Developing Android-Based Mobile through Local Ecosystem Materials to Improve Thinking Skills of High School Students

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This was second year's research in developing a biology learning module of ecosystem material that promotes mobile android-based local region potentials, after first year conducted a field examination on android e-module and limited testing in East Lombok Regency, West Nusa Tenggara and Sleman Regency, D.I. Yogyakarta. The second-year research aimed to investigate the results of biology learning on local ecosystem material towards the development of scientific process skill and divergent thinking ability in Senior High School of Yogyakarta City and Sleman Regency. This module development followed a Design and Development Research approach. Data collecting technique used a posttest of scientific process and divergent thinking skills. Analysis technique were quantitative descriptives analysis. The result showed that the comparison of second year android module dissemination result towards the development of scientific process and divergent thinking skills of Senior High School students of Yogyakarta City and Sleman Regency showed a higher results in problem solving design than project based learning design, however, in z value of problem solving design obtained a value of -1,11, while in project based learning design obtained z value of 12,6. It meant there were other factors that influenced the android module application.

Keywords: biology learning module, mobile android, ecosystem, thinking skills, using problem solving and project based learning

INTRODUCTION

Mobile learning is an up-to-date learning model that utilizes ICT as a learning media with an interesting visualization and is able to be accessed space and time unlimited. This learning model emerges as a response of fast development of information and communication technology world today. *Mobile learning* that can be used as learning media vary such as smartphone and tablets (Meister 2011; Sarrab, Elgamel, and Aldabbas 2012).

The usage of smartphone and tablet as learning media has been much performed (Astra, Nasbey, and Nugraha 2015; Hanif 2020; Hernández et al. 2017; Iksan and Saufian 2017). The results show that Smartphones and tablets have the power to change students' learning experiences; give a positive influence on the cognitive, metacognitive, affective, and socio-cultural dimensions; improve students' critical thinking skills; solve teaching problems; students feel more 'independent' without pressure and coercion (Sarrab et al. 2012).

Milrad & Spikol (2007), say that the development of learning media in smartphone and tablet devices sufficiently are promising. This is because of both devices are now increasingly used by the community include students. Meister (2011) predicts these both devices users worldwide increase from 19,5 million in 2010 to be 208 million in 2014. Device style and operating system used in the devices vary such as iOS, Android, and Blackberry.

Based on those facts, as a result to maximize a mobile communication media, so that developed an android based-biology module as a learning media of high school students. Mobile Android learning is a use of wireless mobile technology by an Android operating system that enables information access and learning materials unlimited everywhere and anywhere. Android is chosen due to it has a Google made operating system most used worldwide, includes Indonesia.

The benefits of mobile learning are include: a) anytime and anywhere access to content, b) support distance learning, c) can enhance student-centered learning, d) great for just-in-time training or review of content, e) more effectively for the differently-abled, f) support differentiation of student learning needs and personalized learning, and g) enhance interaction between and among students, learners, and teachers (Sarrab et al. 2012). The importance of m-learning in the modern era, among others: facilitating learning to adapt to the level of global development, updating material at any time, indirectly increasing technological competence skills, increasing global language mastery skills, and increasing students' insight (Enikanolaye 2021; Hanif 2020; Iksan and Saufian 2017).

Modules developed utilize potentials of Indonesian local ecosystem. This is in order to explore and introduce abundant Indonesian natural treasure to young generation as nation successors. Various biodiversity from the ecosystem available in Indonesia are assets that can be utilized as big as possible as its community prosperity, but if it is not utilized well so that the potentials own will only be potentials. Therefore, it is needed a lot of research and observation activities to discover and promotes Indonesian local potentials both in research as well as scientific publication forms, so that there will be more benefits.

The description of the developed module is in the form of an Android module using an application that can be downloaded from the Play Store. Modules developed using PjBL and Problem Solving models. In the module, a description of the material and student activities is presented in the form of a problem presentation or in the form of a project. At the end of the lesson, the students were asked to do a post-test, which had previously been carried out before the pre-test was carried out. The pretest and posttest questions were developed using a divergent thinking essay model and questions that can improve science process skills.

Based on first year research result by Aminatun & Subali (2016) it was known that internet network availability in high schools of various regions, include in Gunungkidul Yogyakarta Special Region (DIY), Klaten Central Java, Sleman DIY, East Lombok NTB and also in Kupang NTT mostly have an internet facility to support learning. However, the internet availability in high schools in Java Island (DIY and Central Java) show a higher percentage than regions out of Java Island (NTT and NTB). Majority of samples in each school in Java Island provide discretion for its students to utilize android in learning active hours, while in out of Java Island shows a school policy percentage lower than android usage in learning. Nevertheless, that discretion is not utilized well by biology teacher to develop various android-based learning media.

Besides, the research results on ecosystem local object in regions of NTB, marine local ecosystem are potentials to be promoted as a source of regional local ecosystem learning. In high schools of Kupang, East Nusa Tenggara, shallow marine ecosystem and deep marine ecosystem are most learned facts. Because of regional treasure on marine products, so that beach ecosystem are also potentials as a source of local object learning. In high schools of Klaten, freshwater ecosystem is also often presented as a learning than marine and land ecosystems, meanwhile swamp ecosystem are also potentials as a learning source. While in Gunungkidul DIY region, land and freshwater ecosystems are most learned compared with marine ecosystem. The efforts to local object ecosystem in Sleman region includes active volcano ecosystem (Gunung Merapi National Park) as a learning that on of them can be performed by using an e-module learning media (Aminatun & Subali, 2016).

After knowing the results of observations and surveys on the availability of internet networks and supporting facilities in schools that will be used as research locations, in the second year this research was conducted in order to determine the results of android dissemination in learning biology material for regional local ecosystems on the development of science process skills and divergent thinking skills in public senior high school of Yogyakarta City and Sleman Regency. The effectiveness of using local potential-based android modules is also discussed in this regard.

METHOD

The design of research implementation in this research refers to Design and Development Research model by Richey & Klein (2007) that comprises of 4 stages: validity, causal inferences, generalization and interpretation, and anticipating problem. This second year research is a dissemination from android module developed includes Arsikologipedia module, is a mobile android based-mountain ecosystem module uses a project-based learning (PjBL) to improve scientific attitude skills of high school learners and android based-biology learning module with a problem solving model to improve a divergent thinking ability of high school learners in ecosystem subject.

Development Stages

In outline, that development stages cover: model development, model validation (internal), model validation (external), and model use. These stages can be explained as shown in the diagram in Figure 1 below.
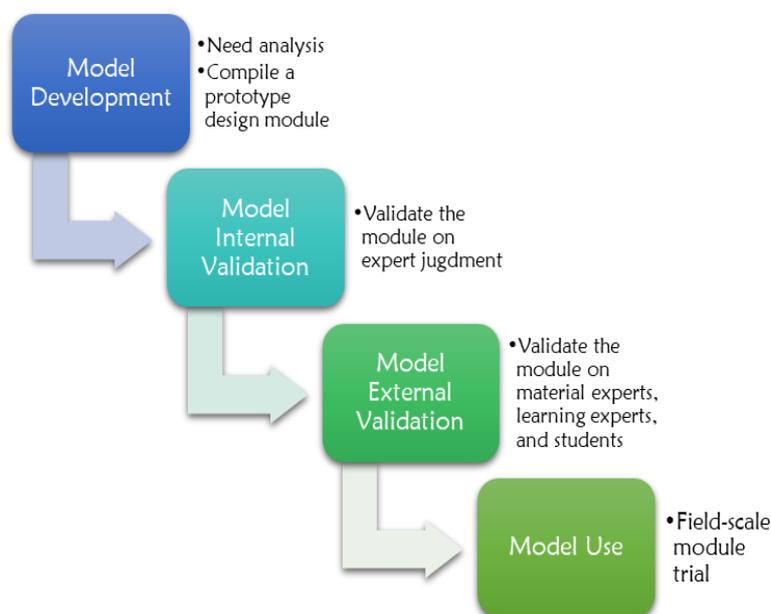
Figure 1
Android module development stage

1. Model development, is a relevant literature stage on module development, high school student characteristics, include examination on mobile android.

2. Model validation (internal), is a module validation stage based on 3 aspects include materials related to material written in the module, language aspect related to language communicativeness used and construction aspect relates to module construct.

3. Model validation (external), is a module validation stage aims to know module quality. The experts get involved are among other: material expert validates material in module, learning expert who validates modules from construction aspect, biology teacher who assess modules from material and construction aspects and learners who assess modules from language aspect.

4. *Model use,* is a module experimental stage in form of field experiment. The experiment is conducted in high school of Sleman Regency, D.I. Yogyakarta and West Nusa Tenggara (NTB). The experimental design uses a quasi experiment includes *non-equivalent pretest-posttest control group design* that consists of experimental class and controlled class.

Samples

Next, to achieve *causal inferences* stage conducted a module dissemination in wider scale includes in high schools of Yogyakarta City and Sleman Regency. The high schools that become research samples are public high school 8 Yogyakarta, public high school 5 Yogyakarta, public high school 1 Yogyakarta, public high school 4 Yogyakarta, public high school 3 Yogyakarta, and public high school 1 Depok. The number of all test subjects are 571 students.

Sample taking of that schools are conducted based on public high school characteristics in Yogyakarta City and Sleman Regency with is accredited A, verge of students have an android smartphone, the presence of school policy that permits its students bring and operate android in learning.

Data Analysis

Data gathering technique uses a posttest of science process skills and divergent thinking. The questions used are of divergent type. Divergent is a type of essay question that has more than one correct answer variation (Subali 2013). Data analysis technique uses a descriptive quantitative analysis. To know comparison of previous research results in first year with dissemination results in this research is used the following formula.

$$Z = \frac{\acute{Y} - \mu_0}{\sigma / \sqrt{N}}$$

Remarks

Z = z count

$\acute{Y}$ = average value of second year dissemination

μ_0 = average value of first year

σ = standard deviation of first year

$\sqrt{N}$ = total of second year learners

Table 1
Comparison of Z values in android module testing

	Approach on	Value Z
1	Android mobile based-biology learning module on mountain ecosystem by a Project Based Learning model	$Z = \dfrac{82,8-79,4}{4,3/\sqrt{239}} = \dfrac{82,8-79,4}{4,3/15,4} =$ $\dfrac{82,8-79,4}{0,27} = 12,6$
2	Android mobile based-biology learning module on ecosystem material by a Problem Solving model	$Z = \dfrac{84,5-85,3}{8,3/\sqrt{331}} = \dfrac{84,5-85,3}{8,3/18,2} =$ $\dfrac{84,5-85,3}{0,45} = -1,11$

FINDINGS

This research is a type of development research that develops android modules based on local wisdom ecosystem materials. The module was developed with a project based learning and problem solving model. Based on dissemination results and descriptive analysis results obtained the following Table 1.

Table 2
Dissemination of android mobile-based biology learning module on ecosystem materials

	Module of android model of PjBL	Module of android model of Problem Solving
	Posttest	Posttest
Sample	239	332
Completed participants	221	289
Average	82.81	84.58
Ideal value	100	100
max. value	100	100
min. value	58	47.36

Based on Table 1 it is known that learners who use Project Based Learning (PjBL) model module there are still 18 students uncompleted, while learners who use a problem solving model there are 43

students uncompleted. Despite average value in android model problem solving model module is higher than mobile android based-biology learning module on mountain ecosystem by a project based learning model.

Based on the results on Table 1, it can be seen that z count in mobile android model Project Based Learning module obtained value of 12.6, while in mobile android model Problem Solving module obtained value of -1,11. Later, the results can be illustrated by the following curve.

| -1.96 | +1.96 |
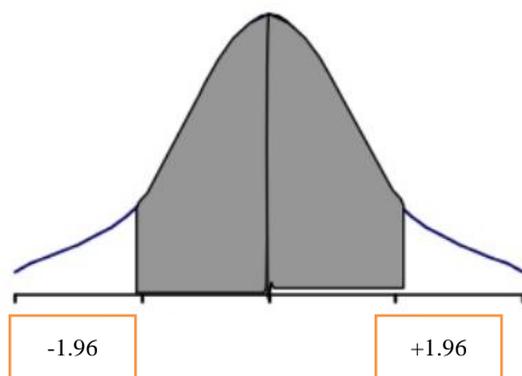
Figure 2
Curve Z comparison of first year and second year of android module application

Dissemination calculation results compared with the above curve, it is seen that calculation of value Z in mobile android based-biology learning module on Project Based Learning of 12.6 and in mobile android model Problem Solving module of -1.11. Out of the results it can be declared that in second year research, dissemination of mobile android model Project Based Learning module showed better results than previous year, while mobile android model Problem Solving module shows decrease/worse results than first year. This is shown by value Z that is in value <-1.96.

This is probably caused by some factors, among other:

1. Ecosystem style used in the module is not familiar with learners in Yogyakarta city, due to basically, the module is developed by adopting regional local potentials. The regional local potentials yang is mountain ecosystem of Merapi area and beach ecosystem in Lombok (NTT).

2. School characteristics that becomes first year module application object different from characteristics of second year module dissemination school. The first year school characteristics cover: schools located in local region in which regional local ecosystem exists. While second year dissemination characteristics tend to schools in urban (Yogyakarta City and part of schools in Sleman Regency) that I far from the regional local object.

3. Time of second year module dissemination at school is not maximum, some classes restrained in accessing e-module, due to school wifi network is not distributed evenly in each classroom. Initiatively, in module implementation, some students move to library room, make co-operation in group, as well as use internet data of each student to be able to access e-module well.

These factors play an important role in influencing the learning process, because as a determining factor for the success of the implementation of learning. As according to Soleh, Pramono, and Suratno (2009), that success in the implementation of learning is influenced by several factors, including: learning infrastructure 24%, teachers and learning implementation (43%), complete facilities and support parents (53%), fulfillment of needs and the environment social (60%), and parental attention

and monitoring (67%) (Hanif 2020; Omiyefa 2021). Condition physical students also greatly affect their learning activities (Mawardi and Indayani 2019). The right learning strategy greatly affects student learning outcomes (Enikanolaye 2021)

Based on results of module implementation in classroom, students averagely have good independence. This is seen when learning process by an e-module students learn independently without teacher overall roles and assistance. Teachers play roles as a facilitator assigned to facilitate students to learn. The results of the same study show that multimedia learning can help to concretize learning and make learning more effective (Enikanolaye 2021; Omiyefa 2021).

Most *of* students are enthusiastic with this learning shown by completing all invoices obliged in e-module, for example making wall magazine, doing exercises, upload invoices required in e-module and so on. Students are active to consult their works, active to ask if they do not understand, active to answer question, active to present discussion results and making reports and also other activities. During doing posttest, they tend to be independent and seriously. According to Diyan & Upik (2016) that the presence of android-based modules, learners can directly interact with learning media that can support learning activity independently.

Nevertheless, some students are also seen less enthusiastic and less interested to attend student activities presented in e-module. According to them, internet network has become each student obstacle. Teachers who are less enthusiastic and less supporting learning also influences student learning motivation interest (Suyoso and Nurohman 2014).

In overall, mobile android based-biology learning module on ecosystem material developed is able to help learners to be more independent, creative to yield work, simplify them to understand ecosystem materials, practical, operable everywhere and anywhere and also enable learners to learn according to their speed. Similarly, Bahera (2013), says that along with the presence of mobile android learning can improve mobility and time efficient, so that enable learners to access learning source suitable with learning speed of each learner.

The usage of android based-biology learning module also able to concrete abstract, for example: in biogeochemistry recycle material. The presence of video presented through android module is able to support student understanding on ecosystem material. Besides, the presence of a hyperlink is also able to provide learner opportunity to find relevant literature (Meliana 2017; Prihartina 2016; Yuningsih 2017).

Similar with the earlier research, the use of project-based learning (PjBL) module is able to improve KPS (Hayati, Supardi, and Miswadi 2013) and scientific attitude of learners. This PjBL model is also known effective to develop student thinking ability (Husamah 2015), equipping ICT literacy learners (Eliana et al. 2016), scientific literacy (Afriana, Permanasari, and Fitriani 2016), scientific writing (Probosari 2015), and also improve student psychomotor ability (Sumarni, Wardani, and Gupitasari 2016).

Besides, problem solving learning model also able to improve learner divergent thinking ability (Fatimah and Widiyatmoko 2014), improve creativity (Risnani and Subali 2016; Yuningsih 2017), think critically (Fakhriyah 2014), science literacy (Ardianto and Rubini 2016), and also positive affected on students' academic achievement and their attitudes and keeps their misconceptions at the lowest level (Akınoğlu and Tandoğan 2007).

The problems presented in learning by a problem solving module is presented through a video show. According to (Higgs 2005) that in learning with problem solving, problems are presentable by teachers as well as students during learning process. The problems presented are in the form of contextual problems that exist in the local area in the research.

Obstacles facing during android module application are among others:

1. Due to module is browser web based, so that it is accessible online when there is internet network available.

2. Module is set by a specific competence achievement target. If able to master 100% of topic I, so that learners can proceed to next topics. This monitors how far is their understanding, however, in other side, the obstructed learners only need time to complete topics well according to each learning speed.

Each learning subject has his/her own account prior to conduct learning with module. This is sufficiently effective to monitor the development of each learner, however, needed a hard work from teachers to do it well.

CONCLUSION

Based on results and discussion it can be concluded that results of first year module dissemination in high schools of Yogyakarta City and Sleman Regency obtained data that average value with Problem Solving design module is higher than Project Based Learning design, however, based on value Z count it is known that second year   project based learning design module is better than first year.

The recommendation of this research is that the use of the android module is very perspective as a digital platform, especially in Indonesia, which is currently a priority program at the ministry of education, culture, research and technology. In the future, this android module can be applied in other schools so that the test results can be generalized.

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