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Development of Basic Geology Mobile Learning Based on Android Indonesia Geodiversity Area

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ABSTRACT
Basic Geology is a prior knowledge that needs to be supported by a flexible learning environment through the use of mobile technology. Through the supports of mobile technology, students will gain freedom of access because they can be used anytime and anywhere. The progress and speed of technological development, the ease and practicality of using smartphone devices are the potential, opportunities and challenges for presenting mobile technology in learning. The presence of generation Z who are already familiar with technology has reinforced the need to utilize technology to accommodate them in learning better. The aim of this development research is to produce a learning product in the form of a Basic Geology mobile learning application to support learning anywhere and anytime and to determine the feasibility of the product in terms of media and materials, as well as responses from users. This research uses the Lee & Owens model in developing mobile learning applications. Data was collected using a questionnaire filled out by media experts, material experts and service users in the Indonesian Geodiversity Area. The results of this research are (1) user needs for mobile learning to support Basic Geology learning by providing learning resources and building learning communities, (2) producing Basic Geology mobile learning products, (3) results of feasibility tests by media experts, material experts and Individual, small group and field trials show that mobile learning is suitable for use in learning.

INTRODUCTION

Geology can be classified as a complex science and has a variety of material discussed, but it is also an interesting field of science to study (Noor, 2014). This field of science also has social relevance through preventing natural disasters and dangers related to floods, earthquakes, volcanoes, buildings, coastal erosion and others (Marcal et al., 2015). Basic Geology is the initial knowledge that needs to be studied by students who study Geography and is one of the knowledge requirements that students need to have in order to proceed to further knowledge so that different and novel learning strategies are needed so that they do not only use traditional methods in conveying but are also equipped with various learning media or teaching aids to make it easier for students to achieve the specified competencies (Sabirin, Mustofa, & Sulistiyarini, 2022). The involvement of technology is very important to support students in understanding abstract, complex and difficult to understand material (Muktiani, Rahayu, & Ardiyanto, 2022). In the digital era, technology plays a role in supporting students to be more independent in their learning process (Rafiola et al., 2020).

The challenge for the future is to prepare learning that is able to expand access to learning, accommodate learning styles and generational characteristics. According to (Ally & Prieto-Blázquez, 2014) in the future higher education must plan education to meet the demands of its student generation. Learning with the support of smartphone technology will be more widely used, intelligent systems will be everywhere, and learning will become more flexible. Students no longer access their learning

resources from just one source but through many sources. Through smartphone devices and Internet access, Z generation has access to more information than other generations. The information they want to know can be immediately obtained with just one click (Seemiller & Grace, 2017). Different from other generations, technology and the Internet for Z generation are things that must exist and are no longer seen as innovation. On the other hand, Z generation has a short attention span and understands visual images more easily so that in learning they can easily accept information presented in the form of images, animations and videos (Hastini, Fahmi, & Lukito, 2020).

Mobile learning is a learning experience that provides fast access so that it can be done anywhere and at any time according to the learner's wishes. This experience is carried out by providing learning tools and resources to build knowledge, gain learning satisfaction, develop experience and collaborate with other people. Mobile devices can link and connect informal and formal learning experiences and enable more real learning experiences (Suartama et al., 2019). Mobile learning technology provides a wider space for learning with a scope of learning inside and outside the classroom, anywhere, and at any time. This technology is effective to utilize if designed appropriately (Churchill, Fox, & King, 2016).

Mobile learning is also part of adapting to technological advances. Through this technological innovation, it is necessary to redefine the role of learner and learner while removing the barriers between formal and informal learning. This effort is part of the realization of lifelong learning and learning that supports the development of knowledge and skills that are currently needed in the workplace (McQuiggan et al., 2015). Currently, there has been a rapid increase in the use of mobile learning for learning to make it more effective and accommodate students' learning styles (Nuseir, Aljumah, & Refae, 2022).

Since being used as a Geology Field Campus in 1964, the Indonesian Geodiversity Area has been visited by thousands of students from various universities and various departments, not only from the geology department, but from the geophysics, geography, soil science, agriculture, civil engineering, and even social science departments. Apart from students, the Indonesian Geodiversity Area was also visited by kindergarten, elementary, middle school and high school/vocational school students. One of the earth education service activities in the Indonesian Geodiversity Area is the field lecture service which is routinely used by universities to broaden their students' insight into earth science. Earth education activities are carried out in class in the form of presentations from resource persons and also in the field by visiting several places and geosites in the Kebuman Geopark area. The Karangsambung area is a natural geological laboratory where various types of rocks with different formation processes due to unique geological processes and plate tectonic concepts can be studied and proven so that this area is important for the development of science, education, research and tourism (Ansori et al., 2022 ; Ansori, Raharjo, & Fariji, 2021; Hidayat et al., 2021).

However, from the results of observations there is no interesting mobile application-based media to increase users' learning motivation, the aim is that learning does not only occur when users receive knowledge while in the Indonesian Geodiversity Area but can also be used as a supplement to knowledge when in the field or anywhere when knowledge is needed. Apart from that, there is also no space to form a learning community and ask questions related to earth or things that the resource person wants to learn about with the support of a mobile device so that it can be accessed anywhere and at any time. In fact, the learning process can occur when there is interaction or communication between facilitator and learner, learner and learner or learner and their environment and is characterized by a reciprocal relationship in the learning process to achieve learning goals (Aisyah & Hardjo, 2022).

Therefore, by looking at the potential of mobile learning to support the learning

process both inside and outside the classroom, it is necessary to develop mobile-based applications that contain basic geological knowledge. Mobile learning provides more flexible access to learning materials, it can be accessed anywhere and at any time and that is one of the benefits of mobile learning (Nguyen & Pham, 2011). Apart from providing the best service to educational service users, this development effort is also to provide a rich learning environment to support active learning, a technology-based learning environment, an interactive learning environment, and building collaborative knowledge. Support in the form of space to form communities and ask questions needs to be developed in mobile applications.

The aim of this development research is to produce a learning product in the form of a Basic Geology mobile learning application to support learning anywhere and anytime and to find out product services in terms of media and materials, as well as responses from users.

RESEARCH METHODS

This development research is using the Lee & Owens model which consists of four stages, namely needs assessment and analysis, design, development and implementation, and evaluation. The Lee & Owens development model was chosen because this model is complete in the process and detailed in the front-end analysis stages. Apart from that, mobile learning contains several media such as text, images and videos so it is more suitable to use the Lee & Owens model rather than using other models that are less suitable, for example models for designing training or education programs specifically used to develop learning media. Because it eliminates multiple procedures. Use the process in this book and design in any media (Lee, W.W & Owens, 2004).

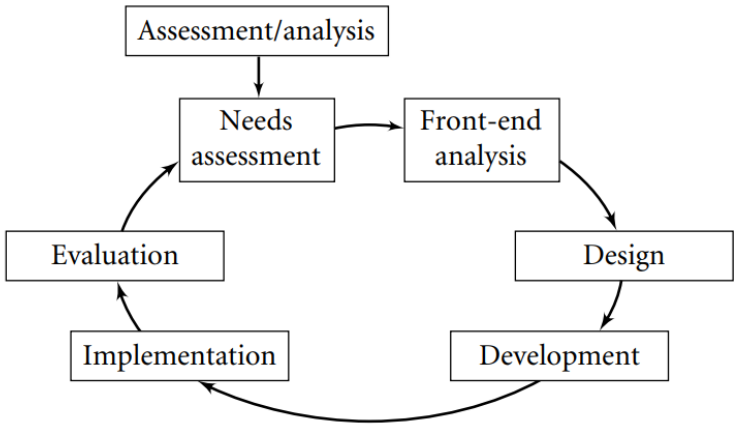

Figure 1. Lee & Owens Development Model

The first stage in developing mobile learning is conducting a needs analysis to determine the gaps that occur in the field. To carry out a needs analysis in developing mobile learning, the first stage is to identify the goals and objectives of the mobile learning that will be developed. The aim and target of developing mobile learning is to develop interesting and interactive learning media to increase learning motivation for students. The next stage is to collect information about the needs and expectations of users who will use mobile learning through interviews and observations. By comparing the information that has been collected, gaps that exist in the development of mobile learning can be identified, namely (1) competency gap analysis, by identifying differences between the expected competencies from mobile learning and the competencies actually possessed by students, (2) technology gap analysis by identifying the differences between the technology that is expected to support mobile learning and the technology that is actually available, and (3) needs gap analysis, by identifying the differences between students' needs for mobile learning

and the features that are actually available in mobile learning. By identifying these gaps, it can be developed appropriate strategies to overcome these gaps and ensure that the mobile learning developed is in line with student needs and expectations.

The activity at the design stage is to create a mobile application design which contains UX/UI design, business process maps, and media designs that will be displayed in the mobile application. This is related to the validity of the mobile learning application which will be assessed for its suitability by 2 (two) media experts and 2 (two) material experts so that this application is designed with 2 (two) main aspects, namely in terms of media and material/content. The next stage is development and implementation.

In the development stage, the activities carried out are developing Android-based applications based on UX/UI design, application business processes and media design. Products that have passed the development and implementation stages are then evaluated.

In the evaluation stage, the activities carried out are determining the evaluation objectives, evaluation strategy, evaluation plan, validity measurement, instrument development, and data collection and analysis. The initial evaluation activity is to determine the level and type of validity. In this development research, the types of validity are face validity and content validity. Face validity is included in formative evaluation where experts validate and review mobile learning and provide input on the appearance of mobile learning in terms of learning media. Media experts are professionals who have experience in the field of learning media. Meanwhile, for content validity, experts validate the suitability of mobile learning with the objectives, content and test items. Materials experts are researchers in the field of earth. The validity instrument developed is in the form of a Likert scale and suggestions. The development of instrument items contains statements related to UX/UI, mobile learning theory, and theory about Basic Geology. The final activity in the evaluation is collecting and analyzing data from trial results. The test subjects for this research were Karangsambung earth training participants. Test subjects are divided into 3 (three) categories, namely individual, small class and field test subjects. Revisions are also carried out at this stage, including revisions to media or material from input or suggestions.

RESULT AND DISCUSSION

Based on the results of observations made, visitors have gained basic knowledge about earth in their campus/school classrooms, but have not yet gained earth knowledge and skills directly from nature. Mobile learning applications are designed to provide user experience (UX) by providing services related to activities that can be carried out anywhere and at any time, making it easier for users to learn and efforts to improve user performance. The user experience will also be supported by a home page that will contain simple and easily recognizable icons. The user interface (UI) display in the form of a grid style will be used to arrange the main icons in the mobile learning application so that they have a structured, symmetrical and orderly nature. Then the line style will be used for the sub menu, making it easier for users to recognize the difference between the main menu and sub menu. Bright colors that give an enthusiastic and warm impression will be the dominant colors in this application. The font type that is planned to be used is the Calibri type font.

The media design takes the form of a video design that will be produced, an information design that will be displayed in text form, and images and illustrations to support the user's imagination. Determining learning objectives and material to be presented in videos and texts is also carried out at this stage. The business process map in the Basic Geology mobile learning application is as shown in Figure 2.

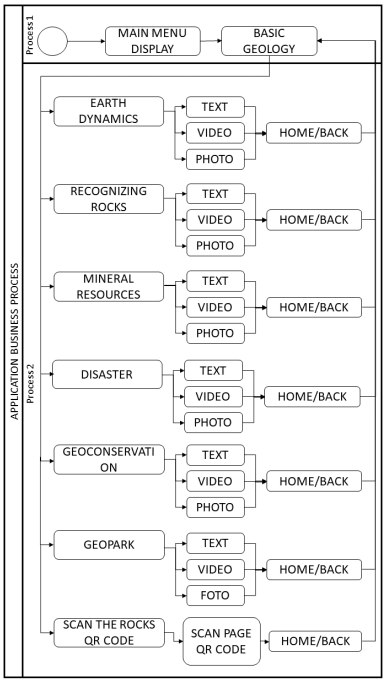

Figure 2. Basic Geology Mobile Learning Application Business Process Map

Video production was carried out at this stage involving earth researchers from the Indonesian Geodiversity Area. Video editing is used to give an interesting impression to the video that has been recorded and clarify the material presented in the video. In addition, several photos are added to help the user's imagination understand the shape of objects, processes or procedures within the scope of Basic Geology knowledge.

Development was also carried out on the contents of the application, namely Basic Geology as the main material which contains sub-materials including earth dynamics, knowing rocks, mineral resources, disasters, geoconservation and geoparks. The development of this sub-material involved earth researchers in the Indonesian Geodiversity Area. Basic Geology Material is also equipped with a rock QR-Code scan feature which makes it easy for users to find out/identify rock types on the Indonesian Geodiversity Areas page.

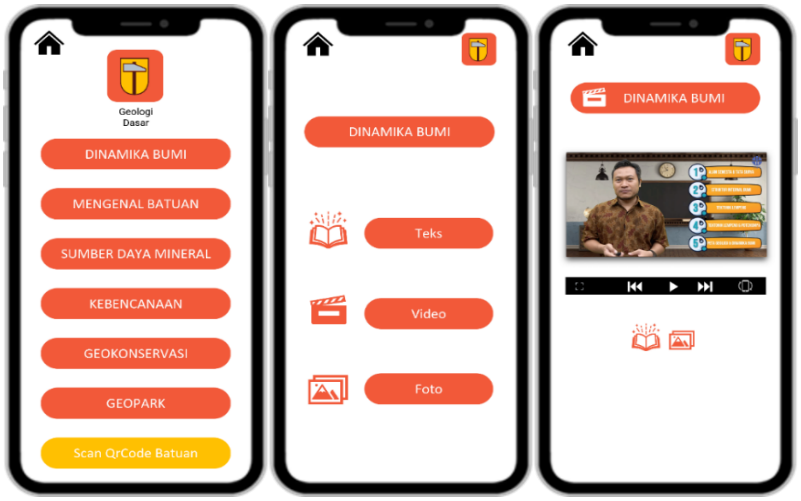

Figure 3. Basic Geology Mobile Learning Application View

Technically, on the home page of mobile learning, the Geodiversitas Indonesia logo is displayed to provide the identity of the application. Then on the main page several main application menus are presented. Above the main menu, a slider displays in the form of images or important information. This also adds to the function of this application, as a medium for conveying information. In this research the main focus is on the Basic Geology menu. In each sub menu there is media in the form of text, video and photos. These various media are used to accommodate different user learning styles. There are different ways to help learn and develop skills, one of which is exploiting videos with illustration techniques for the function of teaching concepts with real examples. Thus, video media can be used to convey knowledge of abstract concepts through illustrations of real examples (Soepriyanto & Rahmatullah, 2016). Orange was chosen as the dominant color for menus, navigation and several application icons. The color orange provides additional energy, creativity, uniqueness, stimulation, social, health, activity (Monica & Luzar, 2011).

Videos from production and editing are then inserted into the Video menu with navigation that allows users to play videos whenever the user needs them. The video page is also equipped with several menu icons to make it easier for users to access other pages such as photo pages, text, main pages or Basic Geology menu pages. After the application development process and media are loaded into the mobile learning application, it is then uploaded to the Google Play Store to make it easier for users to access this application. Users can download the mobile learning application on Playstore with support from smartphone hardware and an adequate internet network. After the download process is complete, this application will automatically be installed on the user's smartphone.

Figure 4. Feature of Asking Geologist

This mobile learning application is also equipped with geological and community question features. The geological questions feature connects users with experts in the field of earth, thus opening up communication access. There are two ways to use this feature, the first is via Whatsapp which is integrated with the application so that when the Whatsapp icon is touched it will immediately be redirected to the Whatsapp application, the second is via Live Chat by filling in data such as name, email address and the message or question you want to convey. The community feature allows users to build social learning networks, providing access to upload images, writing and provide comments or likes to each other. Attracting users who have an interest in studying earth sciences in

one place to share, receive and build knowledge.

The next stage is the evaluation of the basic geology mobile learning application to measure the validity of the development product by media experts and material experts. From the validation results by 2 (two) media experts, a validity value of 92.66% was obtained. The assessment aspects include the accuracy of media selection (text, images and video), interactivity, ease of navigation and attractiveness. With these results, the mobile learning application falls into the very good criteria for use. Suggestions from media experts are also used to improve mobile learning applications from the media side. Media experts commented that Basic Geology mobile learning is good, easy and interesting to use. Apart from that, the color choices used are also appropriate to give a warm and friendly impression, thus increasing the attractiveness of the mobile learning application. Media experts provide suggestions for further development of features that are more useful and easier for users.

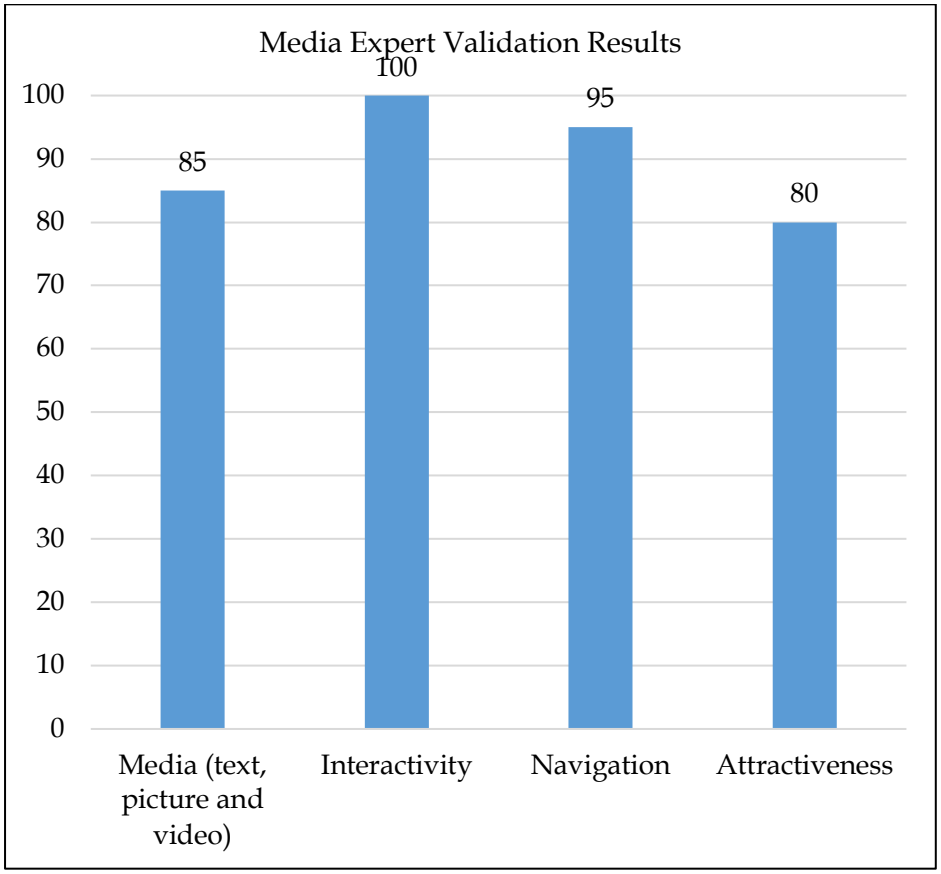

Figure 5. Media Expert Validation Results

Validation results by 2 (two) material experts obtained a validity value of 87.5%. Assessment aspects include completeness of material, novelty of material, language, and geological question features. With these results, the mobile learning application belong to the very good criteria for use. Suggestions from material experts are also used to improve mobile learning applications in terms of material. Material experts provide suggestions for improvements to complete the writing elements in the text menu so that they are complete and comprehensive as learning material, adding videos and photos of activities in the field to make them more contextual. Apart from that, there is still a need for socialization so that this application can be known by academics and the general public.

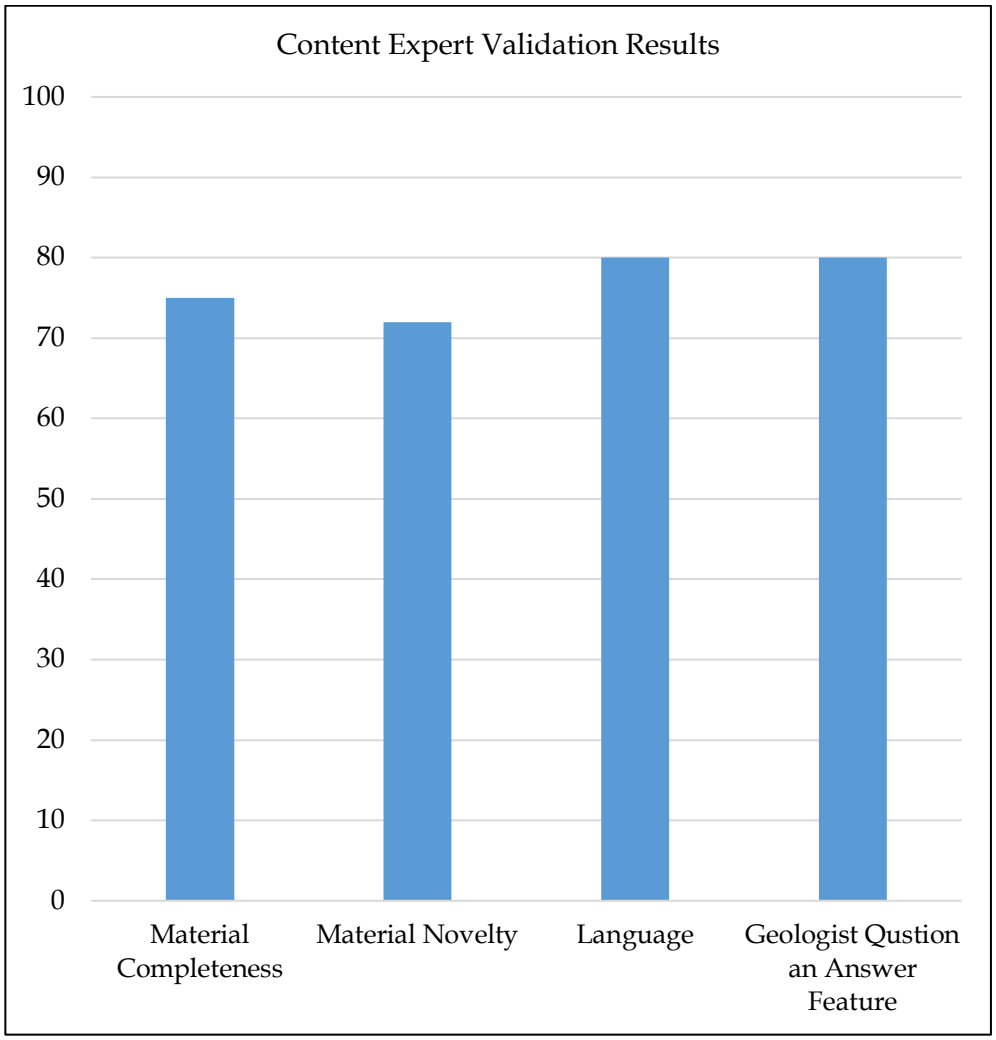

Figure 6. Material/ Content Expert Validation Results

After conducting a feasibility assessment and improvements from suggestions from media experts and material experts. Then individual, small group and field trials were carried out. Assessment aspects include attractiveness, language, access, content and design. Attraction is related to the mobile display which consists of the front display, menu, questions and community features. Besides that, respondents were also asked questions about their opinions if mobile learning was used in learning Basic Geology. The language aspect is related to the grammar presented in this mobile learning. Access is related to the level of ease in operating the development product. The content aspect relates to the material presented including text, videos and images. Finally, the design aspect is related to the choice of colors applied in mobile learning which influences the user's comfort from a psychological perspective when using it.

Individual trials were carried out on 2 (two) participants who were carrying out earth training in the Indonesian Geodiversity Area. The results of individual trials obtained a feasibility value of 93%. Suggestions from the results of individual trials are then used as material for making improvements to mobile learning. The small group test was carried out on 10 (ten) participants and a feasibility score of 89.2% was obtained. Suggestions from small group test results are also used as material for improving mobile learning. The final trial was a field trial involving 39 participants who were taking part in earth training. The results of field trials obtained an average feasibility value of 86.46%. Suggestions from field trials are also used as material for improving mobile learning.

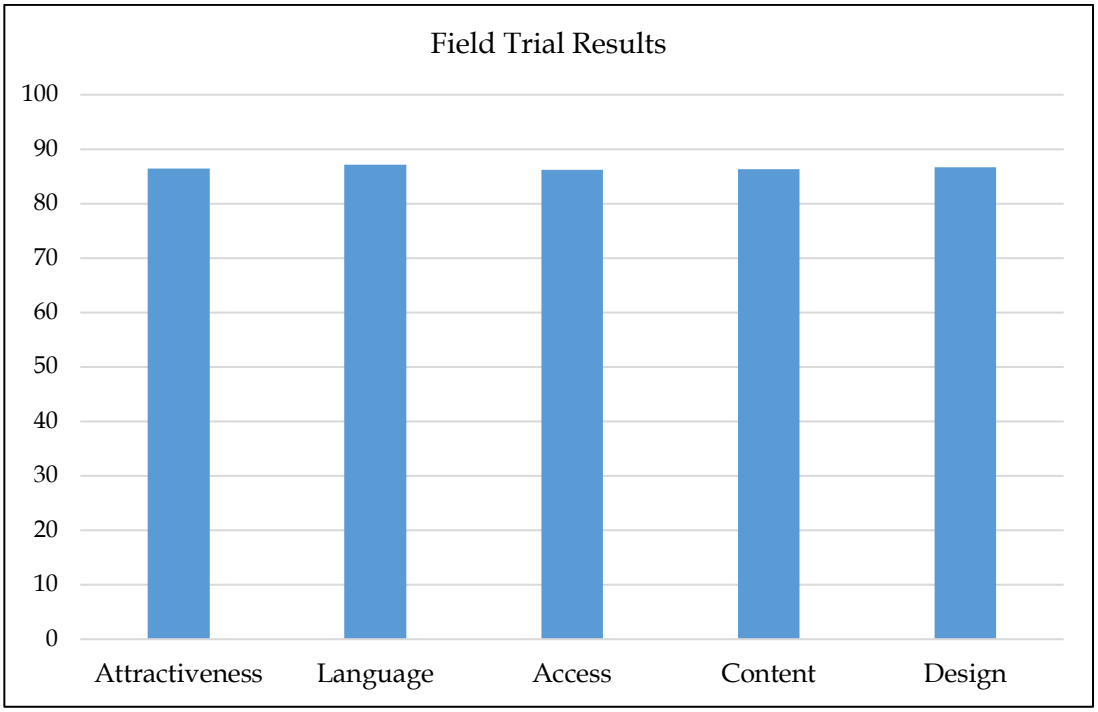

Figure 7. Field Trial Results

The results of the development of Basic Geology mobile learning show 3 (three) topics to discuss related to learning needs, learning design, and the feasibility and application of Basic Geology mobile learning. The three discussions are as follows:

More flexible learning access with mobile technology support

The potential to expand learning opportunities from the use of information and communication technology allows policy makers and learners to improve the quality of the learning process and increase student learning achievement (UNESCO, 2009). Information and communication technology also supports more flexible learning activities through synchronous and asynchronous learning arrangements, enabling real-time communication thereby providing many opportunities for communication and increasing collaboration and involvement in the learning environment (Consiglio, T & van der Veer, 2015). Apart from that, the use of information and communication technology in the form of digital media in learning is an effort to foster interest, motivation, attraction, digital literacy, and improve student learning outcomes (Delita et al., 2022).

Learning with the support of smartphone devices and Internet networks is a new breakthrough in learning as a result of developments in information and communication technology in recent years (Warsita, 2018; Mustadi et al., 2022). Data from a survey conducted by the Center for Research and Development of Informatics Applications and Information and Public Communication, Human Resources Research and Development Agency, Ministry of Communication and Information, Republic of Indonesia in 2017, which was conducted on 6,246 individuals, shows that more than half of Indonesian people already have a smart phone or smartphone. the majority of which are owned by individuals aged 20-29 years and the location where they use smartphones is anywhere and as many as 70.98% of students already have smartphones (KOMINFO, 2017). The results of research conducted by (Wu et al., 2012) show that learning using mobile devices is most often carried out in universities, followed by elementary schools.

This shows the potential for using smartphones as a tool to support learning

because they are practical, light, easy to store, have sufficient specifications and performance and are able to connect to the internet network. The practical characteristics of mobile learning that can be taken anywhere attracts users to make learning easier. This is related to the aim of developing mobile learning, making it easier for participants or users to carry out learning activities wherever and whenever (Ningsih & Adesti, 2019). Learners also expect an independent character to emerge from within the learner so that learners always want to learn starting from themselves and continue learning anytime and anywhere (Suciani et al., 2021).

The challenge of education in the digital era is no longer just focusing on the content of the learning being learned but how and when that learning occurs. Learning is no longer limited to space and time so support is needed to accommodate this situation (Ulfa, 2014). Mobile learning supports classroom learning by providing more flexible learning access, thereby increasing learning duration, accommodating real-time learning needs and hopefully improving learning outcomes. Learning with m-learning will not completely replace learning, but using this model will be more adapted to environments where computer aided learning is not available. Therefore, in order for learning activities to be more effective, it is necessary to combine m-learning with other learning, so that m-learning is a supplement (Warsita, 2018). Android-based mobile learning is an alternative or complement to conventional learning (Ningsih & Adesti, 2019). This is also part of adapting to technological advances. Through this technological innovation, it is necessary to redefine the role of facilitator and learner while removing the barriers between formal and informal learning. This effort is part of the realization of lifelong learning and learning that supports the development of knowledge and skills that are currently needed in the workplace (McQuiggan et al., 2015).

In various studies on mobile learning, the potential for this learning has been described starting from the potential of mobile learning for informal learning, learning that supports lifelong learning, just-in-time learning and situated learning. Nowadays, the development of mobile learning is also packaged in the form of games/game-based learning. In this game, problem solving activities are inserted as in the original situation which are displayed in the form of games. The benefits of game-based mobile learning are increasing learning motivation, training decision-making skills and involving users in lifelong learning (Wang et al., 2011).

Mobile learning is not just about presenting learning content on mobile devices but is a process that can be used in changing situations or learning environments. This process is more about understanding how to utilize daily activities and the surrounding environment as a space for learning so that the discussion of mobile learning does not have to be about technology. In general, the discussion of mobile learning is more about technological mobility and learner mobility by measuring the learning changes that have been experienced, but attention also needs to be paid to the mobility of information so that discussions about mobile learning can cover a wider scope (Pachler, Bachmair, & Cook, 2010) .

The development of interesting and interactive learning media continues to be developed to suit the learning styles of visitors to the Indonesian Geodiversity Area, which is mostly the millennial generation, through the use of technology. The development of technology-based learning media is believed to be able to increase the learning motivation obtained from lecturers/teachers, considering that the use of smartphones owned by visitors has become a support for the learning process. Visitors need a learning platform that is easy and quickly accessible anywhere regarding Basic Geology knowledge to support earth learning.

Previous research on mobile learning in the earth field was carried out by Marcal, Viana & Andrade (2015) which was implemented in field studies. The use of

mobile and computing technology is commonly used in the earth field, such as recording geolocation and visualizing geological maps, but there are no specific applications for learning. The research results show that users respond well to the use of mobile technology because of its convenience and practicality. Stymne (2020) analyzes the application of mobile technology for outdoor learning to subjects. From the results of the analysis, the fields of geology and geography are included in the 6 (six) most common subjects utilizing mobile technology. Manyoe et al (2021) use a mobile learning system as an alternative in geology learning for collecting geological data in the field. The results of using this system have advantages in terms of time efficiency, more complete features, accuracy of results, and easy operation. However, to strengthen students' understanding still requires the role and attention of teachers or lecturers.

Building resources, communication and learning communities

Mobile learning is a learning experience that provides fast access so that it can be done anywhere and at any time according to the learner's wishes (Anderson, 2013). This experience is carried out by providing learning tools and resources to build knowledge, gain learning satisfaction, develop experience and collaborate with other people. Connecting one user and another user to form two-way or multi-way communication so that a communication network is formed in a learning community that is lead by mobile technology. Networks and mobile technology provide unprecedented opportunities through the creation of richer environments for communicating, interacting, sharing, creating meaning, content and context, etc. to overcome competency gaps (Trentin & Repetto, 2013).

The learning design framework leads to strategies for effective use of mobile technology in learning. A learning environment that utilizes effective mobile technology at least includes and integrates four components, namely resources, activities, support and evaluation as in Figure 7.

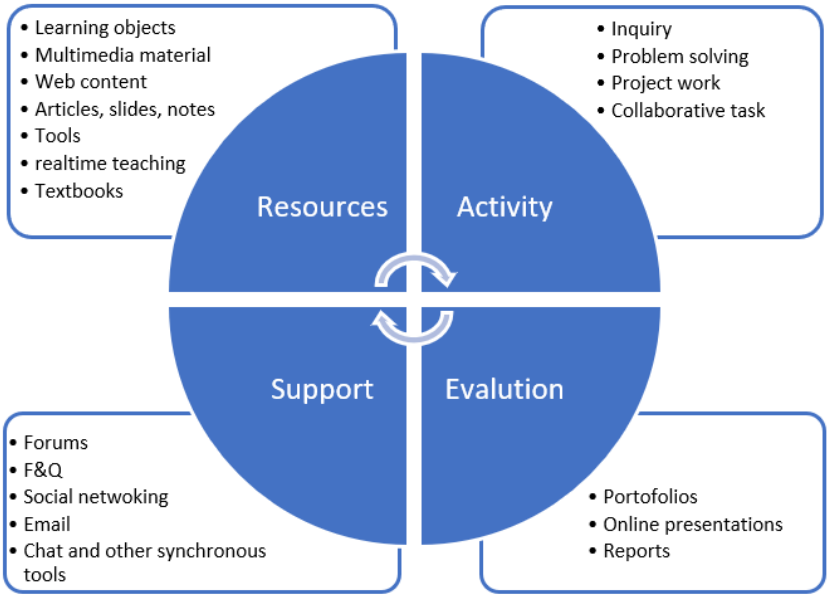

Figure 8. RASE Framework

The RASE (Resources, Activity, Support and Evaluation) framework (Churchill, Fox & King, 2016) is used in developing Basic Geology mobile learning by providing resource aspects in the form of materials related to Basic Geology such as earth dynamics, knowing rocks, sources mineral resources, disasters,

geoconservation and geoparks in the form of text, videos and photos. Support to users is provided through the geological questions feature which is connected directly to the Whatsapp and Live Chat applications so that users can directly ask questions about geology to experts. Apart from that, the Community feature was also developed to support discussions in online forums and form a learning community. The activity aspect is implemented through offline activities in the field and support from Basic Geology mobile learning, one of them is the Rock QR Code Scan feature. The evaluation aspect is a separate aspect of this development because the aim of the development is to determine the feasibility in terms of appearance and content (face validity and content validity). Therefore, it is still necessary to carry out evaluations at a higher level to determine the effectiveness of mobile learning on learning outcomes, learning motivation, interaction or others. For this reason, it is necessary to carry out a summative evaluation on the level of knowledge, performance, or even impact on an organization.

Figure 9. Rock QR Scan Feature

Feasibility and application of mobile learning

The Basic Geology mobile learning application was developed to answer the need for an environment that supports learning by providing access that is more flexible, practical and supports the formation of learning communities. This is in line with the demands of the industrial revolution 4.0 and the challenges of 21st century digital learning which demand changes in a direction that is faster, better and more flexible.

The results of validation by media and materials experts as well as trials of development products in the form of Basic Geology mobile learning applications illustrate that mobile learning is suitable to be used as a support for learning related to the earth. Mobile learning has also been improved as a result of expert suggestions and test subjects.

The result of this development product is an application that can be installed on smartphones with the Android operating system. This is also an advantage because this operating system is widely used and is the operating system for the majority of smartphones. However, on the other hand, this is a drawback of the results of mobile learning application development because it has not yet reached users with various types of operating systems on smartphones except Android. This opens up opportunities for further research.

CONCLUSION

Current technological developments have an influence on all aspects of life, including education, so they need to be responded to with various innovations and development activities. Mobile learning as a learning trend that provides convenience with flexible access is a potential that needs

to be developed. The Indonesian Geodiversity Area is a forum for socializing earth science and playing a role in jointly teaching and providing information about earth to its users. For this reason, it is necessary to make a breakthrough by utilizing developments in mobile learning technology as a means to disseminate knowledge and support learning.

Basic Geology mobile learning has been developed using the Lee & Owens model and has been tested for feasibility. The results of the feasibility test on media experts and material experts show that mobile learning is suitable to be used in learning. Basic Geology mobile learning has also been tested individually, in small groups and in the field. The results show that this development product is feasible and can be used in learning.

This mobile learning development activity is limited to feasibility testing and it is hoped that further research will be carried out in the form of testing effectiveness in learning or the effect of implementing mobile learning on certain variables. Apart from that, Basic Geology mobile learning was developed based on Android so it needs further development so that it can be used on various smartphone operating systems.

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