., Suastra, I. W., & Margunayasa, I. G. (2022). Reconstruction of disaster education: The role of indigenous disaster mitigation for learning in Indonesian elementary schools. *International Journal of Disaster Risk Reduction*, 72, 102874. <https://doi.org/10.1016/J.IJDRR.2022.102874>.
- Syaifulloh, M., Soekamto, H., Wagistina, S., & Hari Utomo, D. (2023). Pengurangan Risiko Bencana: Korelasi Pengetahuan dan Kesiapsiagaan Siswa Sekolah Menengah Atas di Kota Batu. *Geoedusains: Jurnal Pendidikan Geografi*, 4(1), 53–65. <https://doi.org/10.30872/GEOEDUSAINS.V4I1.1940>.
- Syukron, M., Madugalla, A., Shahin, M., & Grundy, J. (2024). A Comprehensive Study of Disaster Support Mobile Apps. *Arxiv*, 1–9. <https://doi.org/http://dx.doi.org/10.2139/ssrn.4919076>.
- Tan, M. L., Prasanna, R., Stock, K., Doyle, E. E. H., Leonard, G., & Johnston, D. (2020). Modified Usability Framework for Disaster Apps: A Qualitative Thematic Analysis of User Reviews. *International Journal of Disaster Risk Science*, 11(5), 615–629. <https://doi.org/10.1007/S13753-020-00282-X/FIGURES/5>.
- Tjahjono, H., Trihatmoko, E., Hanafi, F., & Findayani, A. (2022). Penentuan Tingkat Bahaya Longsor Dengan Bantuan Teknologi Sig (Sistem Informasi Geografis) Di Kecamatan Gebog Kabupaten Kudus. *Bookchapter Alam Universitas Negeri Semarang*, (1), 167–192. <https://doi.org/10.15294/KA.V1I1.89>.
- Turan, M., & Oral, V. (2023). Implications in the light of the experiences and perspectives of Mukhtars as local community leaders in the scope of disaster management. *International Journal of Disaster Risk Reduction*, 85, 103508. <https://doi.org/10.1016/J.IJDRR.2022.103508>.
- White-Lewis, S., Beach, E., & Zegers, C. (2021). Improved Knowledge of Disaster Preparedness in Underrepresented Secondary Students: A Quasi-Experimental Study. *Journal of School Health*, 91(6), 490–498. <https://doi.org/10.1111/JOSH.13023>;Wgroup:String:Publication.
- Wiluyana, A. I., Sanjoto, T. B., & Sidiq, W. A. B. N. (2024). Pembelajaran Mitigasi Bencana Tanah Longsor Dengan Simulasi 3D Pada Siswa Sekolah Dasar. *GEOGRAPHY: Jurnal Kajian, Penelitian Dan Pengembangan Pendidikan*, 12(2), 817–831. <https://doi.org/10.31764/GEOGRAPHY.V12I2.24812>.
- Winarni, E. W., Purwandari, E. P., & Wachidi, W. (2021). The effect of android-based earthquake game toward Bengkulu City elementary school student's knowledge about earthquake disaster preparedness. *Journal of Physics: Conference Series*, 1731(1), 012090. <https://doi.org/10.1088/1742-6596/1731/1/012090>.