Development of Physics Learning Media Based on Self-Efficacy Use Mobile Augmented Reality for Senior High School

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Abstract. It was found that the value of self efficacy in physics learning in high school (SMA) is still low in one school. Self-efficacy was found at the level of 48%. And this is supported by OECD data (3) which also states that the performance of Indonesian science more than 55% of students score below level 2 out of 5 levels. The development of self-efficacy media in learning physics astronomy is an effort made to improve students' self-efficacy. Media self-efficacy is designed using mobile augmented reality which is considered capable of giving students a better learning experience so as to be able to improve student learning abilities so that students' self-efficacy also increases. To be able to improve self-efficacy better this media must be supported by teacher assistance as a motivator to students so that the effects given are even better.

1. Introduction

Self-efficacy is defined as a person's belief about his ability to produce the desired level of performance. How students subjectively perceive their ability to master all their studies often encounters fear and frustration, and that will reduce their academic success. There are three main ways self-efficacy contributes to academic success. First is students' beliefs to master different academic subjects, secondly teachers' beliefs in motivating students and promoting learning to students, and thirdly schools have a sense of efficacy to be able to achieve significant academic progress [1]. Can be seen here to improve student self-efficacy requires the role of all parties both students, teachers or schools. To improve students' self-efficacy increasing student confidence, promoting learning to students and supported by motivation by teachers and schools is one of the ways that is considered sufficient to increase student self-efficacy.

Physics is one of the subjects that is considered difficult for students [2] and students face many challenges that can have an impact on students' self-efficacy levels. So that improvement in science learning will have a direct impact on the development of students' self-efficacy. Using a questionnaire by Rowbotham [3]. Researchers try to find out the level of self-efficacy of students in one junior high school in Indonesia. The survey results show that students' self-efficacy is at the level of 48%. These
results indicate the level of self-efficacy of students is still low. This statement is supported by the 2018 OECD report. Indonesian science performance of more than 55% of students scores below level 2 of the 5 levels of the OECD. Indonesian students from disadvantaged backgrounds are almost two years behind their disadvantaged peers [4]. Student self-efficacy in Indonesia is still low.

Mobile Augmented reality (MAR) is an Augmented Reality (AR) technology that can be carried and used anywhere. The use of MAR in education has a positive impact, many previous studies have been conducted and showed a positive impact after being developed using MAR technology. Following are conclusions of some previous studies:

Table 1. Previous studies about Mobile Augmented reality (MAR)

| Researcher               | Application              | Topic               |
|--------------------------|--------------------------|---------------------|
| Arvanitis et al [5]      | CONNECT                  | Science             |
| Squire and Klopfer (2007) [6] | Environmental Detectives | Environmental       |
| Tang and Ou [7]          | Butterfly Ecological Learning System | Science |

Inspired by previous research, using mobile augmented reality is a good development step to increase student motivation. In this research, trying to develop science learning media especially physics on astronomical material by using mobile augmented reality to improve students’ self-efficacy. Creating learning media that can increase student self-efficacy is the aim of this study.

Problem of this research is “How to design mobile augmented reality learning media that can improve students' self-efficacy at the high school level?” The purpose of this research is to be able to design mobile augmented reality learning media that can improve students' self-efficacy at the senior secondary level. It is hoped that this research can be used as a solution to face the low self-efficacy of students, provide input in the selection of instructional media and can be a reference to various parties, especially teachers in the field of physics to be more innovative. So that difficult learning materials and reducing students’ self-efficacy can be helped facilitate their understanding using mobile augmented reality better.

2. Literature Review

2.1 Students Self-efficacy

Bandura (1) proposed that self-efficacy was task-specific and domain specific. Furthermore, if individuals succeed in related tasks, self-efficacy may be generalized to tasks within a given domain. In other words, self-efficacy incorporates both specificity and generality.

2.1.1 Theoretical framework for student self-efficacy

Bandura’s social learning theory provides the framework for this study. It describes humans as being capable of self-regulation, planning (alternative) strategies, and exercising active control over responses and actions. Translated into academic life this allows students to learn from their experiences and influence their future behaviors and it also emphasizes the power of self-belief on behaviors. (1)

2.1.2 Factor that influences student self-efficacy

According to the theory there is a triadic reciprocal causation. Human action is a result of reciprocal interaction among environment, behavior, and person. The ‘person’ includes the gender, social position, physical attractiveness but especially the cognitive factors such as thought, memory, judgment, and so on. The influence of behavior, environment, and person depends on which of the triadic forces is the strongest at a particular moment.

Bandura pointed out that self-efficacy is established based on four main sources: obtained
achievement; vicarious experience; verbal persuasion; and, physiological status. In present research mobile augmented reality will try to improve student vicarious experience when studying astronomy topic. And when student have better experience in study it will relate and improve the academic achievement. The other two factor verbal persuasion and physiological status will try to improve by students center approach approach.

2.2 Mobile Augmented Reality

2.2.1 Definition

Educators are always looking for a new way to teach students and Jhonson [8] argue that AR is one of the new technologies which considered as having potential for pedagogical applications. Although in recent years AR is becoming increasingly widespread and has garnered much attention, the term AR has been defined in different meanings by researchers.

In 1994 Milgram [6], defined “augmented reality” into two approaches: broad and restricted approach. In term of broad sense, AR was defines as “augmenting natural feedback to the operator with simulated cues” while restricted approach highlight and defined AR as “a form of virtual reality where the participant’s head-mounted display is transparent, allowing a clear view of the real world”.

Azuma [10] tended to present a definition of AR based on a system that fulfills three basic criteria: (1) combination of real and virtual, (2) interactive in real time, and (3) 3D registration of virtual and real objects.

2.2.2 The potential of Augmented Reality in Education

Augmented reality is one the growing technologies that have a great pedagogical potential and have been increasing recognized by educational researchers. Mobile augmented reality learning based systems are more focus mostly on games or simulation and with the ability of mobile devices which has the features and properties such as portability, social interactivity, connectivity, context sensitivity and individuality [11] have make a learning experience more meaningful. Based on the previous studies eventhought most of the participants had never experienced an AR and MAR, overall participants felt motivated, enjoyed and the research show a positive educational effects on participants that leads to students to achieve higher levels of engagement in learning performance.

Although most of previous studies showed a positive impact and encouraging results, it is advisable to focus also on pedagogical and learning theory when implementing and developing the AR application since the educational value of AR are not solely based on its features [12]

3. Methodology

This research is a research and development (R & D) study using ADDIE instructional design model’s. From this step will answer the question whether the media produced is appropriate and used to influence self-efficacy or not. The self-efficacy assessment instrument used in this study was adapted from Melodie Rowbotham [2], which will products physics learning media base on self-efficacy for high senior high school students. In developing this learning media using instructional design models in this case using the ADDIE Model instructional design (ID ADDIE Models). This model was chosen because it is appropriate and easy to implement.

In accordance with the stages of ADDIE Model’s ID, this stage begins by paying attention to the concept of Self-efficacy for senior high school students. In the development of this media from the concepts of self-efficacy and fact in the field conditions that occur where students' self-efficacy is very low and compare to the ideal concept of self-efficacy.

Self-efficacy is integrated in media at the design stage. The design stage forms the base for the next stage of the development stage, as well as the implementation stage that underlies what is at the development stage. At each stage, evaluation is followed. The design of self-efficacy media in learning physics can be seen in the following Figure (1)
4. Result and Discussion

The design of self-efficacy media for learning physics at the high school level is based on the 2013 curriculum. This learning media is designed with the basics of learning and learning theories, namely learning behaviorism, cognitivism and constructivism. The approaches and strategies used in designing this media are scientific, flexible and active. This approach was chosen so that it can give students a better learning experience and can improve their understanding ability for the better.

The process of making learning media is done by using a computer on the minimum specifications of a blender and unity application, namely a dual core processor and 8 GB ram. The chart for making mobile augmented reality is as figure 2.

![Figure 2. Order of making mobile augmented reality base on self-efficacy](image_url)
During the process development of media quite a lot of changes occurred. Both in terms of design, or in terms of performance improvement. The results of the physics media learning base on self-efficacy for senior high school have been completed. Multimedia that is created provides an explanation of the material through augmented reality. Applications that are made can be installed in every android application with a minimum specification of Android type 4.1 Jelly Bean. The camera tracking ability will increase if the camera specifications of the cellphone increase. Result of the media show at Figure 3.

![Physics learning media mobile augmented reality base on self-efficacy](image)

**Figure 3.** Physics learning media mobile augmented reality base on self-efficacy

The things that are influenced by this application by increasing the ability of students to master physics, so they will be more confident in their abilities, with the help of the teacher accompanying students and motivating to be more confident, it is expected to be able to improve students' self-efficacy.

5. **Conclusions**

The design of self-efficacy media for learning physics at the senior high school level using mobile augmented reality on astronomy material has been completed and is ready to be addressed in the field. This media is designed with ADDIE instructional design model's. The design results were developed based on the 2016 revised 2016. curriculum. Mobile augmented reality has values that can improve students' reasoning abilities so as to enhance students' academic abilities. Accompanied by teacher assistance as a motivator in learning, it is expected to improve students' self-efficacy. This research can be an alternative solution in dealing with the problem of students' low self-efficacy.

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