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# The Effectiveness of Android-assisted Optical Devices Learning to Improve Students' Conceptual Understanding

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## Abstract

This research aims to find the effectiveness of Android-assisted optical devices learning to improve students' conceptual understanding. This research was a quasi-experimental research with a pretest-posttest design. This research involved 60 second year high school students in West Kutai Regency, East Kalimantan. The instrument for the data collection was comprehension questions about conceptual understanding on optical devices tested through pretest and posttest. The conceptual understanding data was analyzed using anava mix design. The result shows that learning optical devices using an android application is more effective in improving students' conceptual understanding compared to conventional learning which is not using an android application.

Keywords: Effectiveness, Optical Devices, Conceptual Understanding

## INTRODUCTION

Smartphone with an android operating system is one of the fast-growing technology devices recently. Stat Counter for Indonesia area released statistical data on September 2018 which shows that from the total users of smartphone and tablet operating system, 91.95% of them are using android as the operating system. The estimation and statistical data show that Indonesia is one of the countries with the largest active Android smartphone users in the world. Today, android smartphone is an electronic device that most high school students own.

As the sophisticated device, smartphones can help to analyze the physics phenomena (Kuhn & Vogt, 2013). In terms of learning media, smartphones can be interesting learning media that help students to overcome conceptual difficulties and learn more enthusiastically (Vieyra & Vieyra, 2014; Gonzales, 2014; Fatimah & Mufti, 2014). In education especially the learning process, technology has a very important role (Zatarain *et al*., 2016; Stantchev *et al*., 2014). The use of smartphone applications helps students to improve their skills and build a coherent mental framework (Yang, 2012). Android applications can improve interpretation skills, , and argumentative students in physics learning (Yadianur & Supahar, 2017; Liliarti & Kuswanto, 2018). The use of learning applications with a blend of virtual-based technology can significantly improve student understanding (Wang, 2015; Chiu *et al*., 2014; Blikstein *et al*., 2012). Therefore, the use of android applications for physics learning will help students to understand Physics better.

The use of android smartphone for physics learning is mostly done on mechanical and electricity concept rather than on optical discussion especially on optical devices, whereas students also experience various problems to understand optical devices theories. This indicates that the use of android smartphones in learning process is a form of learning that is contextual and relevant to the students' current condition.

The learning media can be designed and made based on the current technological developments (Yektyastuti & Ikhsan, 2016). Anggraini and Kustijono (2013) state that with an attractive stimulus, students will easily process the information they receive. Besides, Daryanto (2010) also states that in this fast development of technology and information, the teachers' skill in teaching is not enough, the skill in managing information and environment is also required to facilitate learning activities. One of the ways to do is by enriching resource and media learning.

A research conducted by Tural (2015) shows that students have difficulties in learning physics especially about optics in which they have conceptual problems about lenses. Students also have difficulty in explaining optical concepts in daily life (Jhon *et al*., 2018). Those problems are related to the low conceptual understanding of students. Understanding is the second level in Bloom's taxonomy and it is defined as the ability to construct meaning from learning messages, in oral, written and graph, delivered through teaching process (Anderson & Krathwohl 2010). There are seven cognitive processes of the level of understanding, namely interpreting, imitating, classifying, summarizing, concluding, comparing and explaining.

The study of understanding concepts is an effort to understand and overcome basic problems of physics (Streveler et al., 2017; Amin & Levrini, 2018). Researches on students' concept in science learning has been conducted for the past four decades (Gurel *et al*, 2015). The evidence shows that there are researches conducted by teachers to improve students' understanding of physics. It is started from changing and developing learning model so that it can be more fun and interesting (Langitsari *et al*., 2018); to developing the learning media so that students have better understanding of learning materials (Hodijah *et al*., 2018). The improvement of students' ability in physics by using android has mostly been done on mechanical materials rather than optical devices materials.

Therefore, a research on the effectiveness of the learning using android in physics material related to optical devices is necessary to be conducted. Besides, a research that includes other materials in physics such as in the sub-section of optical devices is also necessary.

**METHOD**

This research involved 60 students from two different group of second year high school students in West Kutai regency, East Kalimantan Province. The groups consist of the control group and the experimental group. The control group is the group which uses conventional learning while the experimental groupis the group which uses android applications in the learning process. The experimental group uses android applications as the learning media. The research design can be seen in Table 1.

The instrument used to obtain the research data was a test of comprehensive understanding of optical devices. The test consisted of 1 item, each of 2 test items represents 1 concept understanding indicator in Bloom's taxonomy. The test

was divided into 2, namely pretest and posttest. Therefore, this research used pretest and posttest design. The learning effectiveness was analyzed using anava mix design (Widiharso, 2011).

Table 1. The Research Design

| Group | Pre-test | Treat-ment | Post-test |
|---|---|---|---|
| Experiment | O1 | X1 | O2 |
| Control | O1 | X2 | O2 |

Notes:

O1 = Initial Test

O2 = Final Test

X1 = Learning with android

X2 = Learning with conventional learning (without android)

## RESULTS AND DISCUSSION

The optics Application developed using Android Studio 3.0. Android Studio is the official integrated development environment (IDE) for the development of android platforms. The application was developed using java programming language. Learning materials are displayed in the applications related to optical devices. The main menu display can be seen in the Figure 1.

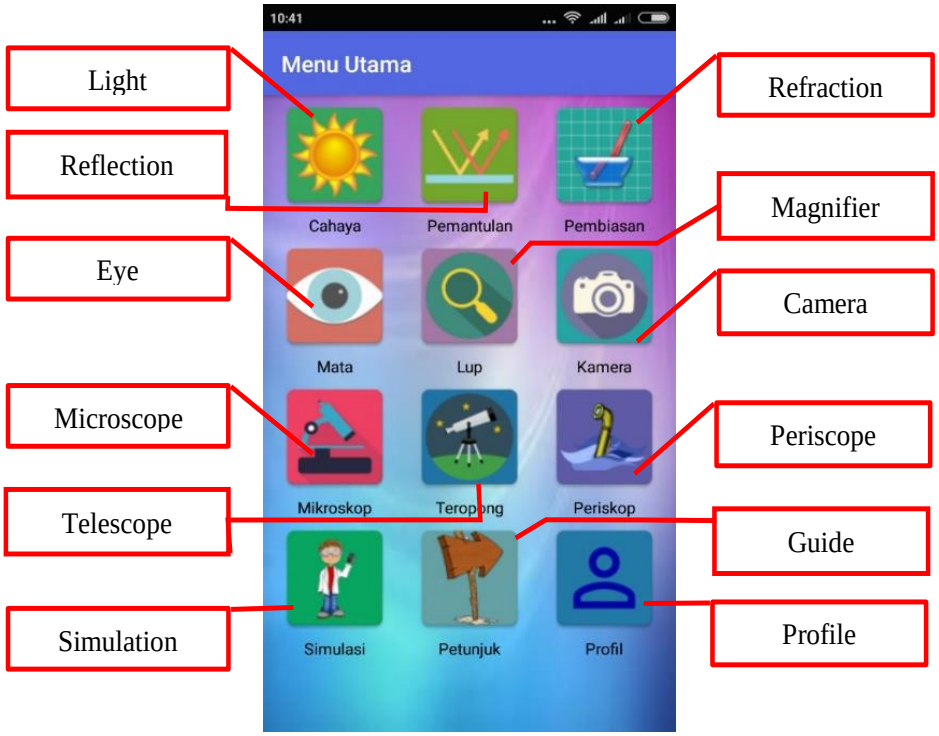


Figure 1. Main Menu App

Each menu button is connected to other pages containing optical devices materials. The details of optical instrument materials can be seen in the Table 2.

Table 2. Materials for Each Button

| Button | Material |
|---|---|
| Light | The history and development theory of light |
| Reflection | Reflection of light, reflection law, reflection on a flat mirror, reflection on a concave mirror and reflection on a convex mirror |
| Refraction | Refractive index, refraction law, refraction on a convex and concave lens. |
| Eyes | Eye parts, eye accommodation and eye defects |
| Magnifying glass | The history of magnifying glass invention, formation of shadow objects on a magnifying glass, magnification of magnifying glass when the eyes are accommodated and not accommodating |
| Camera | The history of camera invention, formation of shadow objects on a camera, roles and functions of camera parts |
| Microscope | The history of the microscope, microscope parts, formation of shadow on a microscope and mathematical equations related to magnification of a microscope. |
| Telescope | The history of telescope invention, star telescopes, earth telescopes, stage telescopes, reflective telescopes and mathematical equations related to telescopes magnification |
| Periscope | The history periscope invention, principles of periscope use and periscope parts |
| Simulation | Application simulation |
| Instruction | Instructions |
| Profile | Developer identity |

The learning material is compiled using Microsoft Publisher and saved as an image file in jpeg format. The image is then inserted into android studio 3.0. The java command is used to call the image, so when the button in the main menu is pressed, the page or activity containing optics materials will be called and displayed. The next page (activity) will be called when the button is pressed. The materials presented contain facts, concept, image and mathematical equations that will help students in learning optics. The display of materials page can be seen in the Figure 2.

In order to help students in learning optics, the android application developed also includes several simulations related to optical devices. The display of camera simulation page can be seen in the Figure 3. The camera simulation illustrates the change in the image taken by the camera when the lens focal distance changes. This simulation is

an adaptation of the focus of the camera's interactive simulation. There are three main parts of this simulation. Part (1) in the form of line drawing is an image of a lens change that changes the focus distance. Part (2) in which the object is two threes and a forest. Part (3) consists of a button – and a button + which are the lens focus converter. In this simulation, when the button + and the button – are pressed, then the focus point of the camera lens will change.

During the learning process, students form the experimental group will be given problems related to optical devices. To answer those problems, students read the material and run the simulation in the android application. Some students will answer the problems and the other will present in front. Android application used is one of the medium to facilitate students to find information and understand the concept of optical devices. For the control class, students will use hand out containing optical devices materials. The hand out will help students find the information related to optical devices.

The data on students' conceptual understanding was obtained using written test in the form of description questions as much as 7 items. The detail of indicators in the questions can be shown on Table 3.

The test was given before (pretest) and after (posttest) the learning process in experiment class and control class. The description of students' conceptual understanding was obtained from the conceptual understanding test result. The recapitulation data of pretest and posttest and physics understanding posttest can be seen in the Table 4.

Table 4 shows the average of pretest and posttest of conceptual understanding in experiment class and control class. This shows that the increase in physics understanding in the experimental class is greater than in the control class. This evidence is in accordance with the theory which states that learning with an android application will improve students' understanding in learning (Vieyra & Vieyra, 2014).

In order to identify the effectiveness and differences of experiment class and control class better is by using Anava Mix Design (Widiharso, 2011). To identify the differences of conceptual understanding in both groups, Pairwise Comparison is used. The result shows that the experimental group is significant (mean difference =-55.467; $p<0.05$) while the control group is also significant (mean difference = - 24.4; $p<0.05$). It means that learning with android (Experiment Group) or without android (Control Group) is equally effective in improving

students' conceptual understanding. This research shows that conventional learning by teachers has been able to improve students' conceptual understanding in the learning process. In the conventional learning process, teachers use students' worksheet that guides students to understand optical devices concept properly. Teachers' ability in managing classroom interactions and mastering learning materials in the conventional learning is very good. It corroborates the research conducted by Prasetyaningsih and Wilujeng (2016) who state that teachers' interaction in class and good mastery of materials can help students to learn better.

Even though the treatment given to both groups shows positive and effective results to improve students' conceptual understanding, learning with android is much more effective than ordinary conventional learning. This result can be seen in Figure 4.

Table 3. Indicator of conceptual understanding

| Indicator of Conceptual Understanding | Detail of Indicator |
|---|---|
| Interpreting | Interpret the truth of concepts related to optical devices<br>Interpret statements related to optical devices |
| Imitating | Imitate eye defect<br>Imitate optical devices that use a mirror as a component |
| Classifying | Classify types of eye defects based on certain characteristics<br>Classify the similarity of characteristics of optical devices |
| Summarizing | Summarize characteristics of shadow in some optical devices<br>Summarize the role of optical devices in everyday life |
| Concluding | Conclude eye defects<br>Conclude what an optical device is |
| Comparing | Compare types of lenses based on eye defects analysis<br>Compare the severity of eye defects |
| Explaining | Explain eye defects<br>Explain shadow formation on optical devices |

Table 4. Students' Conceptual Understanding Description

| Group/Class | Mean | |
|---|---|---|
| | Pretest | Posttest |
| Control | 23.33 | 47.73 |
| Experiment | 24.57 | 80.03 |

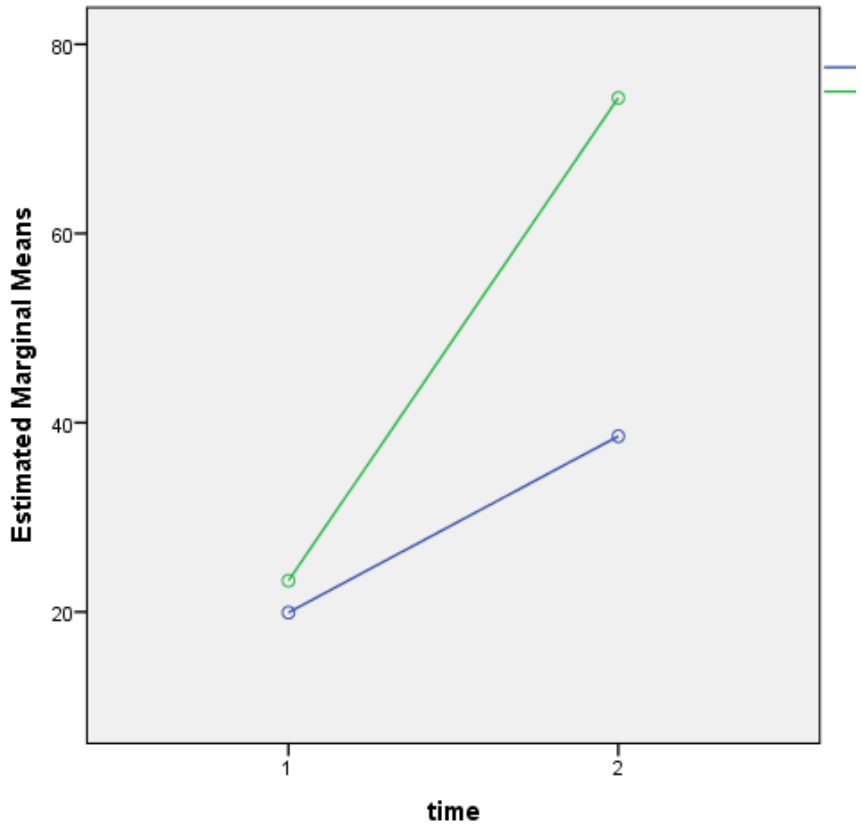


Figure 4. Graph of Differences in Conceptual Understanding ImprovementOn the figure 4 about graph of the differences of conceptual understanding improvement, time 1 (pretest) shows that initial point of both graphs is nearly close. This shows that the initial pretest scores have almost the same score. In addition, students in the experimental or control group have almost the same level of understanding (Homogeneous). In time 2 (posttest), it shows that the experimental group has higher posttest score than the control group. Multivariate tests result can be seen in Table 5.

Table 5. Multivariate Tests

| Group | Sig. | Partial Eta Squared |
|---|---|---|
| Control | 0,000 | 0.499 |
| Experiment | 0,000 | 0.837 |

Partial eta squared from the result of the multivariate test of the control group has a value of 0.499 which means that learning without android application can improve 49.9% of students' conceptual understanding. The experimental group that using the android application has eta squared of 0.837 which means that the learning process can improve 83.7% of students' conceptual understanding. This shows that the experimental group that use the android application in the learning process can improve students'

conceptual understanding compared to the control group. The results are in accordance with Kuhn & Vogt (2013) and Vieyra & Vieyra (2014) who state that android application as the learning media can help students to learn. Through this research, it is also found that the use of android application in learning is also effective in improving students' conceptual understanding of optical devices materials.

The use of android application in the learning process is proven to be more effective in improving students' conceptual understanding. However, there are several things that should be revised when using the android application in the learning process. In the learning process, it was found that there were some students who actually opened a game application in their android smartphone and they did not really study. Therefore, students should be supervised when using their android smartphone so that the learning process can be more effective.

## CONCLUSION

Optical devices learning by using the android application is more effective in improving students' conceptual understanding compared to the learning without the android application. Students with the android application can improve their conceptual understanding, 83.7%. While the conventional learning is 49.9%. This result shows that learning by using the android application is more effective in improving students' conceptual understanding of optical devices materials.

## SUGGESTION

The similar researches need to be conducted for other physics materials in order to improve students' conceptual understanding. When using the android application in the learning process, students should be supervised so that they will not open other android applications which will disrupt the learning process.

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