The effectiveness of android-based physics interactive media to train students’ thinking and process skills

R Kustijono¹, E Wiwin², and S R Hakim³

¹Department of Physics, Universitas Negeri Surabaya
²SMK Negeri 12 Surabaya
³Department of ICT Education, Universitas Muhammadiyah Sidoarjo

E-mail: rudykustijono@unesa.ac.id

Abstract. The purpose of the research is to describe the effectiveness of Android-based Physics interactive media to train students' thinking and process skills. The thinking defined are: analysing, evaluating, applying, generating ideas, expressing ideas. The process skills defined are: observing, classifying, inferring, predicting and communicating. The type of research is pre-experiment by using a one-shoot case study design. The effectiveness of the media is reviewed from the success of training thinking and process skills, as well as student responses. The subject of this research is 40 high school students. The measurement of thinking, process skills, and student response use a Likert scale. Data analysis used is descriptive statistics and correlation. Android-based physics interactive media is effective if the percentage of thinking, process skills, and student response ≥ 61%, and the correlation coefficient between thinking and process skills r ≥ 0.7. The results obtained are 1) the score of students' thinking is categorized good, 2) the score of process skills are categorized good, 3) Students’ response is categorized very good, and 4) the correlation coefficient between thinking and process skills is r = 0.73. The results showed that Android-based physics interactive media is effective to train students’ thinking and process skills.

1. Introduction

Innovation in the learning process needs to be conducted to eliminate students' boredom in conventional classes. One alternative is by using a smartphone, which has now become a tool that integrates into everyday life including students. If the smartphone is not integrated into learning, then its existence can interfere with the process in conventional classes [1]. Students often use smartphones for pleasure that is not related to learning in the classroom, especially to uphold Facebook and WhatsApp that are currently popular. WhatsApp is a free messaging application that can work on a variety of platforms (Iphone and Android) and is widely used to send multimedia-based messages (text, photos, videos, and audio) [2]. Basically, the technology is neutral, so the good and bad effects of the phone use depend on its users. Therefore, it is better for teachers to use smartphones in learning than to prohibit students from taking smartphones to school. Lately, the use of smartphones in learning is gaining popularity especially those used for learning through digital communication between groups of students and between students and their teachers, including those who use the Facebook and WhatsApp applications [3]. Learning to use a smartphone can be applied by packing learning material into applications that can be entered to the operating system. Android is the most appropriate choice alternative because it is currently the most
widely used operating system on smartphones. One reason is that smartphones use visual block programming, so no coding is needed to create applications. Users simply use, manage, and drag-drop visual objects to create the application [4]. Physics learning requires media that can explore material by involving thoughts and skills well. Physics is an idea that results from scientific inquiry that tests the physical properties of the universe. Mastery of the Physics concept requires a learning process that can train science process skills and critical thinking skills. Scientific process skills are the process of thinking and acting to find, develop, and apply knowledge that involves intellectual, psychomotor, and affective skills related to science learning in all aspects based on students’ basic abilities [5]. Critical thinking skills are an attempt to ask and answer questions systematically to produce a coherent and credible explanation [6]. The use of WhatsApp in learning is mostly aimed at building communication, socializing, dialogue, and sharing [7], and with similar objectives used in learning by using Facebook. The use of Facebook and WhatsApp in learning physics that has been conducted effectively can train critical thinking skills [8] & [9]. The use of Android-based Physics media is also effective in training scientific process skills [4], and also increases student motivation in learning Physics [10] & [11]. As far as the author knows, in the process of learning Physics has not found research using Android-based interactive media that trains critical thinking skills which also train scientific process skills. Therefore, this study was conducted with the aim of describing the effectiveness of using Android-based interactive media using Facebook and WhatsApp that utilize chat features and multimedia groups. Group and multimedia chats allow group members to share messages, pictures, and videos, which all group members interact with, and it can be an effective tool for training critical thinking skills and student scientific processes.

The use of smartphones in learning involves a combination of explanation and multimedia, which is proven to improve student learning outcomes [12]. Learning to use multimedia packs teaching materials (facts, concepts, processes, and metacognitive) to be more effective to improve the capacity of students' critical thinking skills and scientific process skills. Besides, it can also minimize learning gaps between students with different levels of ability, so that such learning processes are needed in physics learning because of differences in spatial abilities among students in producing, imagining, maintaining or manipulating an image [13]. The fact that students who have high spatial abilities tend to show better results in understanding Physics [14]. Students’ interest in using Facebook and WhatsApp as an interactive media based on Android can potentially motivate students to learn certain subject topics and allow teachers to integrate lessons into it. In addition, it can be used to facilitate the process of building communication between student groups and between students and teachers. The use of Android-based interactive media uses a data connection (internet) so that users can send messages for free without having to incur additional costs. The use of Facebook or WhatsApp as an Android-based interactive media, each has advantages and disadvantages, even though the features have many similarities. The increasing use of smartphones makes the use of WhatsApp a communication platform between groups of students, and between teachers and groups of students becoming increasingly popular. The main advantage of WhatsApp as a communication channel is that users feel more privacy, but the disadvantage is that the group community that can be built is limited compared to Facebook, besides all messages sent (text and multimedia) will be stored in the sending and receiving smartphone memory, so the smartphone memory becomes full quickly [9].

Nowadays, students are faced with a complex and rapidly changing world, where they must be able to absorb new ideas, filter and interpret information, apply knowledge, and solve life's problems. Such a complex 21st-century information explosion requires students to be able to develop coherent ways of thinking and reasoning so that the ability to think critically becomes very important [15]. Teachers will not be separated from the concept of critical thinking, which is the learning process always requires students to be able to make conclusions or solve problems. Academic life is critical to something that aims to bring something closer to the truth. Students can solve a problem if the learning process provides an opportunity for them to think critically which is process of self-directed, self-disciplined, self-monitored, and self-correction. A person who thinks critically can be seen from the way of reasoning that is clear, accurate, relevant, logical, broad, precise, significant, complete, fair, and profound [16]. People who think critically will consistently strive to live rationally, empathically, and be aware of imperfect human thoughts when left unchecked. Some elements of critical thinking are: analyzing,
evaluating, applying, generating ideas, and expressing ideas [17]. Physics learning not only prioritizes results (products), but the process is also very important in building students' knowledge. Scientific process skills that can be trained in learning to use interactive media based on Android are: observing, classifying, predicting, inferring, and communicating [18]. Observing is the process of gathering information using the senses, as the most basic ability [19]. The results of observing it become the basis for further scientific processes such as classifying, interpreting, predicting, and communicating them. Communicating is the process of presenting information that can be presented in many forms such as words, actions, tables or graphs.

The use of information and communication technology in the 21st-century learning becomes very important. One of them is a message delivery application that can strengthen learning the material in the classroom and positively influence the results of the discussion, collaborative work, and writing. The use of these technologies has the potential to stimulate the ability to think critically, collaborate and build knowledge [20]. The use of group chat and multimedia features, which allows group members to share messages, images, and videos, which can be used to train students' critical thinking skills. In addition, group chat and multimedia features can also be used to train scientific process skills such as observing, classifying, inferring, predicting, and communicating. Presentation of the chat with pictures and videos in the group can facilitate the development of the scientific process skills.

2. Research Methods
This type of research is pre-experimental with the one-shot case study design, namely the treatment of one group then the dependent variable is measured in order to determine the impact of the treatment [21]. The manipulation variable in this study is learning to use Android-based interactive media, while the dependent variable is critical thinking and scientific processes skills. Elements of critical thinking skills that are defined are: analyzing, evaluating, applying, generating ideas, and expressing ideas, whose measurements are based on relevance, logic, breadth and depth. The elements of scientific process skills that are defined are: observing, classifying, predicting, inferring, and communicating, the measurement of which is based on clarity, completeness, accuracy, and precision.

The procedure in this study is to apply physics learning using Android-based interactive media, then critical thinking and student scientific process skills are measured through observation using an attitude scale. Scores of critical thinking and acquired science process skills are then used to determine student performance when learning takes place. To find out how far the relationship between critical thinking and the scientific process skills, the correlation coefficient was calculated based on the average score obtained by students, then students were given a questionnaire to get their response to learning Physics using Android-based interactive media. The research subjects were 40 students from Muhammadiyah High School in Surabaya.

Data collection techniques using observation and questionnaire. Scores of critical thinking and scientific processes skills come from performance assessment instruments with a Likert scale (very less = 1, less = 2, good = 3, and very good = 4). Likert scales with the same criteria were also used for student response questionnaires for learning.

Data analysis uses quantitative descriptive. The description is based on the percentage score of each element and the average score of critical thinking and science process skills, while the relationship between the two uses the average correlation score obtained. The effectiveness of learning in terms of scores of critical thinking and student science process skills, effective learning if the percentage ≥ 61% is good and very good. Correlation criteria (r) used are good if r. ≥ 0.7. Effectiveness in terms of student responses is obtained by adding up all the average scores given by students divided by the maximum score multiplied by 100%, effective learning is when the percentage is ≥ 61%.

3. Result of Research
3.1. Effectiveness in terms of critical thinking
A product is called effective if the product provides results in accordance with the goals set, which in this case is the main success in training critical thinking and student science process skills. The
effectiveness of using Android-based interactive media in terms of its success in training students' critical thinking in which the results can be presented as shown in Figure 1 below.

![Figure 1](image1.png)

**Figure 1.** Percentage of critical thinking scores

Based on Figure 1, this shows that critical thinking skills from students with the good category are when the percentage ≥ 61%. These results indicate that learning Physics using Android-based interactive media can effectively train students' critical thinking skills.

3.2. Effectiveness in terms of science process

The effectiveness of using Android-based interactive media in terms of its success in training students' science process skills which results can be presented as shown in Figure 2 below.

![Figure 2](image2.png)

**Figure 2.** Percentage of critical thinking scores

Based on Figure 2, this shows that the science process of students with good mode is with a percentage of ≥ 61%. These results indicate that learning Physics using Android-based interactive media can effectively train students' science process skills.
3.3. Learning Design effectiveness
The relationship between critical thinking and student science processes skills can be seen from the correlation (r) correlation between the average score of elements of critical thinking skills and student scientific processes which are presented as Table 1 as follows:

**Table 1. The correlation between critical thinking and the scientific process**

| Element | X_{ct} | X_{sp} | r    |
|---------|--------|--------|------|
| 1       | 2.75   | 2.78   |      |
| 2       | 2.83   | 2.83   |      |
| 3       | 2.75   | 2.53   | 0.73 |
| 4       | 2.63   | 2.53   |      |
| 5       | 2.53   | 2.53   |      |

Based on Table 1, this shows that the correlation between critical thinking skills and the scientific process shows a score of ≥ 0.7 which means that it correlates well. These results indicate that there is a significant relationship between critical thinking and the scientific process.

3.4. Effectiveness based on student responses
The effectiveness of using Android-based interactive media in terms of students' responses after following the learning process using Android-based interactive media includes technical aspects and aspects of learning, and the results can be presented as shown in Figure 3:

**Figure 3. Percentage of student responses**

Based on Figure 3, this shows that the percentage of students responds to a good mode with a percentage of ≥ 61%. These results indicate that learning Physics using Android-based interactive media is effective in terms of students.

4. Discussion
Conceptually, Android-based interactive media in physics learning can be used to train students' critical thinking skills. The use of these media allows students to have the opportunity to explore ideas through chat groups so that they build and share knowledge through discussion forums [22]. The features in this media allow learning scenarios, learning materials, learning media, and learning environments to be well developed so that we can choose this mobile learning [23]. The use of this media technically also corresponds to previous research such as low cost, simple, high accessibility, and efficient. Learning to use Android-based interactive media can be used to overcome the availability of facilitators and because learning can be done anytime and anywhere [24]. Learning to use smartphones can increase the
flexibility of accessing learning resources independently whenever and wherever. Messages related to academic material that is sent enable students to interact together, build, and share knowledge [22], and messages sent by students can be used as effective tools for learning through social interaction [25]. Interactions that are established online between students and their teachers can create an effective learning environment [26]. Messages on Android-based interactive media use Facebook and WhatsApp are very easy to use, besides that students quickly get message updates by group members. that is the reason why students use this cellular system.

This Android-based interactive media can train critical thinking and science process skills because all students from the group are required to upload at least one picture and one video related to physical phenomena through the group. Furthermore, each uploaded image and video must be given an explanation regarding the substance of the physical phenomenon by the uploader. Critical thinking skills of students are trained by giving each student the opportunity to comment, criticize, expand and enrich the description of pictures and videos uploaded by other friends. From the pictures and videos uploaded by students and given explanations, students can give their appreciation. The students don't just upload pictures or videos about physics phenomena, but they also had to explain the physics concepts in the pictures or videos are uploaded. Therefore, this learning becomes effective to train critical thinking skills, because students are trained to analyse, assess, apply, generate ideas, and express ideas, which is reflected in student explanations and comments. Score students' critical thinking skills in terms of aspects of relevance, logic, breadth, and depth of student explanations and comments. In addition, student explanations and comments can also describe the ability of science processes which include observing, classifying, predicting, interpreting, and communicating. Scores of scientific process skills are reviewed from aspects of clarity, completeness, accuracy, and precision of student explanations and comments. The results of the study prove that Android-based interactive media can effectively train critical thinking skills and student science processes.

5. Conclusions
The effectiveness of interactive media based on Android uses Facebook and WhatsApp is fulfilled both in terms of technical aspects and learning aspects. Learning to use media can train critical thinking skills that are assessed by relevance, logic, breadth, and depth. In addition, it can also be used to train scientific process skills that are judged by clarity, completeness, accuracy, and precision. Learning to use the media also gets a good response from students, especially the technical aspects because it can be operated whenever and wherever, and aspects of learning because it encourages students to think. Android-based interactive media using Facebook and WhatsApp in the Physics learning process can effectively train critical thinking and student science processes skills.

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