

Geophysics learning transformation: Assessment Of The Need For Technology-Based Learning Media And Environmental Issues

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Abstract

This research aims to analyze the need for the development of geophysics learning media in universities, especially in the context of relevance to technological developments and environmental issues. The method used is quantitative descriptive with data collection techniques through observation and distribution of questionnaires to lecturers and students at two universities that hold geophysics courses. The results of the study show that learning outcomes at both campuses still focus on basic competencies, such as understanding geophysical concepts, practicum skills, and field data analysis. However, new competencies related to the application of technology such as artificial intelligence (AI), machine learning, and big data have not been explicitly accommodated. In terms of learning media, the use of reference books dominated (40%), followed by presentation slides (27%), learning videos (20%), and teaching aids (13%), which showed the tendency to use conventional media. In addition, the integration of geophysics learning materials with environmental issues is still low, with only 33% integrated and 67% not integrated. These findings show the need for the development of geophysics learning media that is more interactive, contextual, and adaptive to technological developments and global challenges. This research provides an important basis for curriculum innovation and the development of learning media that support 21st century learning outcomes.

Keywords: Learning Media, Geophysics, Needs Analysis, Educational Technology, Environmental Issues

INTRODUCTION

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The following revision improves the grammatical structure and academic tone of the original text while preserving its core meaning. The revisions focus on enhancing clarity, precision, and scholarly presentation of ideas related to geophysics education.

Geophysics, a branch of earth science, examines the physical properties of the Earth through mathematical and physical approaches (Chandra et al., 2021). At the tertiary level, geophysics curricula frequently encompass abstract and complex concepts, including seismic waves, gravitational fields, and soil resistivity. Student comprehension of these concepts depends significantly on the clarity of instructional delivery and the efficacy of learning media employed (Chenrai, 2021). Geophysics education necessitates profound understanding of both theoretical concepts and practical applications, enabling students to connect geophysical principles with real-world phenomena (Masyruhan et al., 2020). Consequently, selecting instructional materials relevant to students' experiences is critical for effective learning outcomes (Lestari, 2023).

Despite technological advancements, geophysics instruction in numerous universities remains predominantly characterized by conventional methodologies, such as traditional lectures and static PowerPoint presentations. The scarcity of interactive learning media capable of visualizing complex concepts limits educational effectiveness (Syahrizal et al., 2022). This limitation contributes to students' inadequate conceptual understanding, diminished interest in the subject matter, and reduced active participation in the learning environment. Furthermore, geophysics education should foster high-level thinking skills among students, enabling them to develop advanced cognitive abilities (Heru & Suparno, 2019).

Contemporary developments in information technology facilitate the creation of diverse digital learning media incorporating animation, simulation, and interactive applications to enhance geophysics education (Rizal et al., 2022). However, prior to developing relevant and effective instructional media, a comprehensive needs assessment is essential. This assessment must examine existing pedagogical practices, identify challenges encountered by faculty and students, and determine preferences regarding media formats. The methodologies and media utilized in content delivery significantly influence student comprehension and academic achievement (Imran et al., 2023).

Creative and innovative instructional designs serve as essential components in motivating student engagement. Enhancing educational quality, particularly in quantitative disciplines such as geophysics, is crucial for rendering complex material more accessible and comprehensible to students (Utami, 2019). Contemporary challenges including environmental sustainability, energy resource management, and food security demand specialized attention, requiring geophysics



graduates capable of contributing data-driven solutions and sophisticated geophysical models (Stewart, 2021). Innovation in geophysics education through technological integration has thus become imperative. The educational sector must continuously adapt to technological advancements to improve instructional quality across learning processes (Berlian, 2021).

This research aims to analyze requirements for developing effective geophysics learning media in higher education institutions. The findings will establish a foundation for designing and implementing instructional media aligned with student and faculty requirements and the distinctive characteristics of geophysical subject matter

METHOD

This study employs a quantitative descriptive research design to systematically assess the necessity for developing specialized learning media in geophysics curricula at the university level. The investigation was conducted at two institutions: Alauddin State Islamic University of Makassar and Makassar State University. Data collection incorporated structured observation protocols and Likert-scale questionnaire administration to ensure methodological rigor.

Data Collection Framework

Classroom observations were implemented through systematic monitoring of pedagogical activities, focusing on three critical dimensions: instructional media utilization, student participation levels, and emergent challenges during knowledge transfer. These observations adhered to standardized protocols to capture an authentic representation of current geophysics education practices, particularly regarding the integration of technological tools and student-instructor interactions.

Supplementing observational data, a validated questionnaire utilizing a five-point Likert scale was administered to two key stakeholder groups: undergraduate students enrolled in geophysics courses and faculty members responsible for course delivery. The survey instrument encompassed multiple dimensions, including:

1. Perceived efficacy of existing instructional media
2. Identified knowledge gaps in comprehending geophysical concepts
3. Stakeholder preferences for next-generation educational tools
4. Anticipated functional requirements for proposed learning media.

Sampling Strategy and Analysis



The study employed purposive sampling to select participants directly engaged in geophysics education, ensuring respondents possessed substantive experience with current pedagogical approaches. This targeted sampling methodology enhanced data relevance while maintaining alignment with the research objectives. Collected data underwent descriptive statistical analysis to identify predominant patterns in user requirements and media preferences, with particular emphasis on recurring themes across both institutional contexts.

Through this dual-method approach, the research establishes a comprehensive needs assessment framework that bridges observed classroom practices with quantitatively measured stakeholder expectations. The integration of observational and survey data enables triangulation of findings, strengthening the validity of conclusions regarding media development priorities in geoscience education.

RESULT

The scope of the observation encompasses curriculum analysis, evaluation of learning media usage, and assessment of the integration of environmental issues within the learning process. Each aspect is detailed as follows.

Curriculum Analysis

Curriculum analysis at UIN Alauddin Makassar and Makassar State University was conducted through a combination of observation, document review, and interviews. This process involved examining curriculum documents, particularly the stated Learning Outcomes (CP). The document review provided an overview of the Geophysics course learning outcomes, summarized in Table 1.

Table 1. Summary of Geophysics Learning Outcomes

University	Learning Outcomes
UIN Alauddin Makassar	Mastery of fundamental physics concepts and their applications in geophysics.
	Ability to analyze geophysical phenomena based on scientific data.
	Proficiency in using geophysical measurement and analysis tools.
	Demonstration of a scientific, critical, and responsible attitude in geophysical studies.
Makassar State University	Mastery of basic physics, mathematics, and computing concepts as foundations for geophysical analysis.



	Competence in managing and applying experimental methods and instrumentation in geophysical education and research.
	Ability to develop learning media and innovations grounded in applied physics.
	Analytical thinking skills in studying geophysical phenomena and their applications.

Both institutions emphasize foundational competencies, including understanding geophysical concepts, practical skills in laboratory work, and field data analysis. However, the curricula do not comprehensively address emerging competencies aligned with technological advancements and industry demands, such as the application of artificial intelligence (AI), machine learning, and big data analytics in geophysics.

Analysis of Learning Media Usage

The analysis of learning media utilization was conducted using questionnaires aimed at capturing lecturers' practices in geophysics instruction. The questionnaire results provide insights into the types of media employed by lecturers during the teaching process. Figure 1 illustrates the distribution of media usage.

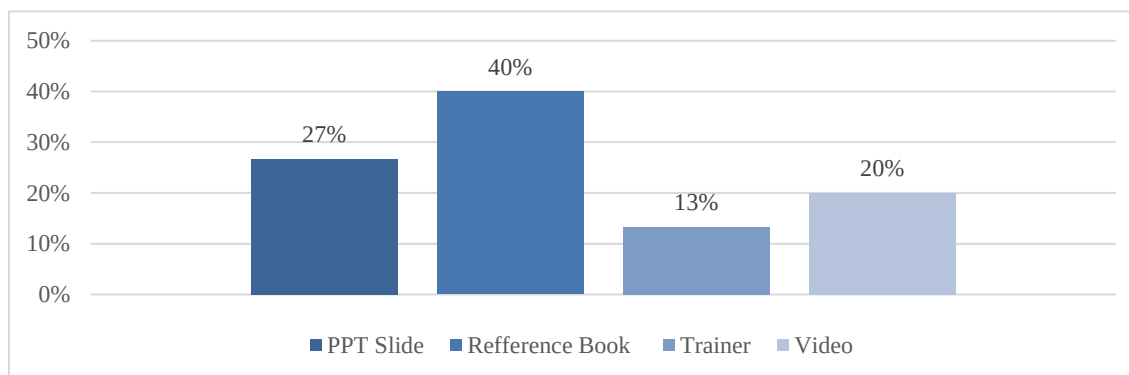


Figure 1. Distribution of Learning Media Used in Geophysics Instruction

According to the questionnaire, 27% of lecturers use PowerPoint slides, 40% rely on reference books, 13% utilize teaching aids, and 20% incorporate learning videos. These findings indicate a predominant preference for reference books as the primary learning media in geophysics courses.

Analysis of Integration of Learning Materials with Environmental Issues

Lecturers' perspectives on the integration of environmental issues into geophysics learning materials were assessed through questionnaire responses. The results are presented in Figure 2.

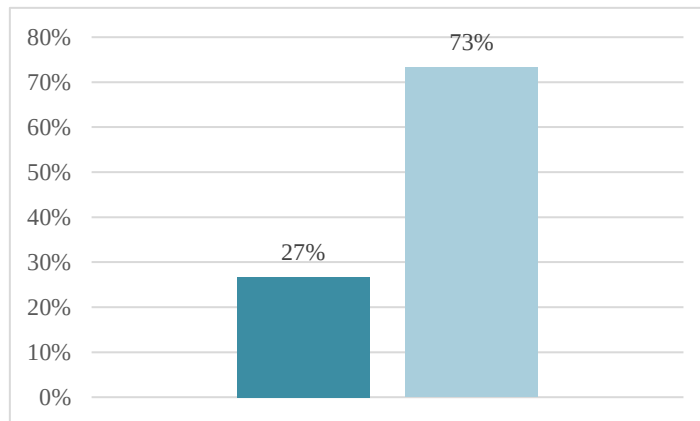


Figure 2. Integration of Environmental Issues into Geophysics Learning Materials

The data reveal that only 33% of the learning materials incorporate environmental issues, whereas 67% do not integrate such topics. This suggests that the majority of geophysics curricula currently lack sufficient integration of environmental concerns within their content.

The scope of observation implementation includes curriculum analysis, analysis of the use of learning media, and analysis of environmental integration of learning. The description of each is explained as follows.

The results of this study indicate that the current geophysics curricula at UIN Alauddin Makassar and Makassar State University primarily emphasize fundamental competencies such as understanding core concepts, practical skills, and data analysis. However, they lack incorporation of emerging technological competencies, including artificial intelligence, machine learning, and big data analytics, which are increasingly relevant to the field.

Regarding learning media, lecturers predominantly rely on traditional reference books, with limited use of interactive or digital media, such as videos or teaching aids. This suggests a need to diversify and modernize instructional resources to enhance student engagement and comprehension.

Furthermore, the integration of environmental issues into geophysics learning materials remains minimal, with only one-third of the content reflecting such concerns. This highlights a significant gap in aligning geophysics education with contemporary environmental challenges.

Overall, these findings underscore the necessity for developing innovative, technology-enhanced learning media that incorporate both advanced technological competencies and environmental integration to better meet the evolving demands of geophysics education.

DISCUSSION

Based on the content of the learning materials, although fundamental topics such as seismology, geoelectric, geomagnetism, and basic geophysical measurements remain the primary focus, the integration of emerging technologies and advanced concepts-such as the application of machine learning in geophysical data analysis and big data techniques-remains very limited. Environmental issues, while acknowledged as significant, are introduced only in broad terms, primarily within the contexts of geological disasters and climate change. Topics related to geophysical exploration for environmental conservation and disaster mitigation have begun to be incorporated but have yet to be developed as a more comprehensive part of the curriculum. This situation necessitates that lecturers adapt to contemporary demands and evolving conditions (Siregar et al., 2021).

Overall, both the learning outcomes and instructional materials at the two universities continue to emphasize foundational knowledge and the application of conventional practical skills. Updates are required in both areas by integrating the latest technological advancements and deepening the coverage of environmental topics to better align with industry requirements and the rapid progression of scientific knowledge. The incorporation of new technologies and cutting-edge geophysical concepts is essential (Stewart, 2021).

Observations of the learning process reveal several issues: (1) The instructional approach remains predominantly teacher-centered, with most activities consisting of straightforward explanations and question-and-answer sessions, resulting in passive student engagement and limited involvement in exploratory or real-world problem-solving activities; (2) Learning methods are largely confined to lectures and discussions, lacking active learning techniques such as simulations, project-based learning, or the use of interactive technologies that could enhance student participation, especially in geophysics, which ideally should be practice- and application-oriented; (3) There is no evidence of structured discussion formats, such as scientific debates, case studies, or project-based learning, thereby underutilizing students' potential for critical and creative thinking. If this situation persists, it may adversely affect the quality of graduates, rendering them less competitive in the workforce (Akhyaruddin, 2022). Therefore, improving geophysics education requires a paradigm shift from teacher-centered to student-centered



learning, emphasizing the development of critical thinking, problem-solving skills, and creativity (Ashar, 2019).

Although lecturers provide summaries of the material and outline subsequent lesson plans, formative assessments-such as quick quizzes or app-based evaluations-are not routinely employed to directly measure student comprehension. Consequently, lecturers lack concrete data regarding the extent to which students have achieved the established learning objectives (Kristiyanti, 2021). This highlights the need for innovation in assessment methods, media, and techniques to make the learning process more interactive, application-oriented, and responsive to advances in science and technology within the field of geophysics (Pinto et al., 2021).

As a discipline that investigates the Earth's physical properties and dynamic processes, geophysics plays a strategic role in addressing environmental challenges, including natural disaster mitigation (e.g., earthquakes, tsunamis, landslides), sustainable natural resource exploration, and climate change (Indriana et al., 2021). Integrating environmental issues into geophysics education not only enriches students' understanding of geophysical phenomena but also fosters critical awareness of how geophysics can contribute to environmental preservation and human well-being (Leininger-Frézal et al., 2023).

Without such integration, geophysics education risks becoming less applicable and contextual, depriving students of opportunities to develop competencies necessary for applying geophysical principles to real-world societal problems (Jedličková et al., 2023). Therefore, it is imperative to strengthen the development of instructional materials that connect geophysical concepts with environmental protection efforts, climate change adaptation, and data-driven disaster management using geophysical technologies. This approach is vital to preparing graduates who are not only academically proficient but also environmentally conscientious.

CONCLUSION

Based on the findings of this research, it is evident that the development of geophysics learning media in universities continues to encounter notable challenges. Regarding learning outcomes, the surveyed universities prioritize fundamental competencies, including comprehension of geophysical concepts, practical skills, and field data analysis. However, these achievements have yet to fully incorporate emerging competencies pertinent to recent technological advancements and industry demands, such as the application of artificial intelligence (AI), machine learning, and big data analytics within geophysics.



The questionnaire analysis revealed that lecturers primarily utilize reference books (40%), followed by presentation slides (27%), learning videos (20%), and teaching aids (13%). This indicates that geophysics education remains largely conventional, with limited adoption of interactive digital media that aligns more closely with advancements in educational technology.

Furthermore, the integration of environmental issues into geophysics learning materials remains relatively limited. A significant majority (67%) of respondents indicated that the taught material was not integrated with environmental concerns, whereas only 33% reported such integration. This underscores the necessity for developing learning materials that are more contextual and relevant to contemporary global challenges, including climate change and environmental sustainability.

In summary, these results highlight the critical importance of developing geophysical learning media that not only reinforce the understanding of foundational concepts but also integrate cutting-edge technologies and contemporary issues to meet the demands of 21st-century education.

REFERENCES

- Akhyaruddin, A. (2022). Implementasi Project Based Learning-Case Method (PjBL-CM) dalam Pembelajaran Morfologi Bahasa Indonesia. *Jurnal Ilmiah Dikdaya*, 12(1), 1. <https://doi.org/10.33087/dikdaya.v12i1.243>
- Ashar, S. (2019). Relevansi dan Tantangan Bangunan Pemikiran Kritis dan Pemecahan Masalah Pendidikan Islam dalam Mengembangkan Literasi Informasi dan Kesadaran global Abad 21. *Progressa Journal of Islamic Religious Instruction*, 3(2), 9. <https://doi.org/10.32616/pgri.v3.2.189.9-14>
- Berlian. (2021). Meningkatkan Motivasi Belajar Siswa Melalui Model Pembelajaran Audio-Visual pada Mata Pelajaran Fiqih di MTsN Palopo. *DIDAKTIKA Jurnal Kependidikan*, 10(3), 187. <https://jurnaldidaktika.org/contents/article/download/104/78>
- Chandra, A. N., Haris, V., & Yulita, D. (2021). Pengembangan Modul Fisika Berbasis REACH Berintegrasi Al-Quran Materi Suhu dan Kalor. *JOSTECH Journal of Science and Technology*, 1(2), 166. <https://doi.org/10.15548/jostech.v1i2.3097>
- Chenrai, P. (2021). Case Study on Geoscience Teaching Innovation: Using 3D Printing to Develop Structural Interpretation Skill in Higher Education Levels. *Frontiers in Earth Science*, 8. <https://doi.org/10.3389/feart.2020.590062>
- Heru, M., & Suparno, S. (2019). The Development of Reasoned Multiple Choice Test in Interactive



- Physics Mobile Learning Media (PMLM) of Work and Energy Material to Measure High School Students' HOTS. *Formatif Jurnal Ilmiah Pendidikan MIPA*, 9(2). <https://doi.org/10.30998/formatif.v9i2.3002>
- Imran, R., Fatima, A., Salem, I. E., & Allil, K. (2023). Teaching and learning delivery modes in higher education: Looking back to move forward post-COVID-19 era. *The International Journal of Management Education*, 21(2), 100805. <https://doi.org/10.1016/j.ijme.2023.100805>
- Indriana, R. D., Nurwidyanto, M. I., & Widada, S. (2021). Re-modeling kaligarang fault base on satellite gravity data. *Journal of Physics Conference Series*, 1943(1), 12004. <https://doi.org/10.1088/1742-6596/1943/1/012004>
- Jedličková, T., Svobodová, A., & Kachlík, V. (2023). Frequent Limits and Advantages of Conditions for Geology Education: Example of Czech and Slovak State Curricula. *Center for Educational Policy Studies Journal*. <https://doi.org/10.26529/cepsj.1449>
- Kristiyanti, K. L. (2021). The Implementation of Online Formative Assessment in English Learning. *Journal of Educational Study*, 1(2), 68. <https://doi.org/10.36663/joes.v1i2.155>
- Leininger-Frézal, C., Sprenger, S., Torres, M. L. de L. y, Domenech, M. de los Á. R., Heidari, N., Pigaki, M., Naudet, C., Lecomte, A., & Gallardo, M. (2023). Global Change Challenge in the Higher Education Curriculum on the Approach of Blended Learning. *European Journal of Geography*, 14(2), 1. <https://doi.org/10.48088/ejg.c.lei.14.2.001.014>
- Lestari, N. (2023). Konsep Fisika pada Sumpit Dayak dari Kalimantan sebagai Bahan Ajar berbasis Etnofisika. *JURNAL PENDIDIKAN MIPA*, 13(2), 551. <https://doi.org/10.37630/jpm.v13i2.1014>
- Masyruhan, M., Pratiwi, U., & Hakim, Y. A. (2020). PERANCANGAN ALAT PERAGA HUKUM HOOKE BERBASIS MIKROKONTROLER ARDUINO SEBAGAI MEDIA PEMBELAJARAN FISIKA. *SPEKTRA Jurnal Kajian Pendidikan Sains*, 6(2), 134. <https://doi.org/10.32699/spektra.v6i2.145>
- Pinto, T., Dias, A. G., & Vasconcelos, C. (2021). Geology and Environment: A Problem-Based Learning Study in Higher Education. *Geosciences*, 11(4), 173. <https://doi.org/10.3390/geosciences11040173>
- Rizal, S., Putra, A. K., Suharto, Y., & Wirahayu, Y. A. (2022). Creative Thinking and Process Science Skill: Self-Organized Learning Environment on Watershed Conservation Material. *Jurnal Pendidikan IPA Indonesia*, 11(4), 578. <https://doi.org/10.15294/jpii.v11i4.39571>
- Siregar, U. H., Samosir, B. S., & Novitasari, W. (2021). UPAYA MENINGKATKAN KEMAMPUAN PEMECAHAN MATEMATIS SISWA MELALUI PEMBELARAN BERBASIS IT (GEOGEBRA). *Jurnal Karya Pendidikan Matematika*, 8(2), 60. <https://doi.org/10.26714/jkpm.8.2.2021.60-65>



- Stewart, I. S. (2021). Integrating the 'the triangle of geography, geology and geophysics' into sustainable development. EarthArXiv (California Digital Library).
<https://doi.org/10.31223/x5p90q>
- Syahrizal, M., Aripin, S., Khairunnisa, K., & Indini, D. P. (2022). Pelatihan Pembuatan Media Pembelajaran Interaktif dengan Power Point di MIS Al Hidayah. Journal of Social Responsibility Projects by Higher Education Forum, 2(3), 111.
<https://doi.org/10.47065/jrespro.v2i3.1321>
- Utami, S. P. (2019). Penggunaan Media Gambar untuk Meningkatkan Hasil Belajar Matematika Siswa. Journal of Classroom Action Research, 1(2), 72.
<https://doi.org/10.29303/jcar.v1i2.307>

