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DEVELOPMENT OF ANDROID MOBILE LEARNING USING APP INVENTOR TO TRAIN HIGH SCHOOL STUDENT'S SCIENCE PROCESS SKILL

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Abstract

The purpose of research is to develope android mobile learning using app inventor to train high school students's science process skill which feasible (valid, practical, and effective). The type of research is development research of ADDIE's model (Analysis, Design, Development, Implementation, and Evaluation). The subject of research are 20 students of XI grade SMA Muhammadiyah 9 Surabaya. The technique of data collection are questionnaire and observation. Mobile learning is declared feasible if percentage of validity (learning, material, media), practicality (learning's implementation is 93% with the constraint that faced was sometimes application stopped suddenly), and effectiveness (students's science process skills and responses) are ≥ 61% with good and excellent category. The result of research shows the validity of mobile learning is excellent (learning 93%, material 96%, and media 86%), the practicality is excellent (learning's implementation 93%) and the constraint that faced is sometimes application stopped suddenly, and effectiveness is good (observing 100%, formulating hypotheses 65%, identifying variables 100%, interpreting data 65%, communicating 65% and students's response are positive with percentage between 81% and 91%. Research conclude that android mobile learning using app inventor can train high school students's science process skill.

Keywords: mobile learning, android, and science process skills.

INTRODUCTION

The realities of globalization, knowledge work, and accelerating societal change in 21st century demand educational system to equip students with the 21st century skills. It is important for students to overcome the challenges of the 21st century. The skills that needed in 21st century are digital age literacy, inventive thinking, effective communication, and high productivity (NCREL 2003). A part of digital age literacy is scientific literacy. Scientific literacy is knowledge and understanding of the scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity (NRC, 1996). In scientific literacy, there is science process which have done by students to apply their knowledge. To do science process, they need the skills, that is science process skills. Science process skills are thinking and psychomotor skills which used to discover, develop, and apply knowledge. Science process skills involve intellectual, psychomotor, and affective skills which are related to the learning of science in all its aspects and derived from fundamental abilities of students (Sheeba, 2013). Therefore, science process skill isn't instructional actions out of students's ability, but it is intended to develop the capabilities which possessed by students. Learning using science process skill allows students to learn independently and allows students to be more active and creative because students are asked to find knowledge using their capabilities. When students use science process skill to find knowledge, it's means that students experience directly the process of discovery. Providing direct experience to students will make learning more meaningful and make it easier for students to understand the knowledge. In addition, science process skill need to be applied in physics learning because students isn't only need knowledge, but also need to be trained to discover, develop, and apply knowledge. (Turiman, et all., 2012). Science process skill is need to be mastered by the students because by mastering science process skill, student will be able to do skill that required in high level study, that is conduct research and solve problem. Ability to conduct research and solve problem are life skill which students need. The level of students' science process skills can be known from PISA (Program for International Student Assessment). Data of PISA three years later show that Indonesia still has not reach the International score standard of 500 (2009 is 383, 2012 is 382, 2015 is 403) (OECD, 2010; OOCD, 2014; OOCD, 2016). It show that Indonesia students's science process skill are low. The low of science process skill is caused by the lack of opportunities given to students to use science process skill to find knowledge. One of the alternative solution to solve this problem is through development of mobile learning that provides facilities to train science process skill. Mobile learning or usually called m-learning is a learning that uses mobile devices such as smartphones that allow learners to access learning resources, communicate with others, and create content anytime and anywhere (UNESCO, 2013). M-learning is part of Information and Communication

Technology (ICT) of education, where technological literacy is the other part of digital era literacy skills that must be mastered by student to thrive in the 21st century. Nowday, technology is being a part of the students's life which is used to make student closer to their daily phenomena. So, it can be integrated with learning of science to improve the quality and efficiency of education. It also nurture science process skills indirectly (Turiman, et all., 2012). Mobile learning involves learning through animated explanations, where more often use of animation in learning process, more enhance the learning process (Najjar, 1998). So, through animation such as of scientific concepts and scientific methods, quizzes, activities, virtual experiments, etc can increase the capacity of students's science process skills. Mobile learning is applied to mobile applications, where mobile application can minimize learning gap between students with different spatial ability level (June-Yi Wang, et all., 2017). It is needed in physics learning because spatial ability is related to the capacity of students to generate, imagine, retain or manipulate images (Yilmaz, 2009), and students with high spatial skills tend to show better result in physics (Kozhevnikov, et all., 2007). Mobile learning can be applicated to mobile application that runs in an operating system. Nowdays, operating system that are growing rapidly and widely used is android. One of the android tool software maker is app inventor. It is a visual block programming tool, so it doesn't need codes to make application. User only use, arrange, and drag-drop visual object to create application. Based on explanation before, it is important to develope android mobile learning using app inventor to train high school students's science process skill which feasible. Feasible is involve validity, practicality, and effectiveness (Akker, et al., 1999). Validity is defined as compatibility of mobile learning with the study of learning, material, and media. Practicality is defined as the success of other users using mobile learning in learning. Effectiveness is defined as the success of mobile learning to train science process skills.

Science process skills that be train in this mobile learning are observing, formulating hypotheses identifying variables, interpreting data, and communicating. Observing is defined as a process to gather information using senses. It is the most basic skill (Turiman, et all., 2012). The outcome of observing skill are identifying and describing the characteristic of object or event. Formulating hypothesis means that giving prediction about experiment result that will be conducted or answer prediction from problem. Hypotheses can be meaned as prediction about effect which given by manipulated variable to response variable (Rezba, et al., 1995). The prediction must be based on the result observasion or theories. Identifying variable skills are skill to identify manipulate, response, and control variable. Manipulated variable are variable which be changed and be investigate its effect. Response variable is variable which its value change as the effect of manipulate variable's change. Control variable is variable which can affect the experiment result, but it controls so that can't give the effect. Interpreting data means organizing and analyzing data which gain by collecting infomation about object or event which describe special condition, then making conclusion based on the relation between variable in the data in form of table or graphic (Sheeba, 2013). Communicating is the process of presenting information.. It can take many forms including using words, action, table or graphic (Turiman, et al., 2012).

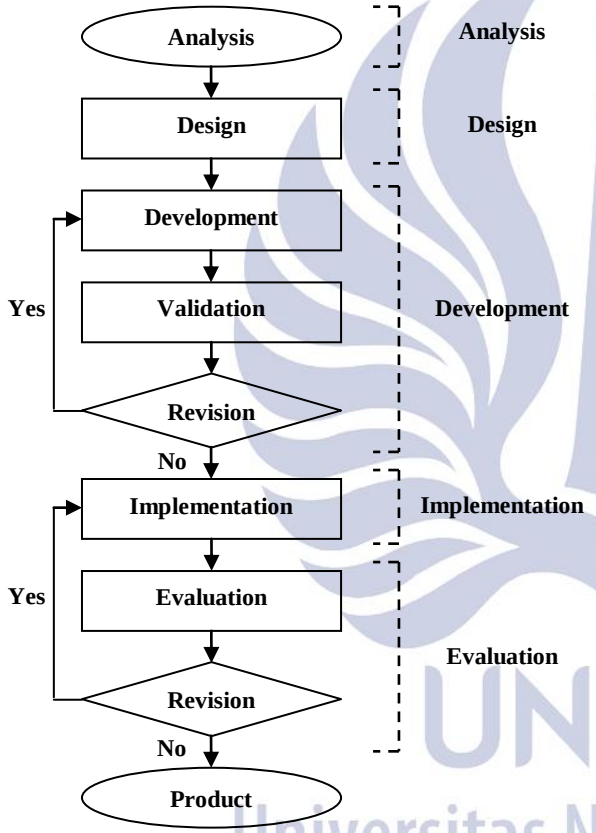
Mobile learning has become widespread. Education institutions started adopting mobile technology to cope students's needs. The advantages of mobile learning is gives learn anytime and anywhere, reach out to students and schools which lacking learning facilities, improves high-level thinking skills, provides new learning environment alternative, provides wider access learning, provides personalized learning, allows self-regulated learning, makes student-centered learning, good for review learning content, helps to facilitate different learning needs among students, improve interaction between students or between students and teacher, and reducing communication barriers, provides useful features for learning (McQuiggan, et al., 2015; Sarrab, et al., 2012; Sha, et al., 2012; Ally, Mohamed, 2009;). Mobile learning also has weakness associated with mobile devices, including small screen size, limited memory capacity, limited battery life, limited applications and software, lack of built-in functionality, difficulty adding applications, differences between applications and the usage condition, network speed, security and external factors problem, and the challenge to design learning using mobile devices (Kukulska-Hulme & Traxler, 2005). Mobile learning which develop in this research is design to android operating system. Android is a Linux-based operating system designed for touch-screen mobile devices such as smartphones and tablet PC. Nowdays, it a widely used and growing rapidly operating system. One of the reason for the rapidly growth of android is because the operating system is open source so that freely distributed and used by any vendor. Android is an operating system that provides many software maker tools and allows for application development.

Android mobile learning is developed by app inventor. Some of the advantages of app inventor are: (1) no need to remember and type code programs; (2) component and event block are organized on a ready to use drawer, so only need to find suitable event block and put it like a

puzzle to program it; and (3) the event handler makes it easy to handle the event directly by retrieving drag and drop block that handles the event, so there is no need to understand classes, objects, and special objects to express an event. In addition have advantages, app inventor also has weakness, included: (1) less flexibility in designing user interface and application commands; (2) when there is a warning notice, it should find its own error location, and (3) can't create file which more than 10 MB.

METHODS

The type of research is development research of ADDIE's model (Analysis, Design, Development, Implementation, and Evaluation). This is procedure of this research are showed by picture 1.



Picture 1. Procedure of Research
(modified from (Branch, 2009))

The first stage is analysis which included analysis of curriculum standards of 2013, science process skills, learning material, learning content, and mobile learning system quality. The results of analysis is used to design learning process in the second stage. The design refer to the study of learning (curriculum of 2013 and science process skills), the study of material (nature of physics and developed competencies), and the study of media (mobile learning system quality). The design of mobile learning is reliazed in the development stage and then it validated by experts of learning, material, and media to test its validity. After mobile learning declare valid which mean that mobile learning is feasible conceptually, it implemented. The pupose of the implemantation stage is to test the feasibility of mobile learning to be implemantated in the real learning. It implementated to the students, who are the subject of this research, they are 20 students of XI grade SMA Muhammadiyah 9 Surabaya. After that is the stage of evaluation. This stage is to test the practicality and effectiveness of mobile larning based on the stage of implemantation. Practicality is reviewed from learning's implementation and constraint. Effectiveness is reviewed from students's science process skills and responses.

The technique of data collection are questionnaire and observation. Questionnaire is used to evaluate the validity of learning, material, and media, and also the students's responses. Observation is used to evaluate the learning's implementation and constraint, and also the students's science process skills. Assessment of all techniques uses Likert scale (1=very poor, 2=poor, 3=good, and 4=excellent).

The instruments of validity are validation sheet of learning, material, and media. Validation sheet of learning assess compatibility of mobile learning with curriculum of 2013 (graduate's competency, content, process, and assessment) and science process skills (observing, formulating hypotheses, identifying variables, interpreting data, and communicating). Validation sheet of material assess compatibility of mobile learning with nature of physics (facts, concepts, and laws of electromagnetic induction) and developed competencies (knowledge and skill). Validation sheet of learning assess compatibility of mobile learning with mobile learning system quality (functionality, accessibility, interactivity, ease of use, and interface design).

The instrument of practicality is observation sheet of learning's implementation and constraint. It assess implementation of opening activity (motivation, learning objective, and material coverage), core activity (instruction on science process skills and material explanation), and closing activity (feedback and test).

The instruments of effectiveness are observation sheet of science process skills and questionnaire sheet of student's responses. Observation sheet of science process skills assess all of student's skills of observing, formulating hypotheses, identifying variables, interpreting data, and communicating. Questionnaire sheet of student's responses assess responses of operation of mobile learning, motivation of learning, understanding of material, and training of science process skills.

Mobile learning is declared feasible (valid, practical, and effective) if percentage of validity (learning, material, media), practicality (learning's implementation and constraint), and effectiveness (students's science

process skills and response) are ≥ 61% with good and excellent category.

RESULTS AND DISCUSSION

Validity

The results of research is the feasibility of mobile learning involve validity, practicality, and effectiveness. The result of validity is displayed on tabel 1 below.

Table 1. Data of Validity

Indicator	Score	Category
Learning		
Curiculum of 2013		
Standard of graduate's competency (core and base competencies)	4	Excellent
Standard of content (Level competency of attitude, knowledge, and skill)	4	Excellent
Standard of process (learning's principle and process)	4	Excellent
Standard of assessment (test for knowledge and practice activity for skill)	4	Excellent
Science process skill		
Training of observing skill	3	Good
Training of formulating hyphothesis skill	3	Good
Training of identifying variables skill	3	Good
Training of interpreting data skill	4	Excellent
Training of communicating skill	4	Excellent
Validity of learning	**93%**	
Material		
Nature of physics (fact, concept, and law)	4	Excellent
Developed competences (science process skill)	4	Excellent
Validity of material	**96%**	
Media		
Fungsionality	3	Good
Accessibility	3	Good
Interactivity	3	Good
Ease of use	4	Excellent
Interface design	3	Good
Validity of media	**86%**	

All indicators in curiculum of 2013 gets excellent category. It shows that learning activities in mobile learning, from activities in motivation menu, discovery activities on student worksheet menu, explanations of experiment result and related materials on material menu meet the learning principle, correspond to the level of competency, involve student's scientific attitudes and science process skills, and help student to ahieve knowledge competency. It also showed that test evaluation in test menu can assess knowledge competency and answer columns on worksheet menu which can be sent via email can assess skill competency.

Training of observing skill gets good category because video phenomenon which presented for observation only provides information visually so that it only involves the senses of sight. Training of formulating hyphothesis skill gets good category because there is no reference of theory or data to formulate hypotheses. Training of formulating hyphothesis skill gets good category because there is no example of how to determine variables. Training of interpreting data skill gets excellent category. It shows that analysis quiestions help student to find the relation between variabels. Training of communicating skill gets excellent category. It shows that mobile learning allows students to report experiment result in the form of table and report their ideas.

Both of validity of material get excellent category. It shows that the material in mobile learning already includes facts, concepts, and laws of electromagnetic induction materials. The fact mentioned is the fact of electomagnetic induction, that is shaking battery. The concepts mentioned are the concept of magnetic flux, GGL induction, GGL induction on GGL motion, and self induction. The laws mentioned are Faraday's law and Lenz's law. The excellent category also shows that mobile learning can help students to achieve knowledge and skill developed competencies.

On validity of media, only ease of use indicator which gets excellent category. It shows that command and information which given are clear and sistematic, so that users can operate mobile learning easily. The others indicator, that is (1) fungsionality get good category because the table which is provide to train interpretating data can't change when users wrong to enter the data, they must be out of application and then open it again to enter the data; (2) accessibility get good category because the speed of some content which is connect to internet is depends on the internet network; (3) interactivity get good category because the help to explain user ideas is easy for interpretating data only; (4) interface design get good category because the color compotition are little.

Percentage of each validity of learning, material, and media show that mobile learning compatible to the study of learning, materials, and media, and also declare feasible conceptually and can be implemented.

Practicality

The result of practicality which viewed from learning implementation and constraint is displayed on tabel 2 below.

Table 2. Data of Practicality

Indicator	Score	Category
Opening activity		
Giving motivation	4	Excellent
Explaining learning objective	4	Excellent
Explaining material coverage	4	Excellent
Core activity		
Guiding to observing	4	Excellent
Guiding to formulating hyphothesis	4	Excellent
Guiding to identifying variables	4	Excellent
Guiding to interpretating data	4	Excellent
Guiding to communicating	4	Excellent
Explaining the experiment result	4	Excellent
Closing activity		
Giving feedback	4	Excellent
Giving test	1	Very poor
Percentage of learning implementation and constraint	**93%**	

All of learning activities get excellent category, except giving test activity to assess students's knowledge competency. It caused by the less of learning time, that is only one meeting (90 minutes). Moreover, the subject of research which come from grade XI have not yet receive electromagnetic induction materials, so it takes a longer time to learn it. If it is applied to the real learning and the time available is also less, these test can be used as homework assignments. However, ideally learning using mobile learning is done for at least two meetings. The first meeting to discuss learning motivation, explore the prior knowledge, and conduct discovery activities accordance to the worksheet. The second meeting to discuss the results of the discovery followed by the discussion of the material then do test. Another constraint is application that can be stop suddenly sometimes and return to the previous screen. It is a weakness of this mobile learning's application which can be solved by submit each answer directly to anticipate if the typed answer lost. Percentage of learning's implementation and constraint show that mobile learning feasible to be implemented.

Effectiveness

The result of effectiveness which viewed from students's science process skills on tabel 3 below.

Table 3. Data of students's science process skills

Indicator	Percentage (%)	Category
Observing	100	Good
Formulating hyphothesis	65	Good
Identifying variables	100	Good
Interpreting data	65	Good
Communicating	65	Good

Based on the table 3, 100% of students get good categories for observing skill. It caused by the advantages of mobile learning that can help to facilitate the different learning needs among students (Sarrab, et al., 2012) and give personalized learning (McQuiggan, et al., 2015), so that students can play back phenomena video over and over until they understand the content of video phenomenon. In addition, students can also submit their observation freely through the column which is provided.

In the formulating hypothesis skill, 35% of students get excellent category. It cauesd by the advantage of mobile learning that can provide wider access in learning (McQuiggan, et al., 2015), it is by providing a google link to facilitate students to formulate hypotheses.

Similar with observing skills, in identifying variables skill, 100% of students get good category. 100% of students are correct in determining manipulation and response variables, but less precise in determining control variables. It caused by the lack of understanding which is given about variables and there is no examples of how to determine variables. Students should be given a description of the experiment steps or should be given a simulation link to make it easier to identify variables.

Based on the data obtained, 35% of students get excellent category in interpreting data skill. It caused by the advantages of mobile learning that can increase the interaction between students and teacher (Sarrab, et al., 2012). Through these advantages, mobile learning can provide format of experimental table and analytical questions that can help students to interpret data.

In communicating skills, 35% of students get excellent category. It caused by the advantages of mobile learning that can provide personalized learning (McQuiggan, et al., 2015) and reduce communication barriers (Sarrab, et al., 2012), so that quiet or shy students can present all their answers freely.

Besides based on the science process skills, the effectiveness of mobile learning is also determined by the results of students's responses. The result of effectiveness which viewed from students's science process skills on tabel 4 below.

Table 4. Data of students's science process skills

Indicator	Percentage (%)	Category
Operation of mobile learning	91	Good
Motivation of learning	84	Good
Understanding of material	81	Good
Training of science process skills	85	Good

Based on the questionnaire data, students's responses are positive with percentage between 81% and 91%.

Operation of mobile learning get 91% good category because it clear to give the command, easy to give answer, easy to connect in internet, and easy to operate simulation. This responses is complay with the validity of media for ease to use indicator. Motivation of learning get 84% good category because the dispayof background and learning content are attracted, and also the facilities given is complete so there are many chooise to learn. Understanding of material get 81% good category because the explaination of material is clear and sistematic, and also all of content given are related and support it. Training of science process skills get 85%. It caused some reason, that are (1) for observing skill, it provide video phenomena which clear and students also can repeat and give their observation result freely through answer column; (2) for formulating hyphothesis skill, there are link of google which connected direcly so that student can freely search information to formulate hyphothesis; (3) for identifying variabels skill, there is explanaiton about variables and the amount of answer columns for each hyphothesis are same with the hypothesis which must be identify; (4) For interpretating data skill, the analysis questions are help to find the relation between variable of these table; and (5) for communicating skill, provided format of data's table which the data can be enter directly and from answers column as always give chance to give their opinion.

Percentage of each of students's science process skill and percentage of students's positive response ≥ showed that mobile learning complays the criteria of effectiveness and succeed to train science process skills.

CONCLUSSION

Research conclude that android mobile learning using app inventor is feasible to train high school student's science process skill because it valid (validity of learning is 93%, validity of material is 96%, and validity of media is 86%), practical (learning's implementation is 93% with the constraint that faced was sometimes application stopped suddenly) and effective (science process skills are good with observing is 100%, formulating hypothesis is 65%, identifying variable is 100%, interpreting data is 65%, communicating is 65% and students's responses are positive with percentage between 81% and 91%).

Based on the research that has been done, there are some suggestions as follows: (1) in the observing section, it recommend that the video phenomenon also provides audio information so that more of the five senses are involved to observe and give commands to give observed results which are only observed by the five senses, (2) to further shorten the time in formulating hypothesis, it should be given reference link of theory or observation data, (3) provide examples of how to identify variables and show a PhET simulation link to make it easier to identify variables, (4) set up the experimental data table so that when something goes wrong the data can still be replaced, (5) Recommend to develope mobile learning for offline access type, (6) Recommend mobile learning is applied in the android type of tablet PC to make it look bigger, (7) If mobile learning application capacity more than 10 MB, it recommend using tooll in addition to app inventor, because app inventor limits the maximum size of application is 10MB.

REFERENCES

Akker, J. v., Branch, R. M., Gustafson, K., Nieveen, N., & Plomp, T. (1999). *Design Approaches and Tools in Education and Training.* Dordrecht: Springer-Science+Business Media, B.V.

Branch, R. M. (2009). *Instructional Design: The ADDIE Approach.* New York: Springer.

Kozhevnikov, M., Motes, M. A., & Hegarty, M. (2007). *Spatial Visualization in Physics Problem Solving. Cognitive Science, 31* (4), 549-579.

Kukulska-Hulme, A., & Traxler, J. (2005). *Mobile Learning a Handbook for Educators and Trainers.* London: Routledge.

McQuiggan, S., Kosturco, L., McQuiggan, J., & Sabourin, J. (2015). *Mobile Learning A Handbook for Developers, Educators, and Learners.* Canada: Wiley.

Najjar, L. J. (1998). *Principles of educational multimedia user interface design. Human Factors*. 40(2), 311-323

OECD (2010), PISA 2009 *Results: Executive Summary*

OECD (2014), *PISA 2012 Results in Focus*

OECD (2016), *PISA 2015 Results in Focus*

Research Council (NRC). (1996). *National science education standards.* Alexenderia. VA: National Academic Press.

NCREL & Metiri. (2003). *EnGauge 21st century skills: Literacy in digital age*. Napierville. IL & Los Angeles. CA: NCREL & Metiri.

Rezba, R. J., Sprague, C. S., Fiel, R.L., Funk, H. J., Okey, J. R., & Jaus, H. H. (1995). *Learning and assessing science process skills.* (3rd Ed.). Dubuque, IA: Kendall/Hunt Publishing Company.

Sarrab, M., Elgamel, L., & Aldabbas, H. (2012). *Mobile Learning (M-Learning) and Educational Environments. International Journal of Distributed and Parallel Systems (IJDPS), 3* (4).

Sheeba, M.N., (2013). *An Anatomy of Science Process Skills In The Light Of The Challenges to Realize Science Instruction Leading To Global*

Excellence in Education. Educationia Confab, 2 (4), 108-123.

Traxler, J. (2009). Current state of mobile learning. In M. Ally (Ed.), *Mobile learning:Transforming the delivery of education and training* (pp. 247-264). Edmonton, Alberta, Canada: Athabasca Press.

Turiman Punia, et al (2012). Fostering the 21st Century Skills through Scientific Literacy and Science Process Skills. Procedia Social and Behavioral Science 59, 110 – 116.

UNESCO. (2013). *Policy Guidelines for Mobile Learning.* Paris: United Nations Educational, Scientific and Cultural Organization.

Wang, J.-Y., Wu, H.-K.,&Hsu, Y.-S. (2017). *Using Mobile Applications for Learning: Effects of Simulation Design*. *Computers in Human Behavior, 66,* 103-113.

Yilmaz, H. B. (2009). *On the Development and Measurement of Spatial Ability*. *International Electronic Journal of Elementary Education, 1* (2), 83-96.