PAEDAGOGIA
Jurnal Penelitian Pendidikan
http://jurnal.uns.ac.id/paedagogia

DOI : 10.20961/Paedagogia.v28i2.102207
Vol. 28, No. 2, 2025, pp. 246-256
p-ISSN 0126-4109
e-ISSN 2549-6670

Development of Rock Teaching Media for Strengthening Students' Geoliteracy Skills in Geography Subjects

Akbar Maulana*, Exsa Putra, Widyastuti, Ika Listiqowati
Geography Education, Faculty of Teacher Training and Education, Tadulako University, Indonesia.

Keywords: *Development, Learning Media, Rock Props, Geoliteracy Skills*

Article history
Received: 14 May 2025
Revised: 2 May 2025
Accepted: 31 May 2025
Published: 21 June 2025

*Corresponding Author Email:
akbarmaulana2aja@gmail.com

Doi: 10.20961/paedagogia.v28i2.102207

Abstract: This study aims to develop learning media in the form of rock props on lithosphere material in Geography subjects. The method used is Research and Development (R&D) with reference to the Alessi and Trollip development model. Data analysis uses a Likert scale with four levels of validity. This research develops rock props media that can be used in geography learning lithosphere material. Then, a limited implementation was carried out by X social studies class students. The results showed that the rock props media developed had a very high level of validity. The validity assessment by media experts obtained a score of 91.66% with a very feasible category, by practitioners (teachers) of 97.61%, and by material experts of 90.27%, all included in the very valid category. Implementation of small group trials on students resulted in an average validity score of 91.73%, with a very valid category. In addition, the results of the student geoliteracy skills test showed an average percentage of 94.22%. Based on the assessment of experts, teachers and the results of student trials, the rock props media is declared feasible and effective to use in geography learning. Thus, this media is proven to be able to improve students' geoliteracy skills on lithosphere material at SMAN 1 Tojo.

How to cite: Maulana, A., Putra, E., Widyastuti & Listiqowati, I. (2025). Development of Rock Teaching Aids Media for Students' Geoliteracy Skills on Lithosphere Material at SMAN 1 Tojo. *PAEDAGOGIA*, *28*(2), 246-256. doi: 10.20961/paedagogia.v28i2.102207

INTRODUCTION

Geography learning is a process that examines various spatial aspects on the earth's surface, including natural phenomena and human life that are influenced by differences in regional characteristics (Wijayanti et al., 2022). Geography aims to integrate the study of the physical environment and human activities and the reciprocal relationship between the two. The main focus is on space, place, and region, with an emphasis on analyzing processes that take place in the short and long term, as well as patterns that arise as a result of these processes (Meadows, 2020). As a complex field of study, geography has a close relationship between natural and social aspects in a unified space. Therefore, geography learning is not only oriented to conceptual knowledge, but also to the direct experience experienced by students. This approach allows students to develop competencies holistically, increase sensitivity to the surrounding environment, and form a more scientific understanding of geographic phenomena (Listiqowati et al., 2020).

Geography subjects have a very broad scope of material because the material objects include various geospheric phenomena, such as the lithosphere, atmosphere, hydrosphere, and anthroposphere (Larasaty, 2024). The complexity of geography materials often requires visualization support so that abstract concepts can be understood more concretely by students. Many geography concepts cannot be explained effectively only through the lecture method or one-way approach. In addition, schools play an important role in implementing various learning methods to support the development of students' skills. In order for the effectiveness of these methods to be known, periodic evaluations are needed to assess the extent to which learning objectives have been achieved. One of the materials that presents these challenges is lithosphere material, which is taught to grade X students. This material covers the dynamics of the lithosphere, namely the various geological activities that occur on the earth's surface, as well as

their impact on the lives of living things (Almugni et.al., 2022). In the context of learning, the use of learning media is one of the innovative strategies that can increase the effectiveness of material delivery, especially for complex and abstract topics (Putra, 2022). Learning media plays a vital role in helping students connect geography concepts with real phenomena they encounter in everyday life. Through the use of appropriate media, the learning process not only becomes more interesting, but also able to improve students' conceptual understanding more deeply (Revlinasari et al., 2021).

Learning about the lithosphere also includes understanding the types of rocks that make up the earth's layers. Rocks are divided into three main types, namely igneous rocks, sedimentary rocks, and metamorphic rocks. Each of these rock types has a different formation process, which is related to geological activities such as weathering processes. In addition, the process of rock weathering is the basic understanding of students in identifying potential disaster vulnerability related to geological conditions. Therefore, an understanding of disaster information literacy is needed to be given to the community so that the information obtained can be applied in everyday life (Novarita et.al., 2023). With the variety of rock types, it is very important to provide teaching media that can improve student geoliteracy. One of the strategic steps that can be taken is to create learning media that not only supports the course of learning, but is also directed to produce meaningful learning experiences (Daryanes et al., 2023). An effective, innovative, interesting, and fun learning process for students is influenced by various factors, one of which is the availability of teaching aids that can support learning resources (Arifin et al., 2019).

Media is basically one of the essential elements in the learning system that must be integrated and aligned with the overall learning process (Nurfadhillah et al., 2021). The use of interesting and easy media will through the geoliteracy approach students can understand the relationship between geological processes of rocks with landscapes, land use, and their impact on human life. Geoliteracy is the ability to apply geographic understanding and reasoning in making strategic decisions Edelson (2012). Geoliteracy is also the ability of individuals to understand geographical conditions and their relationship with various natural phenomena that occur around them (Widyastuti et.al., 2023).

SMA N 1 TOJO students' understanding of basic geography knowledge in the Geography subject is still relatively low. Based on observations and interviews with Geography teachers at the school, it was found that students have not utilized learning media when studying lithosphere material. One of the main causes is the limited internet access and the lack of supporting facilities and technology in the learning process in the classroom. The study data showed that out of 91 students evaluated, the average score obtained was only 55%, below the Minimum Completion Criteria (KKM) for Geography subjects. This shows that students' understanding of lithosphere material is still not optimal. The low utilization of learning media greatly impacts student understanding in learning. Therefore, it is necessary to develop learning media to improve student understanding, especially in lithosphere material.

This research develops a more modern multimedia-based rock teaching aid, which can be used online or offline. The previous small props with limited information will be developed with more detailed information. In addition, this teaching aid is also equipped with a barcode that can be scanned to access a digital flipbook so that the information can be obtained more interactively. This innovation will make lithosphere learning more interesting and improve students' geoliteracy skills. Rock props are important in developing students' geoliteracy skills, especially in learning lithosphere material. Through this media, students can directly observe, feel, and compare various types of rocks, so their understanding of geological properties and processes becomes more real and in-depth. The use of this media is able to solve students' problems in learning by analyzing and making decisions based on the mastery of the three pillars of geographic literacy, namely content, skills, and thinking patterns, in improving geoliteracy (Sugiyanto, 2022).

METHOD

This research uses the Research and Development (R&D) type because its main focus is to produce learning products. The learning product developed in the form of rock props media aims to improve students' geoliteracy skills at SMAN 1 Tojo. The development model applied in this research is the development and design model proposed by Alessi and Trollip (2001), which consists of three procedures:

Planning, Design, and Development. The selection of this model is based on the model that will be specifically designed to develop multimedia-based rock teaching aids because it can be used online or offline during its application. The procedure in this study includes the stages of development, validation, implementation, and evaluation. The development stage procedure can be seen in Figure 1.

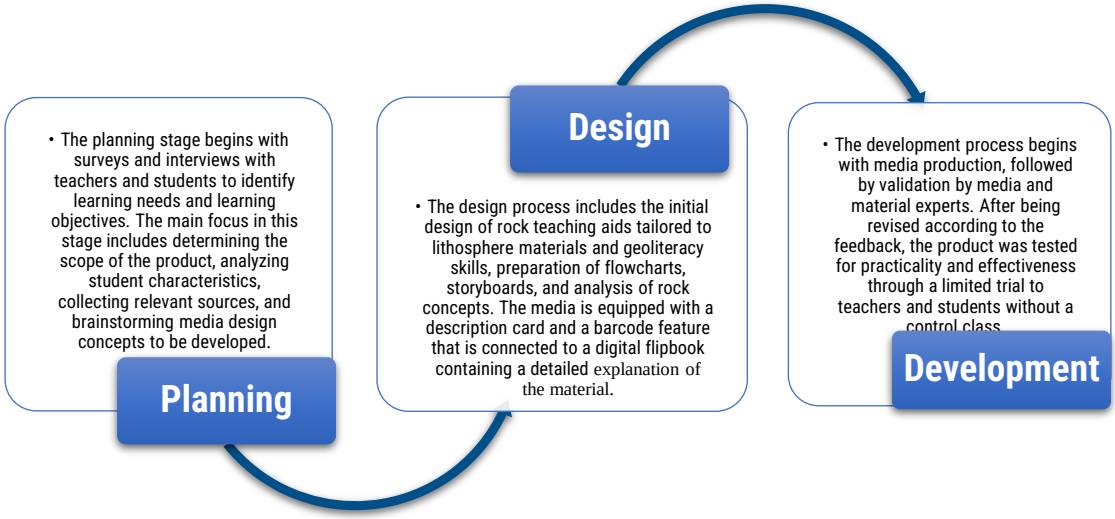

Figure 1: Research and Development (R&D) Research Stages

After conducting the product development stage of the rock props media, researchers adjusted the research instrument to suit the students' characteristics and the local area's conditions. Therefore, validity and reliability testing are needed to ensure its accuracy and consistency (Alfiansyah et al., 2025). The validity test of the rock props media was carried out by media experts, practitioner experts, and small group tests. Furthermore, the validator will provide a general assessment and provide suggestions for improvement or revision. Validation is carried out by experts who are experts in their fields. The validation process is carried out before being tested on students to improve geoliteracy skills.

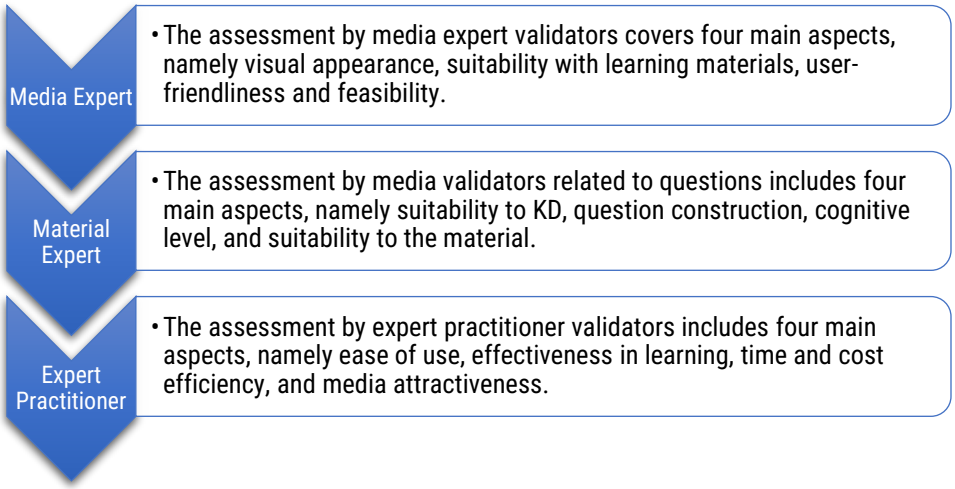

Figure 2. Flow of Media Development Validation

The data analysis technique used in this research is quantitative descriptive analysis, which calculates the percentage of scores given by experts and small group trials. Sample selection in this study was carried out by considering the criteria. Based on the guidelines by Arikunto (2002), which states that if the population is large enough, then 20-25% can be taken with a total population of 91 people. Therefore, in this study, representatives of class X social studies students, totaling 23 people, became the research sample at SMAN 1 TOJO. The selection aims to ensure that the data obtained can reflect the condition of

the population as a whole and provide more accurate and comprehensive results. Simanjuntak (2022). The following formula is used to obtain the percentage of validity of the rock props media.

$$P = \frac{x}{\Sigma xi}\ x\ 100$$

Description:
P = Score sought
x = Total number of respondents' answers in all points
Σxi = Total number of ideal values in points
100 = Constant Number

The feasibility level of the validity of the product resulting from the development is assessed by the percentage of the score obtained. The higher the score obtained, the better the feasibility of the validity of the product. The feasibility of media validation is based on specific criteria: if the percentage is 81%-100%, then the category is very feasible. If the percentage is 61%-80%, then the level can be said to be feasible. If the percentage reaches 41%-60%, then the category is quite feasible. And if the percentage is ≤20%-40%, then the category is not feasible. At the evaluation stage, the data analysis of the students' geoliteracy skills test results was carried out using a limited trial with a true-false assessment technique based on their answers to the questions given. The instrument used in this research is a multiple-choice test (Putra et al., 2020). The questions given have been validated and processed for validity using SPSS IBM 22. Each correct answer is scored 1, while the wrong answer is 0.

Furthermore, the total score of each student is calculated by summing up all correct answers. This score was then converted into a percentage using the percentage formula of the number of correct answers divided by the total number of questions and multiplied by 100%. The results of this percentage were used to group students into categories of geoliteracy skill levels, which are classified in the following table:

Table 1. Analysis of Student Geoliteracy Skills Test Results

No.	Category	Score
1.	Very good	≥85%
2.	Good	70%-84%
3.	Fair	55%-69%
4.	Insufficient	<55 %

Source: Febriyana, (2023)

RESULT AND DISCUSSION

Learning media in the form of rock teaching aids is one tool that teachers can use to support the teaching and learning process. This rock specimen teaching aid consists of a title, two QR codes leading to an online Flipbook, brief information about types of igneous, sedimentary, and metamorphic rocks, examples of real rock specimens, labeled containers for rock characteristic cards, and interactive cards used by students to match rock types in groups. The Flipbook includes a cover, an introduction outlining the objectives and benefits, an overview of the material, a table of contents, an introduction covering core competencies and module descriptions, and usage instructions. The material covers the definition of the lithosphere, its history, types of rocks (igneous, sedimentary, metamorphic), cycles, and their benefits. At the end, there is a summary, practice questions via barcode (Google Form), and a bibliography. This Flipbook was created using the Heyzine platform, which converts PDF documents into interactive digital books with a layout resembling printed books and page-turning effects. Access is easy, simply through a link or by scanning the available QR code, without needing to download additional apps, making it convenient for students to access the material online or through offline teaching aids.

Figure 3. Visualization of rock teaching aids (offline) and flipbooks (online)

Feasibility validation by media experts

Validation of the feasibility of rock props media was carried out by media experts in the field of geography education by filling out the validation instrument. The results of validation from media experts can be seen in Figure 4 below:

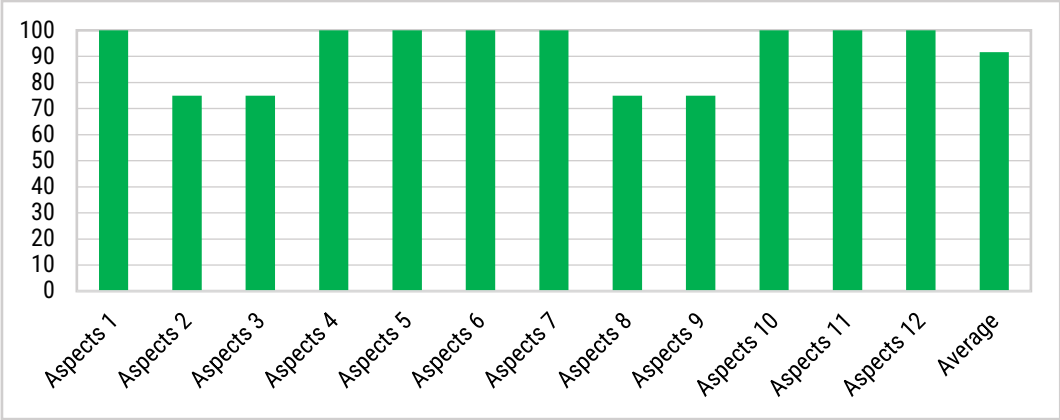

Figure 4. Graph of Media Expert Validation Results

Based on the graph of validation results by media experts, it is known that the first aspect, namely the quality of the media display, obtained a 100% feasibility level. The second aspect, the suitability of the size and shape of the teaching aids to the learning needs, scored 75%. The third aspect, namely the quality of materials and durability of teaching aids, also received 75%. Furthermore, the fourth aspect of content alignment with geography learning objectives reached 100%, as did the fifth aspect that assessed the clarity of information in the teaching aids. The sixth aspect on the relevance of the teaching aids to the characteristics of the rock material and the seventh aspect on the ease of use by teachers/students also received a perfect score of 100%. The eighth and ninth aspects, namely the safety of use and ease of use of the teaching aids to be moved or stored, each scored 75%. The tenth and eleventh aspects, regarding the effectiveness of teaching aids in Lithosphere learning and the attractiveness and motivation of student learning, scored 100%. Finally, the feasibility aspect of teaching aids as learning media was also declared 100% feasible.

Overall, the media expert's assessment shows an average feasibility of 91.66%, so that the rock props are declared very feasible to use in learning. This is in line with research conducted by Seviana, (2022) related to the product developed obtained a very valid assessment from media experts, with a total percentage of feasibility reaching 95%. However, some inputs or suggestions for improvement have been submitted by experts for further improvement.

Feasibility validation by Expert Practitioner (Teacher)

Validation of the rock props media also went through a validation stage from geography subject teachers at SMA N 1 Tojo. The validation results from practitioners or teachers are presented descriptively through the questionnaire method, with a questionnaire instrument. Based on the graph in Figure 5 of the results of the subject teacher validation of the rock props media after implementation, the results show that the aspects of ease of use by teachers and students, clarity of instructions, and no need for special skills all scored 100%. Similarly, the aspects of effectiveness of material delivery, increasing student understanding, support for interactive learning, and time efficiency also received maximum scores. The cost aspect of media procurement against the benefits scored 75%, while the attractiveness and visual appearance aspects of the media again scored 100%. Overall, the average percentage of teacher validation reached 97.5% and was categorized as very feasible for use in learning. These results are in line with the research of Nisa' et al., (2024) which showed that the validated learning tools obtained an average score of 80% and were declared feasible without the need for revision.

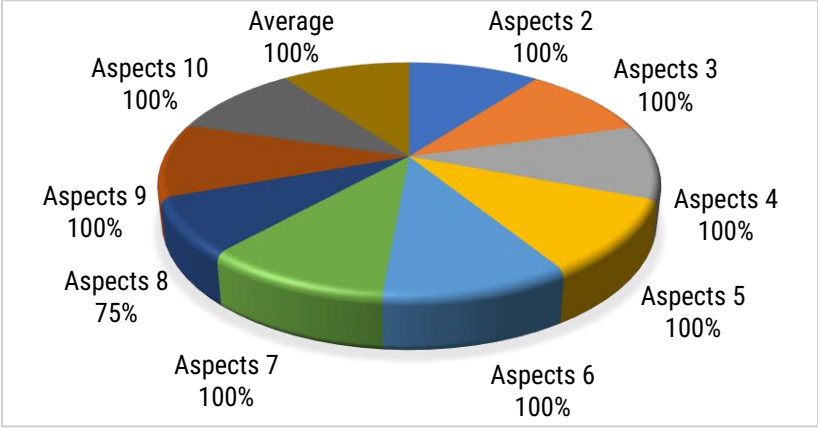

Figure 5. Graph of Teacher Validation Results

Small Group Test (Media Effectiveness)

The product effectiveness test stage is assessed based on student responses after using the learning media and participating in the activities provided in the Lithosphere learning media, namely the types of rock types using rock props. The testing process is generally carried out by individuals who have a deep understanding of quality assurance aspects (Latif et al., 2023). The sample of 23 students in class X IPS is in accordance with the theory put forward by Arikunto (2002) in Simanjuntak's research, (2022).

Table 2. Small group test results

No.	Respondent	P1*	P2*	P3*	P4*	P5*	P6*	P7*	P8*	P9*	P10*	P11*	P12*	X	Xi
1.	Respondent 1	4	4	4	4	4	4	4	4	4	4	3	4	45	48
2.	Respondent 2	4	4	3	4	4	2	4	2	4	3	4	4	43	48
3.	Respondent 3	4	4	3	4	4	4	4	4	4	4	4	4	47	48
4.	Respondent 4	4	4	4	4	4	4	4	4	4	4	4	4	48	48
5.	Respondent 5	4	4	4	4	4	4	4	4	4	4	4	4	48	48
6.	Respondent 6	4	4	2	4	4	2	4	3	4	2	4	4	42	48
7.	Respondent 7	3	3	3	4	3	4	3	3	3	3	3	3	38	48
8.	Respondent 8	4	4	4	4	4	4	4	4	4	4	4	4	48	48
9.	Respondent 9	4	4	2	4	2	4	3	4	4	4	3	3	41	48
10.	Respondent 10	4	4	4	4	4	4	4	4	4	4	4	4	48	48
11.	Respondent 11	4	4	3	2	4	3	4	4	2	4	4	4	42	48
12.	Respondent 12	4	4	3	4	4	4	3	4	3	4	2	4	43	48
13.	Respondent 13	4	4	4	4	4	4	4	4	4	4	4	4	48	48

No.	Respondent	P1*	P2*	P3*	P4*	P5*	P6*	P7*	P8*	P9*	P10*	P11*	P12*	X	Xi
14.	Respondent 14	3	4	4	2	4	4	2	4	4	4	4	4	43	48
15.	Respondent 15	4	4	4	4	4	4	4	4	4	4	4	4	48	48
16.	Respondent 16	3	3	4	4	4	3	2	4	3	3	4	4	41	48
17.	Respondent 17	4	4	2	4	4	2	4	4	4	4	4	4	44	48
18.	Respondent 18	4	4	3	3	4	3	4	4	2	4	4	4	43	48
19.	Respondent 19	4	4	2	4	4	4	4	4	4	4	4	4	46	48
20.	Respondent 20	4	3	2	4	4	4	3	3	4	4	3	3	41	48
21.	Respondent 21	4	4	4	4	4	4	4	4	4	4	4	4	48	48
22.	Respondent 22	2	3	3	3	3	3	4	3	3	3	3	3	37	48
23.	Respondent 23	3	2	2	3	3	4	3	3	2	2	2	3	32	48
Validation Result													921	1.004	

Source: Results of data processing 2025.

Description P1* = Question 1, P2* = Question 2, etc. ....

If calculated, then:

$$P = \frac{921}{1.004} X\ 100\%$$

= 91,73%

Based on the analysis of the assessment score of product effectiveness, a product is considered very effective if it gets a percentage of more than 80%. In the evaluation, the average percentage of student responses reached 91.73%, which is included in the effectiveness category, is very valid or very feasible to use. This is in line with previous research, namely Hasni et al., (2022) ewith the title Development of Interactive Learning Media Using Articulate Storyline on Lithospheric Material for Junior High School Students, which states that if the validation results above are> 72.52%, which means that the practicality of the media is or is included in the practical category, the percentage obtained can be concluded that the media developed is acceptable and gets a good response from students. In addition to the research above, the feasibility of learning media is also reinforced by the statement that a medium is considered feasible if it obtains a percentage score above 79.37% (Nisa' et al., 2022).

Question Validation by Material Experts

Validation of student geoliteracy skills questions is done through multiple-choice questions that have been validated by material experts and then by students at the same school. The validation results from material experts related to questions are presented descriptively through a questionnaire method with a questionnaire instrument.

Based on the graph in Figure 6 of validation results by material experts, aspects one to four related to the suitability of questions with KD and learning indicators each scored 75%. The fifth aspect regarding the clarity of the questions received 50%, while the sixth aspect regarding the accuracy of the answers received 100%. Each of the seventh and eighth aspects, related to language clarity and not trapping answer choices, received 75%. The ninth aspect, which assessed freedom from racial and gender bias, received 100%. The tenth to fourteenth aspects, covering the level of difficulty and cognitive level (C1-C6), scored 75% each. The fifteenth aspect on the suitability of geology/geography concepts received 100%, while the sixteenth and seventeenth aspects, related to the accuracy of the concept and suitability of the material to the level of education, received 75%. The total average assessment from the material experts was 73.61%, which was categorized as feasible. Furthermore, question validation was carried out on 34 students of class X IPS. Of the 40 questions tested, after being analyzed using SPSS IBM Statistics 22, the remaining 28 multiple-choice questions were declared valid and included geoliteracy indicators: interaction, interconnection, and implication. The reliability analysis results obtained were .867 with a reliable category, meaning it can be used for further research.

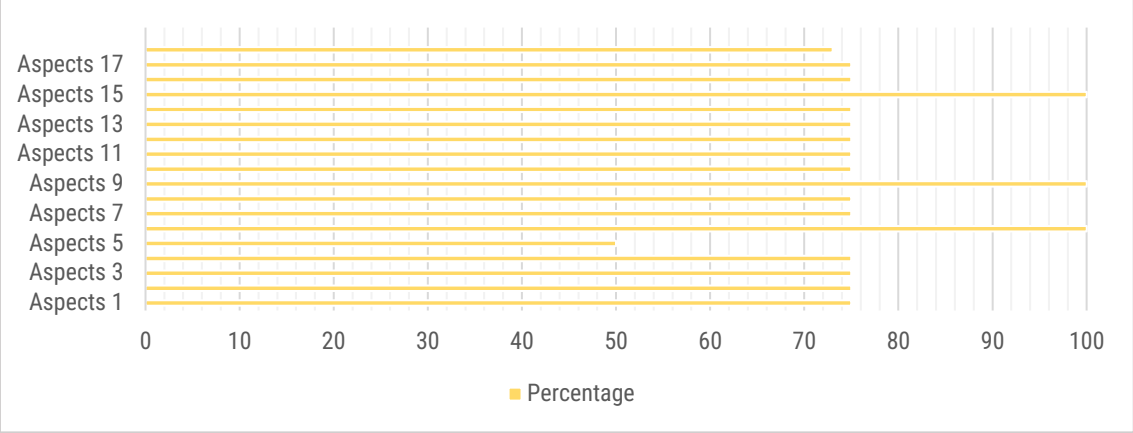

Figure 6. Graph of media expert validation results by material experts

This is in line with research conducted by (2024), which states that based on the results of reliability calculations using the Cronbach's Alpha formula, an r11 value of 0.885 was obtained for the questionnaire and 0.878 for achievement scores. These results indicate that the instruments, both in the form of questionnaires and achievement tests, are classified as reliable. This is because the reliability value obtained for each variable is above 0.60, so the instrument can be considered to have good consistency. This research is also reinforced by (2015), which stipulates that if the r11 value is greater than 0.70, then it is declared reliable, and vice versa, if the r11 value is smaller than 0.70, it is declared unreliable.

Geoliteracy Skills Test

After the validation process, the number of questions used in the student geoliteracy skills test remained at 28 items. These questions were then worked on by SMA N 1 Tojo students, and the test results showed the level of their geoliteracy skills based on the answers given. The questions consisted of 3 geoliteracy indicators, namely interaction, interconnection, and implication, spread across 28 multiple-choice questions. This is in line with previous research conducted by Karismatika et al., (2020) related to the assessment of geoliteracy skills by measuring students' initial scores before being given the post-test treatment. This pre-test consists of 20 multiple-choice questions designed to assess students' initial knowledge. After the treatment was given, geoliteracy skills were re-evaluated using a post-test. The pre-test and post-test contained geoliteracy indicators covering aspects of interaction, interconnection, and implication. The three indicators were randomly distributed in the 20 multiple-choice questions used in both tests (Meechandee & Meekaew, 2025). The results of the geoliteracy skills test of students at SMA N 1 Tojo shown in Figure 7.

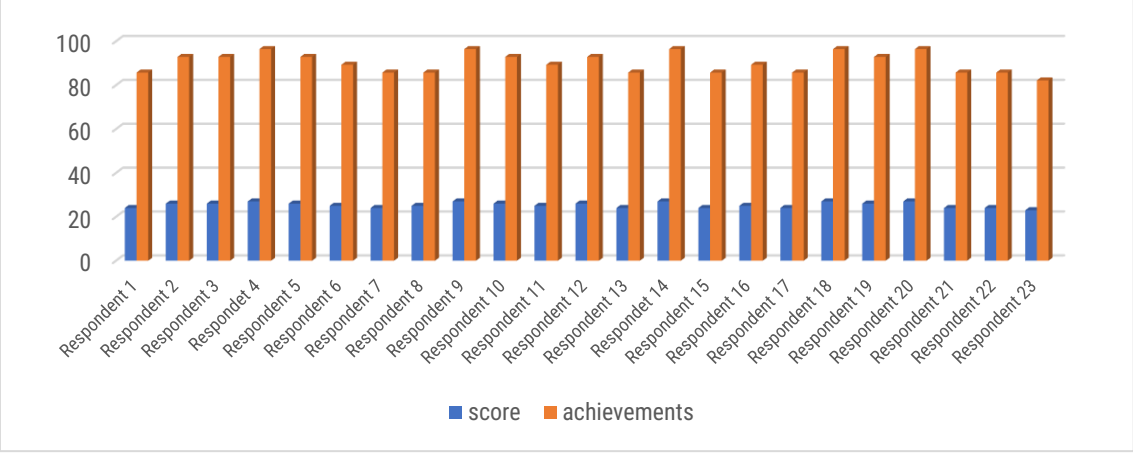

Figure 7. Geoliteracy Skills Test Results (Source: Data Processing 2025)

Based on the achievement of the average score and percentage of student geoliteracy skills test

results above 85%, with an overall category of very good. The percentage of each of the 3 geoliteracy indicators, consisting of interaction, interconnection, and implication, is shown in the following table 3.

Table 3. Percentage of Student Geoliteracy Indicators

Geoliteracy Indicators	Number of valid questions	Total number correct	Percentage (%)
Interaction	10	219	95,21%
Interconnection	10	197	85,65%
Implications	8	147	79,89%
Average Percentage			86,91%

Source: Data processing results 2025

Based on the results of the student geoliteracy skills test, the average score obtained was 86.91%, with a very good category level. The questions are spread over 28 items with the following conditions:

a. Interaction

Geoliteracy indicators in the interaction aspect serve to measure students' ability to understand the interrelationships between geological phenomena as a basis for decision making. This aspect emphasizes the reciprocal relationship between human activities and natural environmental conditions (Karismatika et al., 2020). In the context of the material on rock types and their formation processes, the most relevant items for this indicator are those that test learners' understanding of the concept and process of rock formation. Learners who can answer these questions correctly show an understanding of the dynamics of geological interactions in the context of geography. Out of 28 items, 10 were developed specifically to measure the ability in the interaction aspect. As a result, 23 learners answered a total of 219 items correctly, indicating an achievement percentage of 95.21%.

b. Interconnection

Geoliteracy indicators in the interconnection aspect test students' skills in understanding the relationship between one concept and another. Interconnection is the relationship between interconnected scales, where a place or event can influence and be influenced by other places or events in a broader scope. In the material of rock types and their formation process, the interconnection aspect is closely related to understanding how each type of rock is interconnected in the rock cycle. Natural processes such as weathering, erosion, and changes in pressure and temperature cause rocks to undergo transformation from one type to another. These changes not only affect the surrounding environment but also affect the geological landscape on a broader scale. In this interconnection indicator, there are 10 items out of a total of 28 items aim to measure students' understanding of the relationship between rock types and their formation processes. The total number of correct answers from the 10 interconnection items done by 23 students reached a total of 197, with a percentage of 85.65%, in the very good category. This is in line with Srilisnani et al., (2019), who stated that the average student activity during Practicum II at the second meeting reached a percentage of 83.3%, which is included in the very good category.

c. Implications

The implication aspect of the geoliteracy indicator measures students' ability to make decisions based on an understanding of interactions and interconnections. In the topic of rock types, this indicator assesses students' ability to identify problems and formulate solutions related to changes and the utilization of rocks in everyday life. Of the 8 questions on the implication aspect, 23 students answered a total of 147 correctly, with a percentage of 79.89%. The average score of geoliteracy increased significantly from KKM 55% to 86.91%, including in the very good category.

Limitation and Recommendation

The results of the development of rock teaching aids have limitations in their development such as examples of rocks that are displayed have a relatively small size so that they are slightly less clear when viewed from a distance, which has the impact that respondents must be limited to be effective in their application. The students must look closely and identify it in the learning process. The data collection

also takes a short time, potentially affecting the depth of information obtained from respondents. Based on the results of the product trials that have been carried out, the researcher recommends that the next development of rock teaching aids is expected to be based on augmented reality (AR) technology if the area has better internet access and school facilities. So that it can improve geoliteracy skills optimally, a longer time allocation is also needed in the data collection process to obtain more representative and in-depth results.

CONCLUSION

Based on the assessment of media validators, the developed rock teaching aids obtained an average score of 91.66%, with a very feasible category to be developed. Based on the assessment of the practitioner validator, the rock props media received an average score of 97.61%, with a very feasible category to be tested on students. Assessment from material validators related to the questions used in the geoliteracy skills test, with an average percentage score of 90.27%, in a very valid category. The assessment of the trials received an average percentage of 91.73%, with the category of rock teaching aids media being very valid or feasible for use in the learning process. The rock props media proved to improve students' geoliteracy skills by conducting a geoliteracy skills test and working on 28 items. The average percentage of scores obtained by students is 94.22%, which is in the very good category. The KKM score increased from the previous 55%.

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