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The Analysis of Students' Conceptual Understanding and Motivation in Guided Inquiry Science Learning Model Assisted by Android Virtual Laboratory

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Abstract

This study aimed to: (1) examine the feasibility of android virtual laboratory application in motion of objects material. (2) examine the practicality of android virtual laboratory application in motion of objects material. (3) find out the effectiveness of students' conceptual understanding and learning motivation after participating in learning process with the guided inquiry model. (4) find out the difference in students' conceptual understanding and learning motivation after participating in the guided inquiry model assisted by the android virtual laboratory application . This study used a research and development (R&D) approach by adapting the Alessi and Trolip development models. The participants were 106 grade VIII students at SMP 1 Jepon. The research instruments were conceptual understanding tests, motivational questionnaires, and student response questionnaires. The hypothesis testing of the study was carried out by the Wilcoxon test, the Mann Whitney test, and Independent Simples test using the SPSS program. The results of the study revealed that: (1) The android virtual laboratory developed application was very feasible to be used with an average percentage of eligibility alpha test of 83.34% from media experts, 70.5% from material experts, and 92.9%, from the beta test. (2) Students' responses to the use of android virtual laboratory application scored 27.32 % which means it was "practical" to be used for learning process in science subject. (3) The experimental class was more effective shown by the increase of students' conceptual understanding and motivation seen from the gain value. (4) There was a significant difference in the average of the students' conceptual understanding and motivation of in the experimental class with the control class.

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INTRODUCTION

Based on the characteristics of science subject, studying science should not only mastering the knowledge but also involve the process of discovery, thus learning science cannot be separated from experiments. Experiments or practicums are considered as important methods and processes for understanding scientific phenomena and further investigating scientific principles (Liu, 2015) .Science learning must begin by exposing students to real problems that can be applied in their lives, so that students are expected to gain knowledge and master the science concept more deeply that is done by practicum.

In fact, not all natural objects and phenomenon can be presented in classroom learning and are difficult to learn directly because they are constrained by several things, such as place, time, and equipment (Wahyuni & Djukri, 2015). According to Arsyimelati (2014), teachers also rarely give students the opportunity to make observations or experiments. Students are only given a concept without any scientific process to find the concept. Furthermore, the results of science learning is not optimal because students do not master the concepts taught by the teachers.

Based on the results of interviews with science subject teachers in SMP 1 Jepon, science learning activities especially in KD (Basic Competence) 3.1, which should use practical methods to support learning outcomes, but it is rarely done. As one of the leading schools, SMP 1 Jepon has complete educational facilities and infrastructures as well as science laboratory equipment and materials. However, many laboratory equipment in schools are outdated and damaged due to the impact of use, so it is not ideal if practicum is used. In addition, the problem of effectiveness and time efficiency when implementing practicum is the occurance of obstacles because of the limited hours of practical lessons and the ineffective use of time for practicum. Furthermore, the science lessons that should be delivered using practical methods are still widely taught by using classical methods that are teacher-centered.

In the 21st century, learning is characterized by the rapid development of science and technology in various fields of life in society, especially information and communication technology. Therefore, learning methods are needed that can prepare students for science and technology literacy, being able to think logically, critically, creatively, and be able to argue correctly. There are many innovations appear in learning media, one example is virtual laboratories or better known as virlab . According to Flowers (2011) virtual practicum is a computer simulation that contains a number of instructions and procedures, data analysis and presentations where through virtual practicum, students can carry out a number of activities as in real labors only students do it in computer software. Hermansyah (2015) also explained that the virtual laboratory is the development of computer technology as a form of interactive multimedia object to simulate laboratory experiments into a computer or smartphone .

The use of smartphones in science subject learning can provide convenience for students in conducting learning activities, including the flexibility of access to high learning. SMP/MTs students actually also have their own characteristics who enjoy to follow the current trend . Based on observation data that has been obtained in SMP 1 Jepon, all teachers have an Android cellphone , but it is not used to support learning. Teachers often use an Android mobile for communication purposes only. Furthemore, almost all students have also used an Android mobile in each class. So from this point of view, a learning media is developed, namely an android virtual laboratory that can be used by all students who have an Android cellphone so that students can be more happy and motivated and better understand the material being studied.

Efforts to increase motivation certainly affects the model of learning that students do in the classroom. One of the learning models that are considered suitable for learning science is learning inquiry that is student-centered learning. Learning science have focused on rote

activities can be changed by applying the concept of inkuri models, so that a low student mastery of concepts can be improved. Inquiry learning that is suitable to be applied at the junior secondary level (SMP) is guided inquiry . SMP students are just starting to think logically in solving problems, so that they still need intensive guidance from the teacher in learning (Prasojo, 2016).

The purpose of this study was to examine the feasibility of android virtual laboratory application, examine the practicality of android virtual laboratory application, analyze the effectiveness of understanding of the concept and motivation to learn, and to analyze the differences in understanding of the concept and motivation of students in the motion of a body with a model of guided inquiry.

METHODS

This research is research and development (R&D). The product produced in this development research is a android virtual laboratory learning media in the motion of things material as a VIII grade science learning resource . Development of learning media used a development model developed by Alessi & Trolip (2001). In general, this interactive multimedia development model has three attributes and three phases . The three attributes are standard attributes , ongoing evaluation , and project management . Three phases in the development model are planning, design, and development .The stages of developing virtual laboratory android media adapted from the design of Alessi & Trollip development can be seen in Figure 1.

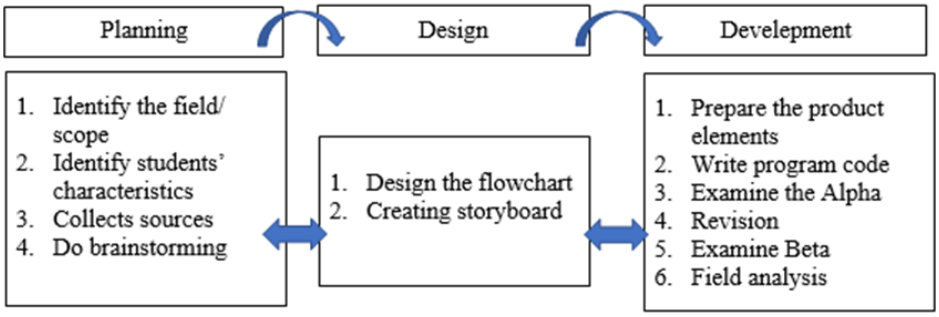

Figure 1. The Steps of Adaptation Model by Alessi and Trollip

The test subjects for the alpha test consisted of three people. The trial subjects for the Alpha test consisted of three material experts and three media experts as competent parties to validate the media developed. The Beta test was carried out by using 9 students from SMP N 2 Karangawen. Field trials are students of SMP N 1 Jepon class VIII E, VIII F, VIII G, each of which has 36 students with random sampling technique .

The data in this study were data from the Alpha test, namely the validation of material experts and media experts regarding the feasibility of android virtual laboratory media , data from the Beta test media assessment questionnaire by students on the developed media, students' motivation questionnaire data in the experimental class and the control class and data the pretest and posttest of the experimental class and the control class. The data was then scored, thus it became quantitative data. Data from needs analysis, advice from media experts and material experts as well as opinions and responses in the media development process were qualitative data.

Effectiveness of android virtual laboratory applications with guided inquiry learning model for students' conceptual understanding and motivations obtained from the gain test. The score of effectiveness was seen from the results of understanding the concept or motivation of students obtained through the pretest and posttest . The score obtained was then changed with the following equation.

$$\text{Score} = \frac{\text{Score gained}}{\text{Maximum score}} \text{ x } 100\%$$

Furthermore, the score obtained by students are analyzed using the standard gain.

$$g = \frac{Posttest - pretest}{\max skor - pretest}$$

The analysis used to test the hypothesis of differences in students' conceptual understanding and differences in learning motivation was to use independent analysis of sample t-test p roses analysis using SPSS.

RESULTS AND DISCUSSION

Based on the results of the Alpha test with a spec being tested are aspects of auxiliary information, affective considerations , interfaces, navigation, pedagogy, and invisible features . Media validation was carried out by one media expert lecturer from UNNES and two applicators who are experienced in their fields using the Likert scale 1 to 5. The average score of the assessment scores from six aspects is 81.33 % . From the results of the assessment, it was included in the criteria of good. Based on the results of assessment of android virtual laboratory learning media conducted by expert validators the material from the aspects of the scope of learning, presentation of information, and deepening of the material obtained the final average value was 69 % with good criteria. Thus, from the results of the average assessment of media experts and material experts is 75.16 %. Hence, it can be concluded that virtual laboratory learning media in the material movement of objects can be categorized as "Eligible".

Beta test was conducted on students of SMP 2 Karangawen grade VIII. This tryout was done pagainst 9 students consisting of 3 students with low ability, 3 students with the ability to moderate, and 3 students with good abilities based cognitive assessment. The following Table 1. was data obtained from the beta test (Prihadi, 2010).

Table 1. Beta Test Assessment Results

No.	Rated aspect	Number of items	AverageScore (%)	Criteria
1	Ease of Product to Operate	6	25.67	Very good
2	Ease of Product to Learn	5	21.44	Very good
3	Drawn Display	9	39.67	Very good
Final score			86.78	

Based on Table 1, it was obtained the final value of 86.78%. Thus it can be said that this media was in "Very Good" category to use . From the results of the Alpha test and Beta test showed that the virtual laboratory android application as the learning media developed in this study met the "valid" qualifications so that it was feasible to be tested in classroom learning.

Based on the results of questionnaire results of students' responses to the practicality of virtual laboratory android application presented in this following diagram Figure 2.

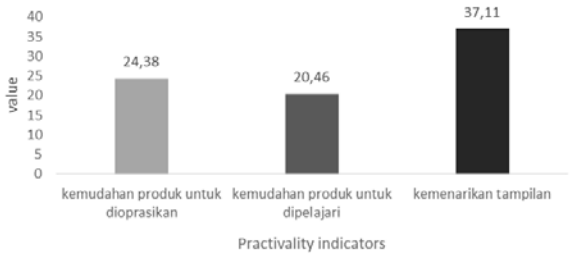

Figure 2. Diagram of Stundent's questionnaire avarages

Based on Figure 2. the average value of the 3 aspects is 27.32%. The acquisition of this value shows that the virtual laboratory android application that has been developed was good or

practical to be used as a science learning media for motion of things for grade VIII SMP students. This is in accordance with the function of learning media according to Alessi & Trollip (2001), namely good learning media are media that have a good navigation structure, attractive appearance, and consistent place and shape.

The effectiveness of the android virtual labolatory application on guided inquiry learning of motion of things was obtained from the gain test. Based on data Table 1. showed the results of the gain value understanding the concept of the experimental class was greater than the control class (gain EP> gain KK). The value of the experimental class gain was 0.41 and the control class was 0.20, which means that the experimental class was more effective in increasing the conceptual understanding than the control class. This showed that learning by using android virtual laboratory application was successfully implemented, according to theory Sudjana & Rifa'i (2013: 37) which states that the optimal teaching process enables optimal learning outcomes as well.

Table 2. Summary of Student Concept Understanding Data

Variable	Results of Concept Understanding					
	Control Class (CC%)			Exp Class (EC%)		
	Pretest	Postes	Gain	Pretest	Postes	Gain
Highest score	64	83	0.52	53	86	0.82
Lowest score	5	8	-0.02	14	36	-0.25
Average	34.23	45.88	0.20	29.77	58.81	0.41
Standard of Desiation	15.69	18.84	0.14	9.67	16.07	0.23
Difference in Pretest and Posttest score	11.65			29.04		
Difference of Inter-class Pretest and Postes score	17.39					
Difference of Inter-class Gain score	0.21					

Based on the results of research by Maulina & Kustijono (2017), namely practicum conducted in the real lab using physics tools has its own weaknesses, one of which is students who are still less skilled in using the tools, resulting in less accurate results. Practicum uses the application of virtual labolatory application performed by students, there are almost no significant obstacles because themeasurement is available and the application is installed easily so as to minimize the occurrence of measurement errors; therefore, students can draw the right conclusions easily. Furthermore, it can improve conceptual understanding greater than real practicum using Science KIT, so that it has an impact on cognitive abilities. The high cognitive passing grade demonstrates the effectiveness of the application of the android virtual laboratory application for learning. Based on these results it can be concluded that the use of android virtual laboratory application on guided inquiry learning model of object motion for class VIII SMP was more effective than using Science KIT.

The level of student learning motivation was seen from giving questionnaires at the beginning and end of learning. The results of learning motivation data can be seen in Table 3.

Table 3. Results of Student Learning Motivation Data

Variable	Learning Motivation Results					
	Control Class (CC %)			Exp Class (EC %)		
	Early	End	Gain	Early	End	Gain
Average	63	65	0.04	66	77	0.31
Standard Desiation	7.18	6.08	0.24	7.34	5.47	0.18
Difference between Early and Final Motivation	2			11		
Difference between Early and Final Motivation between Classes	9					
Inter-class Gain Value Difference	0.27					

In Table 3. it can be seen the gain value from the use of android virtual laboratory application in the experimental class and the use of Science KIT in the control class namely 0.31 % and 0.04 % . It meant that the effectiveness of the motivation of the experimental class students was greater than the control class (EC> CC). Several factors that support the effectiveness of android virtual laboratory application on student motivation were higher than the control class based on observed findings, among others: 1) learning and doing virtual labs using android virtual labolatory application makes students more excited because they have never been used before, 2) attractive display of android virtual labolatory application accompanied by animation motivates students to learn the concept of motion of objects that were previously considered boring. According to the results of research by Maulina & Kustijono (2017) based on field experience, it was very noticeable that students' interest in learning increased when presented with virtual lab media, students are more active and tend to be curious and want to try. Then the results of the study by Cabanban (2013) and Adi et al. (2018) the use of android type media in the teaching and learning process was able to have a positive impact by being shown to increase new learning desires, as well as having a great influence on students' psychology and increase students' learning motivation.

The results of the analysis of the large differences in the level of students' mastery of concepts in the experimental class and the control class were measured from the difference in pretest scores and posttest scores. Based on Table 2 it showed that the highest average gain value of the experimental class is 0.41%. The difference between the pretest and posttest scores between the two classes is 17.39% with the highest difference between the pretest and posttest scores also in the experimental class which is equal to 29.04%. The results are presented in the diagram in Figure 3.

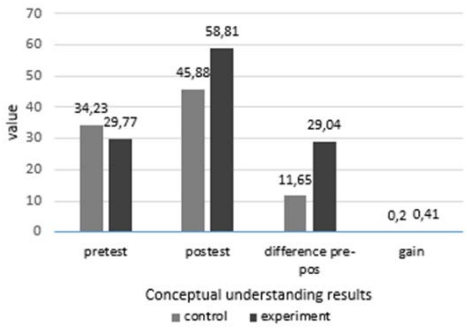

Figure 3. Pretest Average Chart, Postes, Value Difference, and Gain Difference

The output from the Wilcoxon test showed that the control class had an asymp sig value = 0,000 <α = 0.05 and the experimental class had the value of Asymp. Sig = 0.000 <α = 0.05, H_0 is rejected, which means that there were differences in the results of the pretest and

posttest results of the control class and experimental class. The output of Mean Rank in the Mann Whitney test could be seen that the average value of the conceptual understanding of the experimental class was greater than the control class (41.86%> 27.52%). The value of the Asymp. Sig. (2-tailed) = 0.003 <α = 0.05, H_0 is rejected, which meant that there was a difference between the average value of the conceptual understanding value of the experimental class and control class.

These results was in line with results Faour & Ayoubi (2018), showed that students from the experimental group were significantly better than the control group. The difference in the average value of understanding the concept was caused by the learning activities carried out between the experimental class and the control class using different media. According to Bire & Retnoningsih (2017) the use ofguided inquiry models assisted by the media could improve students' conceptual understanding. The use of android virtual laboratory application as a learning media in the experimental class makes the learning process more enthusiastic. The virtual laboratory capability that is used as a learning medium can require students to be more active in understanding the concept of material by doing virtual lab work, compared to the control class that uses the Science KIT.

Through android-based virtual laboratory learning, students were very enthusiastic in carrying out the learning process. According to Yektyastuti & Ikhsan (2016) and Mahardini (2017), Learning with an android-based virtual laboratory was more interesting and fun and could have an influence on improving cognitive learning outcomes. When students do lab practicum assisted by android-assisted labortory with a guided inquiry model, students feel the nuances of learning that are truly new and different. This causes them to be more focused on understanding concepts in matter of motion of matter. Students are also not afraid of being wrong when doing a virtual lab, because errors that occur during a virtual lab do not have an impact, so that they can be repeated until they are correct and understood by students.

Bakti et al. (2013) explained that virtual laboratories have the advantage of being able to do learning effectively and efficiently. In the results study of Permana (2016), it also showed that the results of students' conceptual understanding with virtual laboratory was better than the real experiment. Permana (2016) explained that the increase in the experimental class was higher compared to the control class due to the ability of the virtual laboratory to be able to bridge learning by showing simulations and animations related to the material so that students were easier to understand and able to provide simple explanations related to the material. Some of these reasons led to differences in the average value of understanding students' conceptual understanding in the experimental class with android virtual laboratory application greater than the control class with the Science KIT.

The results of the analysis of student motivation are obtained from the questionnaire given at the beginning of learning and the end of learning . The average results of initial motivation in the experimental class obtained a score of 66%, then the average final motivation score was 77%. In the control class the average initial motivation was 63%, and the average final motivation score was 65%.From these data the biggest increase in motivation was in the experimental group.

There are eight indicators in the student motivation questionnaire sheet according to Sardiman (2014), namely: 1) attentive and diligent in facing the task, 2) resilient facing difficulties, 3) satisfaction in getting an achievement, 4) self-confidence and love to work independently 5) easily bored on routine tasks, 6) can defend his opinion, 7) not easily let go of things he believes in, 8) love to find and solve the number questions. The final value of learning motivation based on indicators in the experimental class can be seen in Figure 4.

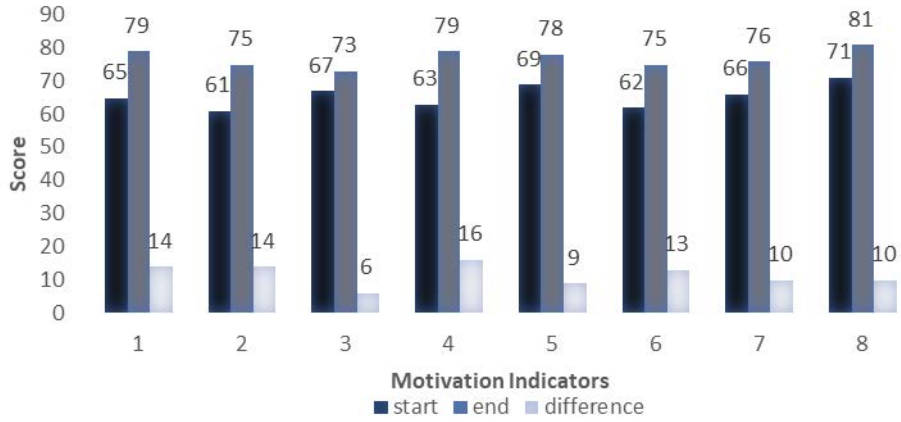

Figure 4. Motivational Diagram in Experimental Classes

In Figure 4. the largest increase in motivation in sequence was in indicators (4), (1), and (2). This means that the learning process with the guided inquiry model assisted by android virtual laboratory can increases self-confidence, enjoys working independently, is attentive, diligent and resilient in the face of difficulties. Keller (2010) explains motivation can be seen from the level of effort and perseverance made by students.

To find out the significance of differences in motivation experienced by students in the experimental class and the control class, the t test was used . Equal Variance analysis calculation Assumed to independent test results of test samples on the value of the post-test showed significance (2-tailed) of 0.000 < 0.05, H0 is rejected, which means concluded that there were differences in the average value of learning motivation in the experimental class assisted by android virtual laboratory application and control class assisted by Science KIT. The difference in student motivation could not be separated from the use of different media. Android virtual laboratory application is the latest technology-based learning media which has its own advantages than other media to support science learning on the motion of material objects. According to Muyaroah & Fajartia (2017), learning that uses android based learning media can motivate students to learn the material provided quickly, make students more interested in joning the learning process. This was what makes learning in the experimental class using the guided virtual model assisted by android virtual laboratory application have an average motivation which was greater than the control class with the Science KIT. Android virtual laboratory application was also able to overcome the limitations of the human senses, more observable, overcoming space and time so that this creates more conducive learning environment than in real practice. As explained by Rohmah (2015) and Surahmadi (2016), a conducive learning environment allows one to learn well, and this condition plays a role in increasing students' learning motivation.

CONCLUSION

Based on the results of the Alpha test from media experts and material experts, it showed an average value of 75.16 %. Meanwhile, the Beta test received an average score of 86.78 % . These results indicate that the android virtual laboratory application is valid and can be used . The questionnaire responses of students get an average score of 27.32% with a good category which means is is practical to be used for learning . Learning with the guided inquiry model assisted by android virtual laboratory application on the motion of things material is effective to improve students' conceptual

understanding and motivation. There is a difference in the average of students' cenceptual understanding and learning motivation of Grade VIII students of SMP 1 Jepon in the experimental class using the android virtual laboratory application and the control class with the Science KIT with guided inquiry model learning.

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