

Developing an android-based biology learning module utilizing local ecosystem materials to improve thinking skills of senior high school students

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Abstract. This research is a second year's research in developing a biology learning module of ecosystem material that promotes *mobile android*-based local region potentials, after conducting a field examination in the first year on android *e-module* and a limited testing in East Lombok Regency, West Nusa Tenggara and Sleman Regency, D.I. Yogyakarta. This research aims at investigating the results of biology learning on local ecosystem material towards the development of scientific process skill and divergent thinking ability at Senior High Schools in Yogyakarta City and Sleman Regency. This module development employed a Design and Development Research approach. Data collection techniques include *posttest* of scientific process and divergent thinking skills. Analysis technique utilized qualitative and quantitative descriptives analysis. The results show 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 in Yogyakarta City and Sleman Regency show a higher results in problem solving design than project based learning design. However, z value of problem solving design obtained a value of -1,11, while project based learning design obtained z value of 12,6. It indicates that there are other factors that influence the android module application.

1. Introduction

Mobile learning is an up-to-date learning model that utilizes IT as a learning media with an interesting visualization and is able to be accessed in unlimited space and time. 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 is varied such as Senior High School smartphone and tablets [1][2].

The use of Senior High School smartphone and tablet as learning media has been greatly performed [3]. The results provide a positive effect towards a cognitive dimension, meta-cognitive, affective, and socioculture. Senior High School smartphone and tablet have a strength to transform a learning experience [2].

The development of learning media in Senior High School smartphone and tablet devices are promising [4]. This is because of both devices are now increasingly used by the community including students. Both devices users worldwide increase from 19,5 million in 2010 to 208 million in 2014 [1]. Device style and operating system used in the devices vary such as iOS, Android, and Blackberry

Based on that facts, an android based-biology module of learning media for Senior High School students is developed. Mobile android learning refers to the use of wireless mobile technology utilizing Android operating system that enables unlimited access of information and learning materials. Android is chosen because it utilizes a Google made operating system which is used worldwide including Indonesia.

The benefits of m-learning include: a) provide anytime and anywhere access to content, b) support distance learning, c) enhance student-centered learning, d) promote just-in-time training or review of content, e) enhance more effective learning for the disable, f) support differentiation of student learning needs and personalized learning, and g) enhance interaction between and among students, learners, and teachers [2].

Modules were developed by utilizing the potentials of Indonesian local ecosystem. This is intended to explore and introduce abundant Indonesian natural treasure to young generation as nation successors. Various biodiversity from the ecosystem which exist in Indonesia are assets that can be utilized as big as possible for community prosperity, but if it is not utilized appropriately, the potentials remain useless. Therefore, it requires a lot of research and observation activities to discover and promote Indonesian local potentials both through research and scientific publication forms so that more benefits can be gained.

Based on the first year research conducted by [5], Senior High Schools in Gunungkidul Yogyakarta Special Region (DIY), Klaten Central Java, Sleman DIY, East Lombok West Nusa Tenggara, and Kupang NTT mostly have an internet facility to support learning. However, the internet availability in Senior High Schools in Java Island (DIY and Central Java) show a higher percentage than regions out of Java Island (East Nusa Tenggara and West Nusa Tenggara). Majority of samples in each school in Java Island provide discretion for its students to utilize android in learning active hours, while out of Java Island shows lower android usage in learning. Nevertheless, discretion is not utilized well by biology teacher to develop various android-based learning media.

Besides, the research results on local ecosystem objects in West Nusa Tenggara, marine local ecosystem are potentials to be promoted as a source of regional local ecosystem learning. In Senior High School of Kupang, East Nusa Tenggara, shallow marine ecosystem and deep marine ecosystem are mostly learned. Because of regional treasure on marine products, beach ecosystem are also potentials as a source of local object learning. In Senior High School 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 mostly learned rather than marine ecosystem. The efforts to utilize local ecosystem in Sleman region includes active volcano ecosystem (Gunung Merapi National Park) that can be performed by using an e-module learning media [5].

This second year research aims to know results of android dissemination on regional local ecosystem material of biology learning towards the development of scientific process skills and divergent thinking ability at Senior High Schools in Yogyakarta City and Sleman Regency.

2. Method

This research employs *Design and Development Research* model of Richey & Klein (2007) that comprises of 4 stages: *validity, causal inferences, generalization and interpretation, and anticipating problem*. This second year research is a dissemination of android module including *Arsikologipedia* module, which is an android based-mountain ecosystem module utilizing a *project-based learning* (PjBL) intended to improve Science Process Skills and scientific attitude of Senior High Schools learners and android based-biology learning module with a problem solving model to improve a divergent thinking ability of Senior High Schools learners for ecosystem subject.

The development stages include *model development, model validation (internal), model validation (external), and model use*.

1. *Model development*, is studying relevant literature on module development, Senior High Schools students characteristics including examination on *mobile android*.

2. *Model validation (internal)*, is a module validation consisting of 3 aspects which include materials, language use which include language communicativeness, and construction aspect which deals with module construct.
3. *Model validation (external)*, is a module validation stage aimed to know module quality. The experts involved in this stage are: material experts who validate material of the module, learning experts who validate modules from the construction aspect, biology teachers who assess modules from material and construction aspects and learners who assess modules from language aspects.
4. *Model use*, is a field experiment of using the developed module. The experiment was conducted in Senior High Schools of Sleman Regency, D.I. Yogyakarta and West Nusa Tenggara (NTB). The experimental design uses a quasi-experiment which includes *non-equivalent pretest-posttest control group design* that consists of experimental class and controlled class.

To get *inferences*, the researchers conducted a module dissemination in wider scale including in Senior High Schools located in Yogyakarta City and Sleman Regency. The Senior High Schools that becomes research samples include SMA N 8 of Yogyakarta, SMA N 5 of Yogyakarta, SMA N 1 of Yogyakarta, SMA N 4 of Yogyakarta, SMA N 3 of Yogyakarta, and SMA N 1 of Depok. The number of testee reached 571 students.

Samples were taken based on the characteristics of Senior High Schools in Yogyakarta City and Sleman Regency such as the schools have been accredited A, most of the students have android or smartphone, there is a school policy that permits its students to bring and operate android in learning. Data collection techniques utilize a *posttest* of science process skills and divergent thinking. Data analysis technique employs a descriptive qualitative analysis and quantitative analysis

3. Results and discussions

Mobile learning technology has been progressing rapidly so that it affects people especially students. Its presence gives a good impact since it is easy-to-use and provides wider access in presenting learning materials and continuous needs for fast communication. One good example of the application of new technology is the e-learning system that has radically transformed learning - from being trapped inside school walls to borderless landscapes, empowering many trainees, students, others to learn with more academic scrutiny [6].

A key benefit of m-learning is its potential for increasing productivity by enabling learning anywhere and anytime, allowing learners to participate in educational activities without restriction of time and place. Mobile technologies have the power to make learning even more available and accessible than we are used to in existing e-learning environments. M-learning can be just in time learning where learners can actually access education and training at the place and time that they need it [7]. Mobile learning presents students and professionals with the unique opportunity to access information quickly regardless of location [8]. The portability and immediate communication properties of mobile devices influence the learning processes in interacting with peers, accessing resources and transferring data [9].

Mobile learning provides effective learning in educational activities to achieve various pedagogical goals and provides a learning resource with remote access, reflecting the trends in modern education by providing instant access to information; mobile learning as a tool in obtaining information, where new learning environment is created, regardless of time and place. Learning using android system is an interactive learning. systems designed to deepen and consolidate students' knowledge and skills in the field of mobile application programming for Android. Android is the operating system for Senior High School smartphones, tablet computers, e-books, digital players, watches, game consoles, net books, Senior High School smart books and other devices [10].

The dissemination and descriptive analysis results are presented in Table 1 below.

Table 1. Dissemination of *android mobile*-based biology learning module on ecosystem materials

	Module of <i>android</i> model of PjBL	Module of <i>android</i> model of <i>Problem Solving</i>
	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, there are 18 students who did not complete the materials when using *Project Based Learning* (PjBL) module, while there are 43 students who did not complete the materials when utilizing a *problem solving* model. In addition, the average value of android-based learning module utilizing *problem solving* model is higher than *mobile android*-based biology learning module on mountain ecosystem which employs *project based learning* model.

To know the comparison between previous research results in the first year and the dissemination results in this research, the following formula is used.

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

Z = z count

\bar{Y} = average value of second year dissemination

μ_0 = average value of first year research

σ = first year standard of deviation

\sqrt{N} = total of second year learners

The results of the calculation are:

1. *Android mobile* based-biology learning module on mountain ecosystem employing a *Project Based Learning* model is indicated with the value of Z :

$$Z = \frac{82,8 - 79,4}{4,3 / \sqrt{239}} = \frac{82,8 - 79,4}{4,3 / 15,4} = \frac{82,8 - 79,4}{0,27} = 12,6$$

2. *Android mobile* based-biology learning module on ecosystem material employing a *Problem Solving* model is indicated with the value of Z :

$$Z = \frac{84,5 - 85,3}{8,3 / \sqrt{331}} = \frac{84,5 - 85,3}{8,3 / 18,2} = \frac{84,5 - 85,3}{0,45} = -1,11$$

Note: Z-table for alpha 5% \pm 1,96

The results show that z count value for *mobile android* model utilizing *Project Based Learning* module is 12,6, while *mobile android* model employing *Problem Solving* module is -1,11.

The dissemination calculation results compared with the above curve show that the value of Z in *mobile android* based-biology learning module employing *Project Based Learning* is 12,6 and *mobile android* model utilizing *Problem Solving* module is -1,11. It can be declared that in the second year research, the dissemination of *mobile android* model employing *Project Based Learning* module show

better results than that of previous year, while *mobile android* model utilizing *Problem Solving* module shows worse results than that of the first year. This is shown by Z value $< -1,96$.

This is probably caused by the following factors:

1. Students in Yogyakarta city are not familiar with ecosystem model used in the module because the module was developed by adopting regional local potentials. The regional local potentials in this research is mountain ecosystem of Merapi area and beach ecosystem in Lombok (NTB).
2. The characteristics of the school that become the object of first year module application are different from that of the second year. The schools which become the samples for the first year research are located in local region where regional local ecosystem exists. While the schools selected in the second year research are located in the urban areas (Yogyakarta City and part of schools in Sleman Regency) that are far from the regional local object.
3. Time allocated for the second year module dissemination at school is not maximum, some classes are restrained in accessing *e-module* because school Wi-Fi network is not distributed evenly in each classroom. Therefore, some students move to library room, make co-operation in group, as well as use internet data of each student to access *e-module* better.

Based on the results of module implementation in classroom, the average students have good independence. This can be seen when students learn independently using *e-module* without the help of teachers. Teachers play roles as a facilitator assigned to facilitate students to learn.

Most of students are enthusiastic with this model of learning indicated by completing all invoices obliged in *e-module*, for example making wall magazine, doing exercises, *uploading* 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 so on. During posttest, they tend to be independent and serious. According to Diyan & Upik (2016), the presence of android-based modules enables learners to directly interact with learning media that can support learning activities independently.

[11] reveal that learning using android applications enhance students to learn at their own pace, anywhere and anytime. This mobile learning application aims to complement the current class system and traditional e-learning. The approach used is to combine the concept of multimedia animation with command language to create a widespread learning environment in presenting mobile learning applications.

Nevertheless, some students are also less enthusiastic and less interested to attend student activities presented in *e-module*. According to them, internet network has become an obstacle. Teachers who are less enthusiastic and do not support learning also influence student learning motivation [12]. Based on research conducted by [13], the use of android in learning gives impact to the learning satisfaction in which 95% of student stated that they were satisfied in accessing application. With the use of application, learning process can be more flexible because it can be carried out anytime, anywhere and in any condition.

[14] explain that learning using Android provides efficiency in learning. Learning materials are downloaded by students using their android phone where Android apps are installed. Students can use mobile devices easily and learning materials can be learned anywhere and anytime.

Overall, *mobile android* based-biology learning module on ecosystem materials which have been developed is able to help learners to be more independent and creative to yield work; facilitate them to understand ecosystem materials; and enable learners to learn based on their learning speed. Similarly, [15], says that the presence of *mobile android learning* can improve mobility and time efficiency, so that it enable learners to access learning source suitable with their learning speed. Another benefit of these tools is that learning cost can be reduced because independent and self-paced learning can be performed outside the schools and campuses [16].

The use of android based-biology learning module is able to visualize abstract objects into concrete ones, 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* may provide learner opportunity to find relevant literature [17][18][19].

Similar to the earlier research, the use of *project-based learning* (PjBL) module is able to improve science process skills [20] and scientific attitude of learners. Moreover, this PjBL model is effective to develop student thinking ability [21], equip ICT literacy for learners [22], develop scientific literacy [23], improve scientific writing [24], and increase student psychomotor [25].

Besides, problem solving learning model help improve learner divergent thinking ability [26], increase creativity [27][19], think critically[28], develop science literacy[29], and provide positive effects on students' academic achievement and their attitudes and keep their misconceptions at the lowest level [30].

The problems presented in learning utilizing a problem solving module is presented through a video show. According to [31], learning which utilizes problem solving enable either teacher or students to present problems during learning process.

Obstacles faced by the students in using android module application are:

1. Since the module is a web-browser based, it is accessible when there is internet network.
2. Module is developed focusing on a specific competence achievement target. If learners could master 100% of the presented topic, they can proceed to next topics. This monitors how far their understanding is. However, on the other side, the obstructed learners only need time to complete topics well based on their learning speed.
3. Each learning subject has its own account prior to conduct learning with module. This is sufficiently effective to monitor the development of each learner, however, a hard work from teachers is needed to perform it well.

4. Conclusions

Based on the results and discussion, it can be concluded that results of the first year module dissemination at Senior High Schools in Yogyakarta City and Sleman Regency show that the average value of utilizing *Problem Solving* design module is higher than that of *Project Based Learning design*. However, based on Z count value, the second year *project based learning* design module is better than that of the first year.

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