The Development of Mobile Geography Virtual Laboratory for Rock and Soil Practicum Studies

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Abstract—The concept of concrete lithosphere material has limitations in being verbally stimulated by the teacher, so students have difficulty understanding the material. During the learning process, lithosphere material is rarely carried out in practicum activities due to the lack of media that can involve students directly. This study aims to produce, measure feasibility, and determine the effectiveness of mobile geography virtual laboratory learning media. This research was included in R&D research by adopting a 4-D development model. The results obtained, namely the Mobile Geography Virtual Laboratory media, are feasible and effectively used in rock and soil practicum activities. The results of this research can be an innovative solution for geography learning, especially in adequately supporting the implementation of practicum activities so that students can become more active and independent.

Keywords—mobile geography virtual laboratory, practicum, rock and soil

1 Introduction

Learning media development is a process used to produce learning media by providing stimulus to students [9]. Learning media planning also refers to the development of media influenced by technological developments. The use and application of technology have experienced rapid development and affect various aspects of learning. Therefore, the development of learning innovations combined with information technology can improve the quality of learning.

Mobile Geography Virtual Laboratory is one of the software learning innovations developed and can be used flexibly and effectively on any smartphone [10]. In this case, using the Mobile Geography Virtual Laboratory allows students to get material reflections quickly and minimize differences in understanding concepts during learning. The development of the Mobile Geography Virtual Laboratory as a means of practicum with the support of school-owned e-learning will facilitate the needs of students in learning geography so that the learning process in the network does not reduce the competence and capability of students. Various features provided by the technology allow the presentation of material that can be accessed and applied outside

and inside the classroom, especially in geography learning. The benefit of using the Mobile Geography Virtual Laboratory can be used to demonstrate theoretical concepts through visual representations to students. It is because the Mobile Geography Virtual Laboratory is an essential supporter of strategically implementing learning activities in school [11].

Geography learning has characteristics in each learning material and is closely related to practicum activities. A practicum is a learning activity requiring students to be more active in problem-solving [31]. In this case, students can gain a deep understanding and solve problems through a scientific process that connects with the concepts of the material taught in the classroom [21]. The Geography competencies that can be supported by the existence of the Mobile Geography Virtual Laboratory media include the competencies of affective, cognitive, and psychomotor aspects. It is because the practicum activity using the Mobile Geography Virtual Laboratory can equip students to analyze and evaluate phenomena related to the object of study of geography. Thus, the Mobile Geography Virtual Laboratory can support students in improving attitudes, knowledge, and skills [14]. One of the material objects in geography that requires practicum activities to support students' understanding is lithosphere material. The lithosphere is material that requires contextual understanding [13].

The Mobile Geography Virtual Laboratory is a necessary alternative when the availability of a natural laboratory does not allow it to exist in every school, especially in supporting the delivery of lithosphere material, which is the object of geography study. It is due to the expensive practicum costs and the limited facilities of tools and materials [28]. The characteristics of the lithosphere material are not limited to memorized material, but practicum activities need to be carried out. Lithosphere material has limitations in being simulated and explained orally by the teacher, so it is necessary to have a concrete experience to understand the material's essence. In the material characteristics of the earth's crust and the distribution of soil, which have many differences, teachers need innovative media to support school geography learning. The Mobile Geography Virtual Laboratory media developed on lithosphere material includes studying rock and soil types.

Learning media based on Mobile Geography Virtual Laboratory is a solution to supporting students to develop inquiry and motivation in the learning process. Mobile Geography Virtual Laboratory technology provides a flexible learning environment that can provide meaningful learning. Mobile Geography Virtual Laboratory positively impacts learning objectives and can compensate for the lack of laboratory facilities in schools [30]. The use of geography laboratories is very effective in improving student learning outcomes [33]. As an answer to the obstacles that arise during the learning process, the existence of the Mobile Geography Virtual Laboratory is critical, particularly in lithosphere material that requires various teaching aids as a medium to support student understanding [32]. Thus, the existence of a Mobile Geography Virtual Laboratory needs to be developed to support geography practicum activities in schools.

2 Method

This research was included in R&D research with a 4-D development model (Define, Design, Develop, and Disseminate). The defining stage, namely, there are steps including front-end analysis, learner analysis, task analysis, concept analysis, and specifying instructional objectives. The design stage involves selecting media development tools, making storyboards, and prototyping. The development stage was producing development products, expert validation, product revision, and feasibility tests [16]. Finally, the dissemination stage is empirical validation, packaging, deployment, and use.

The types of data used are qualitative and quantitative data. Qualitative data is obtained from the comments, criticisms, and suggestions of expert validators and geography teachers. Quantitative data comes from the results of product feasibility tests and effectiveness tests. The research subjects included geography teachers and 36 social sciences students at MAN 2 Banyuwangi [27]. The location was chosen because MAN 2 Banyuwangi is the best Islamic school in Banyuwangi. In addition, according to the needs analysis in the school, there is no geography laboratory, so practicum activities are still carried out in the physics laboratory. It is one of the obstacles for teachers because of the limited management and utilization of laboratories in schools. Practicums in geography are held approximately 4-5 times per year. This study uses quantitative-qualitative combined descriptive analysis techniques [12]. The percentage calculation process is with the following formula:

$$Percentage = \frac{Obtained\ score}{Max\ score} x\ 100\% \quad (1)$$

The data calculated for the feasibility percentage is then classified into five feasibility criteria as stated by Arikunto [12]. Before the effectiveness test stage is carried out, it is necessary to test an instrument in the form of an analysis of question items, which includes validity and reliability tests. The effectiveness test results are derived from the experimental and control group's post-test scores, which are then processed with normality tests, homogeneity tests, and an independent sample t-test to determine differences in students' understanding related to the study of rock and soil types. As for measuring the success of the effectiveness of the Mobile Geography Virtual Laboratory learning media, an assessment was carried out based on research by De Lone and McLean [8].

The assessment model of success regarding the effectiveness of the Mobile Geography Virtual Laboratory learning media, according to De Lone and McLean, is by reflecting on six indicators, including 1) system quality; 2) information quality; 3) service quality; 4) user intentions; 5) user satisfaction; and 6) net benefit [19]. The data that has been calculated the percentage of effectiveness is then classified into five criteria of effectiveness [18].

Table 1. Feasibility and effectiveness criteria

Percentage of assessment results (%)	Interpretation
81–100	Very feasible/very effective
61–80	Feasible/Effective
41–60	Sufficient feasible/ Sufficient effective
21–40	Less feasible/Less effective
0–20	Unfeasible/Uneffective

Sources: Arikunto [12]; [18]

3 Results and discussion

The learning media in the form of a virtual laboratory is named "Marvelo: Mobile Geography Virtual Laboratory", packaged in the form of an application (.apk). The Mobile Geography Virtual Laboratory was developed on lithosphere materials focusing more on rock and soil practicum materials. The Mobile Geography Virtual Laboratory can be operated easily on all types of Android, requires an internet network when downloading, and the application screen is landscape-shaped with a two-segmented (2D) display and can be accessed anywhere and anytime. The development of this learning media aims to be one of the innovations in practicum activities when the provision of a natural laboratory is still inadequate so that this learning media can be an alternative to overcome these problems [7].

1. The initial view of the application

Fig. 1. Start view of application and login menu

2. There is a main menu that includes competencies, materials, practicum, evaluation, and references

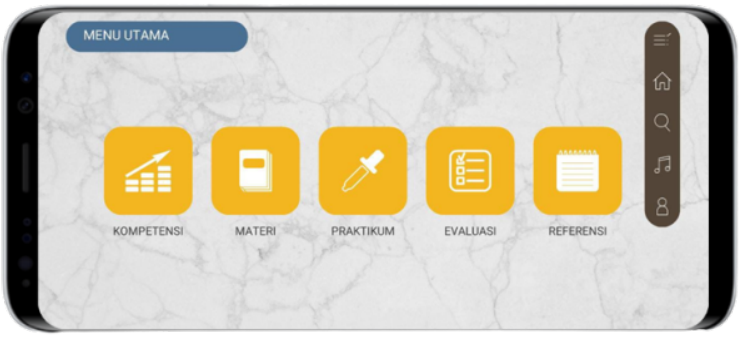


Fig. 2. Main menu of the application

Based on the results of an online questionnaire related to needs analysis distributed to 40 students at MAN 2 Banyuwangi, it shows that 92.5% chose the need to create a Virtual Laboratory for Geography subjects, especially lithosphere materials in the school. This is because, from the questionnaire results, as many as 80% of students said that in geography learning, especially lithosphere material, it is rare even to do a practicum, considering that practicum equipment is quite expensive. Information was also obtained that in MAN 2 Banyuwangi, there is no geography laboratory, while as many as 95% of students agree that practicum activities will be better if there is a geography laboratory. It then impacts the lack of student experience in understanding the material in detail. The lithosphere material is one of the materials that are difficult to teach because it is factual, concrete, and contains many concepts.

Table 2. Students analysis

Analysis	Agree	Disagree
Is it necessary to create a virtual geography laboratory on lithosphere material for practicum studies, so that you can better understand it?	92,5%	7,5%
Has there ever been a practicum during the geography learning process, especially for lithosphere material?	20%	80%
Do you agree that practicum studies would be better if there was a geography laboratory?	95%	5%

The Mobile Geography Virtual Laboratory can provide practicum experience, make students more active, and provide opportunities to explore the knowledge taught so that it is not only centred on the teacher [29]. The Mobile Geography Virtual Laboratory can support the creation of dynamic, flexible, interactive, and animative practicum activities [23]. These learning media can also support independent learning and collaborative problem solving and improve students' skills [5]. The Mobile Geography

Virtual Laboratory makes students more comfortable in the laboratory without having to look for practicum tools and materials so that students become more focused.

In this case, although the virtual laboratory cannot replace practicum activities directly in the natural laboratory, the existence of a virtual laboratory can provide students with an overview of practicum simulations [6]. Thus, the existence of the Mobile Geography Virtual Laboratory can support the learning process of student geography, especially in lithosphere material, and can be an alternative media when practicum activities cannot be carried out directly due to various things.

The Mobile Geography Virtual Laboratory is one of the digital applications developed using the Contains Adobe AIR technology by Adobe Inc. and the HARMAN program. Before the practicum is carried out, students must read the instructions for use first to facilitate the operation of the application.

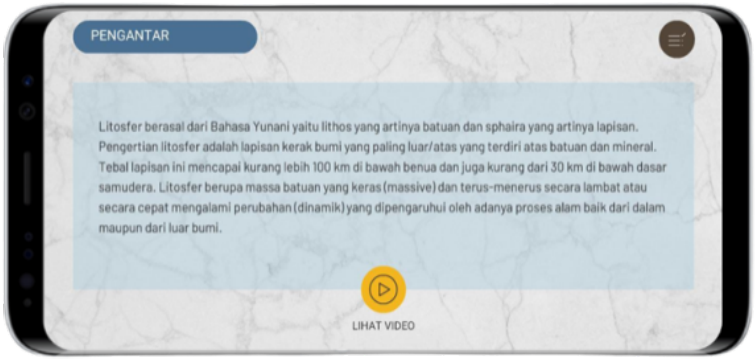
Fig. 3. Instructions menu of the application

The material in the Mobile Geography Virtual Laboratory media consists of the concept of the lithosphere, rock cycles, types of rocks and soils, soil formation processes, and additional information. The presentation of material in the Mobile Geography Virtual Laboratory is to support practicum activities and become a source of knowledge for students. Before studying the material, students must read the competencies provided as a reference for expected behaviour changes after learning is completed [25]. The lithospheric concept material is presented in text form with an animated video. The rock cycle material contains rock cycle processes that are depicted simply in the form of text and animated images.

Rock and soil type materials are sourced from geological structures that are by the conditions of the student learning environment (Banyuwangi Regency) [24]. The types of rocks being studied are igneous, sedimentary, and metamorphic rocks, each equipped with an explanation and five examples of rocks and their characteristics. The type of soil used refers to the Indonesian Soil Classification System, which includes latosol, alluvial, peat, podzolic, regosol, lithosol, volcanic, humus, and grumusol soils [26]. The material of the soil formation process includes five factors, namely climate, organisms, time, vegetation, and parent material, which are packaged in the form of animated images. The material also includes explanations ranging from the processes of weathering, leaching, transformation and illuviation, podsolization and translocations.

Fig. 4. Material menu of the application

The Mobile Geography Virtual Laboratory content must refer to learning objectives and outcomes. Content is presented with multimedia concepts in a text, video, images, and animations relevant to the lithosphere material [4]. It aims to make it easier for students to understand the material and carry out practicum activities.



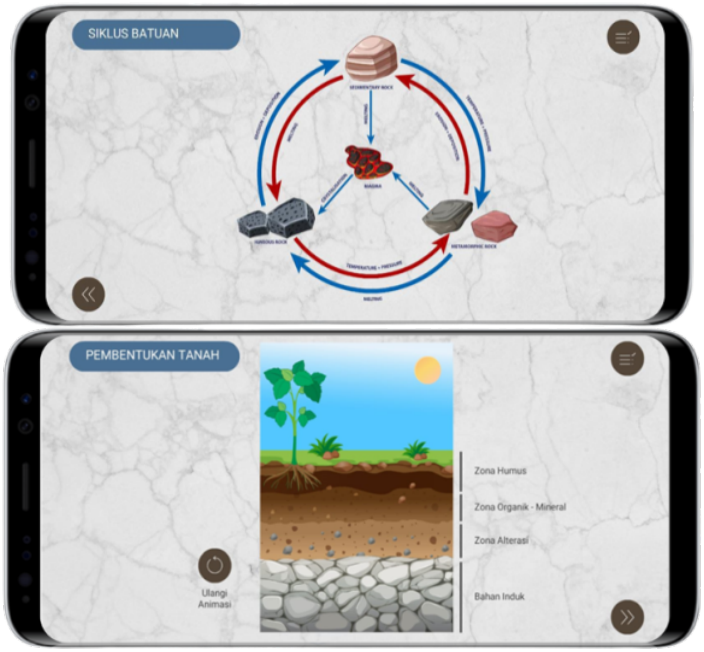


Fig. 5. Multimedia content of the application

The Media Mobile Geography Virtual Laboratory also provides an additional information menu containing local content in Banyuwangi Regency. In this case, local content is defined as all the works and potentials contained in a region that later become characteristic of the region [15]. The local content in the Mobile Geography Virtual Laboratory learning media includes excellence, wisdom, and renewal (contemporary). The advantage is in the form of an explanatory video about the process of forming Ijen Crater as knowledge for students. Wisdom is in the form of a video explanation of the process of forming sulfur and blue fire. The renewal (contemporary) is based on the type of rock and soil in Banyuwangi Regency in 2020.

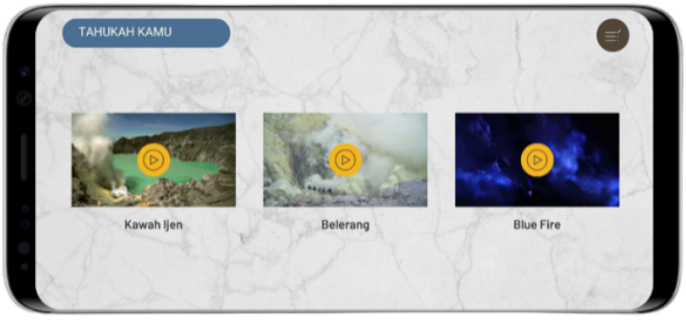


Fig. 6. Local wisdom material

The Mobile Geography Virtual Laboratory media practicum menu consists of the Rock Laboratory and the Soil Laboratory. In each laboratory room that has been provided, each of them lists the purpose of the practicum, tools and materials, as well as practicum steps. For example, the Rock Laboratory menu is to test the lime content of the rocks that have been provided. The "Soil Laboratory 1" menu tests lime and soil organic matter content, while the "Soil Laboratory 2" menu identifies soil colours using the Munsell Soil Colour Chart Book. In this case, students can do the practicum independently by selecting (touchpad) the tools and materials used and seeing the experiments' reactions. The resulting reaction is in the form of a "bubbly" reaction if the rock or soil has "lime content" or "organic matter".

Fig. 7. Practicum menu of the application

The evaluation menu in the Mobile Geography Virtual Laboratory media contains five multiple-choice questions related to the practicum material. The goal is to see students' depth of understanding after conducting practicum activities. It is also done to train students' skills and understanding to achieve minimum competence [17]. The evaluation questions are integrated directly with the Google Form quiz format so that they can be accessed online and students can determine the number of scores obtained.

Fig. 8. Evaluation menu of the application

The advantage of the Mobile Geography Virtual Laboratory is that it can facilitate online learning. Mobile Geography Virtual Laboratory can help students save money on laboratory equipment, which can be costly, complicated, and dangerous [2]. The media allows students to carry out practicum activities without having to go to the actual laboratory room, so it can be a solution to the demands of using technology in learning. In its use, the Mobile Geography Virtual Laboratory is more flexible in terms of time and location, the practicum is safer to do, and the results are fast and can be repeated directly [3]; [22]; [20]. The disadvantage of the Mobile Geography Virtual Laboratory media is that the material developed is still limited, so it is recommended to be developed in other sub-materials that are still related to practicum activities. Another drawback is that students will experience a little difficulty in operation if they

do not adequately pay close attention to the instructions for use and without guidance from the teacher.

The feasibility of the Mobile Geography Virtual Laboratory media comes from the validation results of media experts and material experts, as well as product trials with geography teachers and 18 students of social sciences [1]. Based on the validation results, the Mobile Geography Virtual Laboratory has a criterion of "very feasible" to be tested. As for the results of product trials for teachers and students, the Mobile Geography Virtual Laboratory media has criteria that are "very feasible" to use.

The effectiveness of the Mobile Geography Virtual Laboratory media comes from the assessment of student post-test results in the experimental group and control group. As for measuring the success of the effectiveness of the Mobile Geography Virtual Laboratory media. The following is a summary of the results of the research data acquisition.

Table 3. Result of independent sample t-test

Observation	Mean Difference	Result of Independent Sample T-Test	Conclusion
O_1 dan O_2	10,55	(Sig. 2 Tailed) 0,025 < 0,05	Terdapat perbedaan signifikan dan hasil *post-test* $O_2 > O_1$

Table 3 shows that the independent sample t-test is 0.025 < 0.05, meaning they have a significant difference, while the post-test results have a mean difference of 10.55. It is because the O_2 post-test value is more significant than O_1. It shows that there are differences in student learning outcomes and understanding in the study of rock and soil material, which is delivered without media assistance and using the Mobile Geography Virtual Laboratory. Thus, there is a conclusion that the Mobile Geography Virtual Laboratory learning media is effective in learning lithosphere material. The Mobile Geography Virtual Laboratory is a relatively new media for students, therefore the media is packaged by incorporating one of the principles of media development, it is the principle of simplicity. This media contains the main points in accordance with the material and learning objectives, resulting in a simple impression, with details focused on practicum activities. The media also displays images that contain elements of motion in accordance with the principle of simplicity. The Mobile Geography Virtual Laboratory contains the function of a media, which can attract students to learn geography; there is a presentation of information that is packaged in a compatible manner; and there is instruction with practicum activities carried out. Mobile Geography Virtual Laboratory can create interaction and communication between teachers and students directly or indirectly, which can help overcome obstacles in the learning process. Therefore, the Mobile Geography Virtual Laboratory can also be used as an alternative media for improving student learning outcomes.

In this case, questionnaires are also disseminated related to measuring the success of media effectiveness through assessing effectiveness indicators, according to De Lone and McLean [34]. Based on the results of the effectiveness assessment, it can be concluded that the Mobile Geography Virtual Laboratory is "very effective", according to students' responses. At the packaging stage, the Mobile Geography Virtual

Laboratory learning media is packaged in the form of an application (.apk) which can be accessed for free on all types of Android. At the deployment and use stage, it is carried out by distributing dissemination posters from the results of the development of mobile geography virtual laboratory media products to the geography teachers group via WhatsApp. This is done so that the dissemination and use of the Mobile Geography Virtual Laboratory media can be broad and utilized by geography teachers throughout Indonesia. In this case, the dissemination of the dissemination poster received various positive responses from teachers interested in trying the Marvelo Application for use in learning geography.

4 Conclusion

A virtual laboratory is one way to improve students' attitudes, knowledge, and skills. The virtual laboratory allows students to carry out practicum activities independently. Virtual laboratories as learning media can be found in the Mobile Geography Virtual Laboratory media. The Mobile Geography Virtual Laboratory used to demonstrate theoretical concepts through visual representations to students can be an effective medium for learning geography. When natural laboratories are still limited, the Mobile Geography Virtual Laboratory can facilitate student practicum activities actively and independently. The results showed that the Mobile Geography Virtual Laboratory media is feasible and effective for rock and soil practicum activities. Thus, the Mobile Geography Virtual Laboratory can be an innovative solution for geography learning, especially in adequately supporting implementation practicum activities. The weaknesses of the media can be minimized by further media development, which is focused on other sub-materials in practicum activities.

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