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RESEARCH ARTICLE

PHYSICS MOBILE LEARNING OF LOCAL CULTURE (FIDDLE) TO IMPROVE THE VERBAL AND DIAGRAM REPRESENTATION COMPETENCE

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ABSTRACT

The research aimed to: (1) obtaining physicsmobile learning of local culture-based (Fiddle) with appropriate android assisted (2) improving the verbal representation and (3) the diagram representation abilities of Senior High School students. This research used 4D development model; (a) defining, (b) developing, (c) designing and (d) disseminating. The material was presented in an android application. The learning media feasibility had tested by experts, material experts, media experts, and physics teachers. The main field test subjects were 71 students. The effectiveness of physics learning media was obtained from the gain score of students' pre-test and post-test. Manova was used in data analysis techniques. The results showed that the learning media categorized as "very good". There was difference of final score between the experimental class after used the physics learning media product of local wisdom-based (Fiddle) and the control class.

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INTRODUCTION

The development of information technology drive the innovation in the learning process as a solution to assist the studens to learn more easily and able to reach. The learning innovation may in the form of e-learning and m-learning. Bahera (2013) states, the use of m-learning is more practical than e-learning. Mobile learning or called as m-learning, is a development of e-learning. The use of m-learning in learning has benefit for students and teachers in deliver the material. Moreover, m-learning generate the students' interest and motivation toward the learning activities. Bogatinoska (2013) used m-learning applications in physics learning. The Bogatinoska's application of m-learning was presented in a simple design, and presented a lot of material, and it haseffect on easier for students in learning. Sarrab, Elgame l, & Aldabbas (2012) states, m-learning is a assisted tools for the learning process in the educational environment. It is supported by Oprea, Miron (2014), applicatethe m-learning in miniature laboratory physics android based. Oprea implement a mini physics laboratory Android based that aimed to facilitate students in understand the scientific concept. Android is a most up-to-date technology that has ability to resemble a laptop computing. Android may be used in m-learning because it iseasy to use. Android has multimedia capabilities, including display images, text, videos and internet access. Android-based applications and windows in physics learning facilitate the students to explore and develop their knowledge of physics concepts, and it facilitates the learners to understand the concept of physics (Thomas, 2013). Yunita (2013) states, the benefits of android applications in the form of physics equation that is designed interactively may increase the students' interest on learning, and then students are easy to learn. Besides the learning process android assisted, there need a meaningful learning activities. Azizahwati (2015), etal, states that the implementation of local wisdom may increase the learning outcomes and then, it make students obtain a meaning from learning process. A meaningful learning process may apply to the physicssubject, because physics is related to natural phenomena around the human. Rusilowati, A., Supriyadi & Widiyatmoko (2015) deliver local wisdom material by linking the natural disasters and physics learning with SETS vision. Courvoisier (2017) supports by states the phenomena in nature / environment haverelations to science. Thus, the learning of physics can be associated with the phenomenon in a nature / environment. Fiddle traditional music instrument is one example of local wisdom. Fiddlemayfind at the wayang performance, *Sekaten* celebration at the Great Mosque of Yogyakarta and Keraton, and other traditional ceremonies that use the strains of gamelan.Fiddle has a closed resonator component and stringed strings.

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Components in the fiddlemay apply to physic material about friction, tension and strain, sound waves on closed resonators, and the N-basic tone of the strings. Rusilowati (2007) states that generally the students of Senior High School has difficulty to understand the material about vibrations, waves and sounds. The weaknesses of students in those material are about misconception, mathematical ability, the ability to convert units, and the ability to understand pre-requirements knowledge. The students' weakness in the friction force material is caused by the difficulty in visualizing the frictional force. Based on the learning difficulties, students need to improve the problem-solving skills. Sweller (1998) explains, the problem-solving skills are central to learning. Representation is one example of problem solving abilities. Representation is the way of students' views to describe the information in problem solving. Representations commonly used by learners are: free-body diagrams, field line diagrams, or bar graphs, concept maps, graphs and equations (Docktor, Mestre, 2014 p.19-20). The representation ability is a bridge to describe the mathematical equations into an explanation or reason, and then, it may convert into a knowledge (Hubber 2017; Paty 1995, 2001; Pietrocola 2010). Thus, there is a great opportunity to develop aphysic learning media of local wisdom-based in android assisted applications. Applications in android aims to assist the students in improving the representation ability of verbal and diagrams by way providing a number of simulations and materials in interactive design. In the application, it will provide with sound, animation and an attractive appearance to improve the learning interests of students.

Review of Related Literature

Android Technology

Technology has a role to support the learning activities. Chau (2013), et al, used technology to create 3D (3 dimensional) learning environment. The learning environment provides comfortable environment, and may increase the students' concentration in learning. Wang (2013), et al, used technology to present a complex concept, and significantly influence the students' learning. Hašková et al. (2010) used multimedia technology to support the learning process of geometric optical materials. The multimedia is designed to change negative perspective toward physics. The development of information technology led to rapid changes in teaching learning methods. Previously, teaching use a traditional method, and then, it turn into IT-based teaching. Targamadzė and Petrauskienė (2010) explain the development of IT make the process of new learning formation. Yektyastuti (2016) states, the influence of the learning media has a positive effect because it reduces the limitations of teachers in teaching. Learning process undergoes development from traditional to e-learning and virtual learning. Simkova, Tomaskova and Nemcova (2012) states, E-learning and M-learning is an example of the development of ICT in education. M-learning is the development of e-learning. M-learning uses mobile devices such as PDAs, net book, tablets and mobile phones that connected to wifi or mobile networks. Android is a types of mobile phone. Meier and Thomas states, Android is a software stack that has open source properties consisting of middleware, key aplication and API (Application Programming Interface). Android uses the java programming language (Meier 2009; Thomas 2013). Android-based apps may create and develop easily. Android application is also easy to download. Using android makes an animation looking more interesting. The use of technology in a mobile learning (android) may use as a support device of learning media local wisdom-based.

Local Wisdom of Fiddle

Geertz (2000) states, local wisdom may obtain from a logical meaning culture. Meliono (2016) states, local wisdom is an expression of the interaction of community groups that proceed. Suastra (2005, 2006) mentions, local wisdom is a natural source of art creation, culture, and human resources that become specific characteristic of a region. Local wisdom is able to apply in the physics learning media. Fitrianingsih & Albab used the gods of ruci on light material, and developing local wisdom-based modules on newton's law material gained good responses from students (Fitrianingsih 2013; Albab 2014). Rahayu (2015) supports by conducted the development of newton's law learning media with fotonovella of otok-otok boats to increase the students' interest in learning. Fiddle is a traditional musical instrument. Fiddle is part of the gamelan instrument. The leader of a song or state is the role of the fiddle. Fiddle made from jackfruit wood, heart-shaped with a closed cavity. The cavity is called as resonator, and it is made from skin, gut or dried bulls' urine. The fiddle string is made from brass metal. The position of the string is strained and footed on a small buffer called as *Srenten* (Palgunadi, 2002: 400).

Representation Ability of Verbal and Diagram

Representation ability is a tool in understanding the concept of physics (Etkina *et al.,* 2009). Representations may divide into representations of external (concrete) and mental. The use of representation ability need be mutual to the physics problem. There is difference between expert and novices in using representation skills as solutions to solve the physics problems. The experts have the steps to solve the problem; observation, analysis, problem visualization, conceptual analysis, and planning the stages before solve a problem (Kohl and Finkelstein, 2008; Mason and Singh, 2011). Menwhile, the novices solve the problems without associating to the existing physics concepts. The forms of external representation (concrete), which are: writing a language (verbal), diagrams, equations, graphs and sketches (Lucas, 2014). Verbal representation is the ability to store an information in written and oral, in order to build new knowledge (Clark and Paivio, 1991; Tabachneck *et al*., 1994; Villegas *et al*., 2009; Saeki and Saito, 2009). The representation of diagram is a technique to solve the problems with the images assisted. The diagram representation ability include of theorem proving, visual programming, qualitative physics, free body diagram / diagram newton, and presentation of data (Joseph Smith, 1994; Raghavan and Glaser 1995; Ayesh and Bdellfattah, 2010). Joseph and Setiawan (2009) states, the diagram/ figure representation in physics is based on the concepts of; free body diagrams, field line diagrams, electrical circuit diagrams, ray diagrams, wave front diagram, and energy state diagram.

Related to Local Wisdom, Physics Concepts, Representations of Verbal and Diagrams

The environment has an important role in developing the representation skills. The local wisdom is a phenomenon occuring in the environment (Bao *et al*., 2011; Lin and Singh, 2011). Thus, local wisdom is a way to develop the

representation skills. Multirepresentations are useful to describe the concepts with different forms of; verbal, images, diagrams, graphs and mathematical equations (Rosengant, 2007; Nguyen and Rebello 2010). Multirepresentations are used to facilitate thestudents to solve problems. The form of multirepresentations include of; verbal, images, diagrams, graphics, computer simulations and mathematical equations (Rosengant, 2007). Verbal representations can be either written or spoken, able to have information from the past directly, and able to overcome the misunderstandings of students (Villegas, Castro and Gutirrez 2009; Saeki and Saito 2009; Johnson *et al*., 2013). Kulpa (1994) states, the other forms of diagrams representation include of theorem proving, visual programming, qualitative physics and data presentation. Raghavan and Glaser (1995) states, diagram representation (free body diagram / newt on diagram) may use to explain the phenomenon in physics. Ainsworth (2008) states, an elusive scientific concept mayillustrate through a free body diagram. Local wisdom is able to present the physics concepts from its components. Fiddle, a traditional musical instrument is one of the local wisdom products. Fiddle has the components of *Kosok Fiddle* (tool for stringed) and string. These components may use to describe the forces by using diagram representations. Other component is sound waves where fiddle produces an abstract sound wave and may represent in diagrams. Moreover, there are other physics concepts such as friction, strain and modulus of elasticity on the strings before tuning and after tuning. And, verbal skills are used to provide descriptions and association in the physical symbols.

Research Gap

The study aimed to produce a medium of physics learning by inserting fiddle as local wisdom that is provided in the Android application. The media expected able to improve the students' ability representation of verbal and diagrams. Research questions were; how the level of feasibility and suitability of the development of physics learning media fiddle-based with android assisted based on the rules of research and development; how the level of influence of the development of physics learning media fiddle-based with android assisted toward the verbal representation ability of high school students; and how the level of influence of the development of physics learning media fiddle-based with android assisted toward the diagram representation ability of high school students?.

Method

The research has purpose to produce a fiddle-based learning media with the Android assisted on the forces material to find out the application's feasibility and it is expected to increase the representation of verbal and diagram of high school students. The research development used 4-D model, which are; define design, develop, and disseminate (Thiagarajan, Semmel & Semmel 1, 1974: 5).

Define

In the define step, conducted pre-research and analysis. The analysis included of material analysis, students analysis, and task analysis that conducted to obtain information for making of media, curriculum, lesson plan and research implementation. Data collection techniques used observation and unstructured interviews.

Design

In the design step conducted the preparation of test. The test is designed in essay. The essay task is validated by experts, teachers and students. Experts and teachers validate by filling in the assessment instrument test section. Then, conducted empirical test followed by 100 students to obtain the proper questions. Table 1 presented about the designed question indicators. The next step is media selection and selection of media formats. The media is created by Adobe Flash Professional CS 6 using Action Script 3.0. Android specifications are android minimum version 4.0. (Ice Cream Sandwich), minimal 1 GHz dual core processor, minimum 512 Mb RAM, display resolution of 480 × 800 (screen resolution unit) with 16 million byte color depth, and installed of Adobe Air application. The instructional media is designed to describe the representations of verbal and diagrams on friction force physics materials. The directions of instructional media are presented in Table 2.

Development

In the development step, it conducted validation and development test. The validation process is assessed by lecturers, physics teachers, peers and students' responses. Validation by lecturers, teachers and peers was conducted by filling out the assessment rubric. Meanwhile, the development test conducted on students through a limited trial. Limited trials were conducted on 10 students. At this step, it may understand the response of students toward the media. After the media is stated as valid, and then conducted dissemination step. The dissemination step is conducted through product trial.

Product Trial

Participants of the research for initial / limited trial consisted of 10 students. Then, after the initial trial, it conducted a major field trial with participants divided into two groups; treatment groups and non-treatment groups. Each group is given pre-test and post-test. The research was designed into two classes; experimental class and control class. The differences in experimental and control class were found on the media using. The experimental class used physics learning media of local wisdom-based (Fiddle) with the Android assisted. The control class used media of PowerPoint, and displayed through LCD. Subjects of experimental class were 35 students. Meanwhile, subjects of control class were 36 students. The research was conducted from January to February 2017. The product trial was conducted to determine the effectiveness of the media product. The effectiveness of media was conducted by analyze the gain score (increase). The gain score equation was written in equation 1 (Hake, 1998):

$$g = \frac{S_f - S_i}{100 - S_i} \quad (1)$$

The gain score was adjusted to Table 3. The criteria of gain score is presented in Table 3.

RESULTS AND DISCUSSION

Media Developed Result

This study aimed to produce a feasibility learning media. Learning media is provided in an android application.

Table 1. Indicators of media

Indicators	Material	
	Static Friction	Kinetic Friction
Explain the concept verbally	Presented images of Fiddle players are putting *Kosok* Fiddle (tool for stringed) on Fiddle's strings, students are asked to build facts based on the phenomenon.	Presented video of Fiddle player is playing the Fiddle by fiddling the strings horizontally. Students explain the concept of the forces when the Fiddle is played
Give labels and physical symbols on free body diagrams verbally	Presented a Fiddle image, and then students are asked to analyze the forces.	Presented a Fiddle image are being played, and then students are asked to analyze the forces.
Determine the correct concept based on data or physical phenomena	Given a Fiddle image, the students are asked to calculate the forces, and interpret the relationship of some symbols in the physics equation.	
Solve the problems with sentences or words verbally	Given a Fiddle image are being played, and then the students are asked to analyze the facts.	
Use the assist of free body diagram to solve the problem	Given a Fiddle images where the *Kosok* Fiddle are attached to the fiddle's string, and another images of Fiddle are being fiddled horizontally, and then students are asked to mention the forces in the phenomenon by the assist of free body diagram	

Table 2. Learning media directions

Material	**Know the forces on an object and the Fiddle**			
Indicator	**Weight forces**	**Normal forces**	**Friction forces**	**Application in everyday life**
1. Explain the concept verbally	Presented definitions verbally	Presented definitions verbally	Presented definitions verbally	
2. Give an label and physics of symbol on free body diagram verbally	- Presented a weight forces symbol. Presented a weight forces diagram on flat plane and inclined plane.	- Presented a normal forces symbol. - Presented a normal forces diagram on flat plane and inclined plane.	Presented a explanation, symbol of friction forces, and direction of friction forces on a diagram.	
3. Determine the correct concept based on data or physic phenomenon.	Presented a relation between weight and mass according to Newton Law.	Presented a formula of normal forces.	Presented a formula from static and kinetic of friction forces.	- Implement a friction forces when racer conduct a curve forces. - Presented a formula of relation between friction forces and centripetal forces.
4. Use assisted of free body diagram / diagram to solve the problem. 5. Mentions the forces in the Fiddle by assisted of diagram mentions	Presented a diagram of weight forces on flat plane and inclined plane.	Presented a diagram of normal forces on flat plane and inclined plane.	Presented a diagram of friction forces.	

Table 3. Gain score criteria

No.	Gain Score	Criteria
1.	$g \geq 0{,}70$	High
2.	$0{,}30 \leq g < 0{,}70$	Medium
3.	$g < 0{,}30$	Low

Table 4. Criteria of Product feasibility assessment

No	Score Interval (*i*)	Quality Category
1	$\bar{X} \geq X_i + 1{,}8\ Sbi$	Very Good
2	$X_i + 0{,}6\ Sbi < \bar{X} \leq X_i + 1{,}8\ Sbi$	Good
3	$X_i - 0{,}6\ Sbi < \bar{X} \leq X_i + 0{,}6\ Sbi$	Good Enough
4	$X_i - 1{,}8\ Sbi < \bar{X} \leq X_i - 0{,}6\ Sbi$	Less
5	$\bar{X} \leq X_i - 1{,}8\ Sbi$	Very Less

Table 5. Result of product feasibility

No	Product	Score	Score Interval	Category
1.	Material	53,75	$50{,}4 < X \leq 60$	Very Good
			$40{,}8 < X \leq 50{,}4$	
			$31{,}2 < X \leq 40{,}8$	
			$21{,}6 < X \leq 31{,}2$	
			$21{,}6 < X \leq 12$	
2.	Learning Media	63,63	$58{,}8 < X \leq 70$	Very Good
			$47{,}6 < X \leq 58{,}8$	
			$36{,}4 < X \leq 47{,}6$	
			$25{,}2 < X \leq 36{,}4$	
			$25{,}2 < X \leq 14$	

Table 6. Gain Score of representation of verbal and diagram

Criteria	Verbal Gain score		Diagram Gain score	
	Experimental class	Control class	Experimental class	Control class
Average	0,43	0,13	0,49	0,17
Deviation Standart	0,19	0,30	0,21	0,19
Maximum	0,91	0,49	0,83	0,45
Minimum	0,00	-0,63	0,00	-0,63

Developed Learning media may be used as assisted tool to study the physics material. The media displayed representations of verbal and diagrams on physic materials. The instructional media was designed according to the matrix in Table 2 and Table 3. The main menu display is presented in Figure 2. The main menu page contains information of; the Fiddle music instrument, the Fiddle physics material, the route maps, PIFIDREB media information, the researcher's profile, and instructions for use. In the information of Fiddle music instrument presented tuning video of rebab, Fiddle information, and parts on the rebab. Meanwhile, in the Physics material presented material of friction force (know the forces that move on an object), stress, strain, modulus of elasticity and sound waves. Each of physics material contains competency achievement index (IPK) and physical phenomenon in everyday life. Task exercises may find in the friction force material. In the friction force material presented an image of free body diagram of forces on objects in the flat plane and inclined plane. The force diagram is representative of the diagram representation. The form of verbal representation in the learning media is found in the explanation of the physics concept with the phenomenon of daily life. The form of verbal representation presented in the verbal explanation of definition and interpretation of the forces in the Fiddle, the type of frictional force andphenomenon of curve motion in GP motto races. Figure 3 presented a form of diagramrepresentation on media.

Figure 1. Fiddle Player

Product Feasibility Test Results

The developed products included of representation instruments tests of verbal and diagrams, friction force physical materials, and local wisdom-based learning media (Fiddle). Developed media was in the form of android applications. Assessment is converted from quantitative on rubric into qualitative data using Table 4. Meanwhile, the feasibility test results are presented in Table 5. Based on Table 4 and Table 5, it may state that the developed products were stated as feasible to use.

Figure 2. Main Menu Page

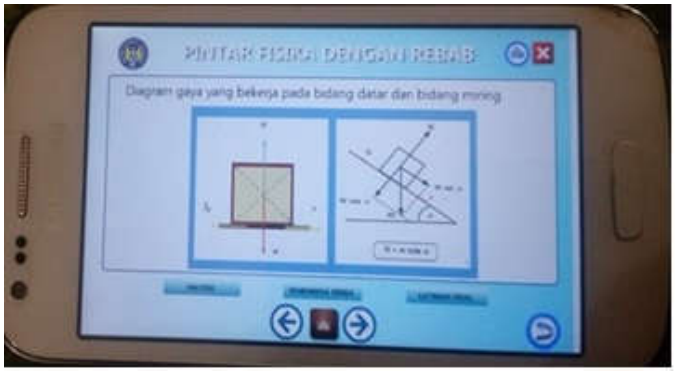

Figure 3. Physic Material Page

The Gain Assessment Result

After the product is stated as feasible, and then conducted a major field trial. At this step, the data analysis technique used the students' score of pre-test and post-test both of experimental class and control class. The score of pre-test and post-test resulted the gain score (increase). The gain score of representation of verbal and diagrams in experimental class and control class is presented in Table 6. Table 6 shows that there is a significant score in experimental class compare to control class. The experimental class has an average score of 0.43; in contrast, control class has average score of 0.13 for verbal representation skills. Moreover, the verbal representation skill of experimental class is higher than control class. The average assessment of experimental class is 0.49, and the average assessment of control class is 0.17.

Conclusion

Based on tabulated and analyzed data, it may conclude that the product in the form of Android media on local wisdom-based (Fiddle) is accordance to the rules of research and development. Media android is stated as feasible by experts, teachers and peers with the score of 63.63 with the category of "very good". Android media has an influence to improve the verbal representation skill in friction force materials. The gain score in experimental class is 0.43 higher than control class of

0.13. And it is also on the ability of the diagram representation that the gain score of experimental class are higher than control class. The gain score of experimental class is 0.47 and the control class is 0.17.

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