L A P O R A N
PENELITIAN

Effects of Mobile Augmented Reality and Self-Regulated Learning on Students' Concept Understanding

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Effects of Mobile Augmented Reality and Self-Regulated Learning on Students' Concept Understanding

Abstract. Several studies have shown an increase in students' interest towards implementing augmented reality. The majority of these studies focus on how this technology can affect student performance with various abilities and skills. Therefore, the purpose of this study is to examine differences in students understanding level after using mobile augmented reality and conventional learning based on their self-regulated learning levels in the solar system class. Data were obtained from 91 students, with 47 of them in the experimental group using mobile augmented reality, while the remaining 44 are in the control group using conventional learning. This study measured students' self-regulated learning ability using a four-point Likert scale and 2multiple-choice questions. This result showed higher levels of concept understanding among students in the experimental group compared to the control. Furthermore, the results indicate the effect of the self-regulated learning level towards students' concepts understanding. It showed that students with high self-regulated learning levels had a different conceptual understanding from those with low self-regulated learning levels.

Keywords—Mobile Learning, Augmented Reality, Self-Regulated Learning, Students' Concept Understanding

BAB I
PENDAHULUAN

Mobile computing devices such as smartphones are currently used to provide positive contributions in learning. The smartphone also known as a mobile device as an instrument used to achieve learning goals irrespective of place and time[1]. Therefore, there is a need to adopt cellular technology in learning due to its capacity to attract and motivate students[2], providing an understanding and visualization of complex scientific reasoning[3]. Various studies have shown that this instructional technology encourages students to be directly involved in learning, influences performance, and motivation[4][5]. In addition, mobile learning has changed the educational paradigm effectively and flexibly. continuous[16]. Users experience natural and real human-computer interaction with virtual objects placed in a real view[17]. Preliminary observations have been made regarding the use of tools and learning technology. It was found that augmented reality was developed based on markers, with the use of computer equipment as teaching material. This study adopted sural[6] using the Vuforia SDK and Unity tools to achieve good support and documentation. Unity and Vuforia plugin are used to develop learning material because it is one of the best development platforms for building high-quality 3D and 2D games. The main components used in the development process are shown in figure 2.

Fig. 2. Marker-based mobile Augmented Reality development process[6]

1. 3D Models: This is the most important part of an augmented reality application. The quality and functionality of virtual objects such as video, text, or 3D computer models, affect the application. The first step in marker-based augmented reality design is developing a 3D model or video, with a link used to show when the camera is scanning markers[6].
2. QR Code: QR code is an evolution of the barcode. It is a type of matrix code or two-dimensional barcode with the main functionality readable by the scanner or smartphones and cellphones with cameras[18]. Initially, the QR code was used for tracking vehicle parts in manufacturing. QR codes are now used in a broader context, including commercial applications and the ease of tracking smartphone-oriented applications. The presence of this code allows the audience to interact through smartphones effectively and efficiently. QR codes have a smaller appearance than

bar codes. QR code is able to accommodate data horizontally and vertically. Automatically, the size of the appearance of the QR code image can be only one-tenth of the size of a barcode.

3. Vuforia: Vuforia is an augmented reality (SDK) software development device for mobile devices. It uses computer vision technology to recognize and track 3D objects, being able to position and orient virtual objects, such as 3D models and other media with real objects when viewed through a mobile device's camera. Vuforia SDK supports various types of targets, including image targets, 3D models, and fiduciary marker shapes. It also allows developers to create augmented reality applications and games easily[19].

Dimensions of self-regulated learning. The study also used a 19 Likert scale items with a 4-point type, ranging from 4-always to 1-never to collect students' responses. Therefore, the research can be evaluated to answer the MOSLQ questions which were carried out using the following dimensions: Goal Settings (GS), the process where students set specific predetermined goals and plan, Task Strategies (TS), as students' ability to plan and strategize how to achieve set goals, Time Management (TM), as a dimension that involves the ability or skills of time management during learning, Environment Structuring (ES), as a learning dimension in an online or virtual environment, Help-Seeking (HS), as students ability to ask for help in their area of concern when studying online and Self-Evaluation (SE), as the process of reflecting student ability to understand the fields that have been achieved. One component in MOOC is the ability to collaborate and interact while learning, which are all aspects of discussion forums. Table 1 shows the 19 items of MOSLQ instrument questions.

Table 1. MOSLQ survey question

GSQ1	I know what to achieve in this study.
GSQ2	I have prepared myself to study in this class.
GSQ3	I have high standards in learning performance on this subject.
GSQ4	I have set targets to achieve success in this lesson.
GSQ5	I was not directly involved in this learning because it was carried out online.
GSQ6	I have written down my predetermine goals after this lesson.
TSQ1	I have a strategy to complete study assignments in order to achieve learning goals.
TSQ2	I prepared myself by reading the available learning material before participating in this study.
TSQ3	I set the study agenda before participating with online resources.
TSQ4	I am prepared to face the challenges associated with learning.
TMQ1	I have mapped out plans on how to spend a lot of time studying online.
TMQ2	I found the right time to study, to avoid distractions.
ESQ1	I chose a quite location (place) to avoid distractions while studying.
ESQ2	I found a convenient learning location.
ESQ3	I chose the right location to learn effectively.
HSQ1	I plan to use the interactive communication channel in order to get support from peers and teachers (tutors).
HSQ2	I intend to actively participate in the discussion forum in order to acquire maximal learning results.
SEQ1	When following this lesson, I intend to reflect on my studies in each module
SEQ2	I intend to be proactive in involving and reviewing progress in my chosen learning path

BAB II
METODE PENELITIAN

This instrument was developed to determine students' concepts understanding during the study. It starts by making a grid based on the concept understanding indicators and learning objectives for grade IX students in Junior High Schools to fulfill the content and items validity. The content validity in this study consists of conformity with learning objectives as reflected by indicators, tests arranged in a clear and simple form, and suitability tests to measure the conceptual understanding level on Physics. A trial was carried out for students group considered to have the same characteristics as those used as research subjects to analyze the test items' validity, differentiation, and difficulty level. This study utilized a conceptual understanding test in the form of multiple choices consisting of 27 items. Furthermore, 20 items out of the 27 were found to fulfill the below 0.05. These findings indicate that the augmented reality mobile application is an effective learning tool in improving students' concept understanding.

BAB III
HASIL DAN PEMBAHASAN

A. Differences in students' concept understanding based on self-regulated learning

This study also tested the differences in students' concepts understanding with low and high self-regulated levels, as shown in table 3.

Table 3. The differences students concept understanding based on self-regulated learning

Concept Understanding

Self-regulated learning	N	Mean	Std. Deviation	Minimum	Maximum
High	44	81.36	3.889	72	87
Low	47	77.47	4.059	70	86
Total	91	79.35	4.413	70	87

The findings show that the average score of students' concepts understanding with high and low self-regulated levels was 81.36 and 77.47, with a score difference of 3.89 at a significant p below 0.05. The rejection conclusion of the null hypothesis indicates that students 'self-regulated learning causes differences in students' concept understanding. This is supported by the results of the pairwise comparisons, which act

Table 4. The differences between mean scores of concept understanding based on self-regulated learning, Pairwise Comparisons.

Dependent Variable: Concept Understanding

(I) SRL (J) SRL	Mean Difference (I-J)	Std. Error	Sig	95% Confidence Interval for Differencea	
				Lower Bound	*Upper Bound*
High low	3.791*	.661	.000	2.476	5.105
Low high	-3.791*	.661	.000	-5.105	-2.476

as outputs of estimated marginal means, as shown in table 4.

B. The influence of interaction students' concept understanding between mobile augmented reality and self-regulated learning

Inter-subject effect test is interpreted as the interaction between learning with mobile augmented reality and self-regulated learning towards students' concepts understanding, as shown in table 5.

Integrated into certain learning strategies, with further research carried out to determine the effectiveness of teaching and learning materials designed with augmented reality devices. Teachers and students' responses in measuring the satisfaction level using mobile augmented reality are not included as the main objectives of this study. However, they performed a dynamic two-way interaction during the learning process and were motivated to achieve learning goals. This is in line with Ozdamli & Hursen [26] research, which stated that prospective teachers are very enthusiastic in managing to learn using mobile augmented reality. Meanwhile, Tugun [27] stated that the use of augmented reality applications on some material and other subjects influences students' positive roles. Teachers and students find it challenging to change the learning environment from conventional to integrated technology[28].

This is because the use of technology and mobile devices requires them to possess different perspectives on learning and teaching[29]. This study shows that the aspects of technological mastery are essential for effective time management. This research is in line with Papadakis et al.[30] study, which stated that the use of software for the development of daily routines makes a substantial contribution in accelerating student learning time and understanding. Other empirical results obtained in this study are that students with high self- regulated learning can manage to learn independently while mastering the online tools. This research is in line with the study carried out by Albelbisi and Yusuf [31], which measures six main factors that influence students' self-regulated learning in an online environment. In this study, MOOC online self-regulated questionnaire (MOSLQ) was developed and used as an instrument to measure the students' self-regulated learning level.

This research is in accordance with Kizilcec et al.[32] and Littlejohn et al.[33] studies, which stated that the significant influence of self-regulated learning is in e-learning environments. This research explained that concept understanding depends on students' level of self-regulated learning, which requires the online implementation of effective e- learning strategies[34]. The pairwise comparisons test results were used to determine the different levels of students' concepts understanding with variations between their high and low self-regulated learning. This study is in line with Cho and Shen[35] research, which stated that students with high self-regulated learning can learn independently. Therefore, their ability to successfully learn online is greater[36]

BAB IV
PENUTUP

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