Journal of Physics: Conference Series

PAPER • OPEN ACCESS

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Optimizing the use of smartphones for M-learning as a supplement for magnetic learning with a scientific approach

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Abstract. The purpose of this study was to optimize smartphone utilization for m-learning as a supplement to magnetic learning with a scientific approach that could be used in learning without limitation of space and time. The research method was based on the ADDIE research and development (R & D) design. The research procedure used was limited product design that had been validated. Data sources at the analysis stage of smartphone utilization needs and student needs for physics learning media are 60 high school students from several provinces. The Validation of the M-learning design was carried out by lecturer who were experts in physics education and physics teacher. Data on needs analysis and m-learning design validation were collected using a questionnaire and analyzed using descriptive quantitative. The results of the questionnaire were obtained 100% of the students who were respondents had an Android smartphone and only 68.3% of students had used an Android smartphone for learning. The results of expert validation and practitioners showed that the m-learning design suitable for magnetic learning supplements was interactive, could be used for independent learning, had learning objectives content, interactive modules, broadcast material, video and animation magnetic phenomena, experimental simulations, material summaries, hyperlinks to other learning sources, as well as interactive quizzes. Learning activities including study of teaching materials, experimental simulations, assignments, quizzes, discussion forums. Synchronous learning activities were carried out for discussion forums, asynchronous for others.

1. Introduction

The current development was running so fast in this 21st century. In the field of education, there were ten 21st century competencies which should be learned and mastered including creative thinking and innovation, critical thinking and problem solving, decision making, metacognitive thinking, communication and collaboration skills, information literacy, information and communication technology (ICT) literacy, ability of socializing both locally and globally, life and career and personal and social responsibilities including culture [1]. To achieve those competencies require a change in the educational model, which was the process of learning from teacher-centered to student-centered, from isolation to networking, from passive to actively investigating, from abstract to contextual, from personal to team-based learning, from sense stimulation single direction to stimulation in all directions, from a single tool to a multimedia tool, from a one-way relationship shifting towards cooperation [2]. The scientific learning approach directed at the 2013 curriculum was seen to being able to meet these challenges. Scientific learning was learning that adopted scientific steps in building knowledge through scientific methods [3]. So learning using a scientific approach would produce students who had 21st century skills which were critical thinking, creative thinking, collaboration, communication (4C). The application of a scientific approach could help teachers developing more varied learning activities to facilitate students to optimize the development of their potential so that it helps optimizing the acquisition of learning outcomes [4]. Based on the observations results from several schools in various regions about high school physics learning was still teacher-centered. The limited time and the state of class facilities and infrastructure in teaching and learning activities in schools was an obstacle in applying the scientific approach. The tightness of the exam preparation activities for class XII resulted in reducing face-to-face hours in learning. There were 96.7% of students stating that they needed learning media that could describe physics in everyday life. More than 85% of students agreed that physics learning involved observing, formulating hypotheses and formulating questions, collecting data or information, processing data and drawing conclusions. This illustrated that students need physics learning delivered with a scientific approach. The development of wireless and cellular technology has grown rapidly in recent years [5]. The number of Android smartphone users with high specifications could be utilized to support the learning process. The results of the needs analysis, 100% of students already had an android smartphone but the use in learning was still 68.3%. The number of students of Android smartphone users allowed for the initiation of learning to supplement Android smartphones. This learning system was known as mobile learning. M-learning was defined as a form of learning achieved by the use of mobile technology [6]. M-learning was considered as a supplement to traditional E-Learning where mobility was an additional value for students [7]. M-learning allowed students to learn wherever and whenever without the limitations of space and time. The constraints of face-to-face time limitations in Physics learning could be overcomed by using m-learning as a learning supplement. Material that was considered difficult and required a scientific approach based on the results of student questionnaires was magnetism. Magnetic fields were physics material taught in BC 3.3, 4.3, 3.4 and 4.4 in class XII SMA in the 2013 revised 2017 curriculum [8]. In accordance with the basic competencies of the knowledge domain, students were expected to be able to analyze magnetic induction and magnetic force in various technological products and in the realm of application of knowledge, students were expected to be able to observe the magnetic induction and magnetic force around the wire. To achieve the ideal education in accordance with learning objectives, it was necessary to optimize the use of smartphones for m-learning as a supplement to magnetic learning with a scientific approach that could be used in learning without space and time restrictions.

2. Method

The research method was based on a research and development (R&D) design, which used the ADDIE development model, consisting of analysis, design, development, implementation, and evaluation. The research procedures used were limited to the product design stage. The first stage was analysis. The analysis stage of m-learning using interactive data sources in the form of questionnaires from 60 high school students in several regions. This stage was carried out to determine the required m-learning criteria. The design stage of m-learning as a supplement to magnetic learning with a scientific approach includes an illustration of the appearance of m-learning. The design of m-learning would go through an illustrated display of assessment by experts and physics teachers. The m-learning assessor respondents consisted of 6 physics lecturers from various state universities and 9 physics teachers in several high schools. The data was taken with a questionnaire instrument using five scales with the information as in table 1. The collected data was then analyzed in a descriptive quantitative manner.

Table 1. Score convertion.

Average Score	Decision
4,20 – 5,00	The Design of m-learning is very appropriate
3,40 – 4,19	The Design of m-learning is appropriate
2,60 – 3,39	The Design of m-learning is appropriate enough
1,80 – 2,59	The Design of m-learning is less appropriate
1,00 – 1,79	The Design of m-learning is not appropriate

3. Result and discussion

Here were the results of data analysis on the use of android smartphones from 60 students from various regions. The data could be seen in Table 2.

Table 2. Results of needs analysis in high school physics learning.

Students' Statements	%
Physics is difficult to understand	59,3
Learning physics is not fun	50,8
The teacher uses learning media in addition to printed books	81,7
Physics learning is related to daily life	83,3
Need learning media that can describe physics in everyday life	96,7
Agree if there are observing physics learning activities	98,3
Agree physics learning needs to be active in formulating hypotheses and formulating questions	89,8
Agree physics learning there are activities to collect data or information	86,7
Agreed in learning physics there are activities to process / analyze data / information and draw conclusions and present them	88,3
Have an android smartphone	100
Using an android smartphone while learning	68,3

Based on the results of the needs analysis in Table 2, some students stated that physics was difficult to understand and unpleasant. Therefore, almost all students agreed that teachers needed to use learning media other than printed books. The physics lessons that students wanted could describe the phenomena of daily life. Students also wanted that in the learning process, there were activities to observe, formulate hypotheses and formulate questions, collect data or information, process data and draw conclusions as well as students need to understand physics. The stages of learning that students need were the stages of scientific learning. Scientific learning was learning that consists of observing activities, formulating questions and hypotheses, collecting data or information, analyzing, drawing conclusions and communicating [9]. The implementation of the 2013 curriculum had been applied in all schools observed, but the implementation of the scientific approach had not yet been implemented. The tightness of preparatory activities facing the national exams results in limited face-to-face time in learning. Technological advances had the potential to make students more active and change student learning styles to become independent so they could do learning without space and time restrictions. Mobile devices that had developed so quickly could be utilized in learning. The number of mobile device users was increasing every day and their usage almost disrupts most activities in our lives [10]. The results of the needs analysis are obtained 100% of students observed of having an Android smartphone and this was very supportive for the development of learning design based on mobile learning. The use of mobile devices in learning activities was called mobile learning (m-learning). M-learning was defined as a form of learning achieved by the use of mobile technology [6].

Table 3. Results of analysis of the use of android smartphones by high school students.

Utilization of an Android Smart Phone	Frequency of usage (%)
Phone/SMS	12,52
Facebook/other social media	12,91
E-mail	0,60
Online shop	5,28
Whatsapp/other room chat	25,22
Game	9,39
Browsing lessons	9,95
Other browsing (besides lessons)	5,87
Streaming/offline watching/youtube	13,47
Mobile learning	4,78

Table 4. Results of the analysis of the m-learning design display assessment.

M-learning design	Score	Advise
Content		
Learning objectives	4,30	Expand the essential material on m-learning design and provide student worksheets on experimental simulations.
Interactive module	4,30	
Airing material	4,70	
Video	4,45	
Experimental simulation	4,30	
Summary	4,40	
Hyperlink	4,20	
Interactive quiz	4,35	
Learning activities with scientific approach		
Study of teaching materials	4,10	Assignments, quizzes and discussion materials must be able to stimulate HOTS
Virtual practicum	4,37	
Assignment	4,30	
Quiz	4,50	
Discussion	4,30	
Learning resources	4,60	
Emerge the curiosity and stimulate HOTS	4,10	It is necessary to complete each aspect with study material that can emerge the curiosity and stimulate HOTS
Interactive Design	4,50	
Average overall score	4,36	The design of m-learning is very appropriate

Based on the analysis results in table 3 there were 25.22% of students using an Android smartphone to send messages with Whatsapp media or other chat media. 13.47% of Andorid smartphones were used to watch offline or YouTube. Only 4.78% utilization of Android smartphones were used for m-learning. This was in line with previous resarch which stated the emergence of smartphone cellphones made many teenagers more intent and busy with the features contained in these tools, they were much more likely to interact via social media networks, rather than having to face to face [11] The existence of a smartphone also had a new effect on the behaviour of its users [12]. Smartphones could generally be used by high school students to find important information related to school lessons, establish and facilitate communication, store important data, and were often used as a medium of entertainment [13]. The number of students using Android smartphones and the use of learning was not optimal, it was necessary to optimize the use of Android smartphones in the learning process. This optimization was done by creating a m-learning design with a scientific approach. The design phase was assessed in the design of m-learning as a supplement to magnetic learning with a scientific approach. The m-learning design that had been made was then assessed by lecturers and physics teachers. The results of the evaluation analysis of the m-learning design illustration display could be seen in Table 4

Based on the results of an analysis of design assessments by lecturers and physics teachers in table 4, the m-learning design was considered to be very suitable for magnetic supplement learning which was interactive. An interactive media had the integration of digital media including a combination of electronic text, graphics, moving images, and sound to be structured in a digital computerized environment that allowed people to interact with data for specific purposes [7]. This m-learning design could be used for independent learning, had learning objective content, interactive modules, broadcast material, video and animation of magnetism phenomena, experimental simulations, material summaries, hyperlinks to other learning resources, and interactive quizzes. Learning activities in the design of m-learning were considered in accordance with the positive approach. The learning activities including the stages of observing, formulating problems, formulating hypotheses, collecting data with various techniques, analyzing data, drawing conclusions and communicating [14]. The scientific stages were arranged in the m-learning design activities in the form of study of teaching materials, experimental simulations, assignments, quizzes, discussion forums. The scientific approach had advantages, one of which was increasing intellectual ability, especially HOTS [15]. The m-learning design was complemented by assignments, quizzes, and discussion forums that foster curiosity and stimulate HOTS. The cognitive domain used was to analyze the cognitive scope (C4), evaluate (C5), and create (C6). The HOTS problem encouraged students to think broadly and deeply about subject matter, guided the relationship between materials in the lesson and use information that had been previously learned [16]. Mobile use had encouraged student motivation and support learning activities [17]. The use of mobile could support the learning process took place without the limitations of space and time. The design of m-learning was complemented by synchronous and asynchronous learning activities. Synchronous learning activities were carried out for discussion forums, asynchronous for others. After going through the physics teacher's lecturer and teacher evaluation stages, the m-learning design was designed with a scientific approach as a supplement to magnetic learning for high school students. Flowchart of m-learning design could be seen in Figure 1.

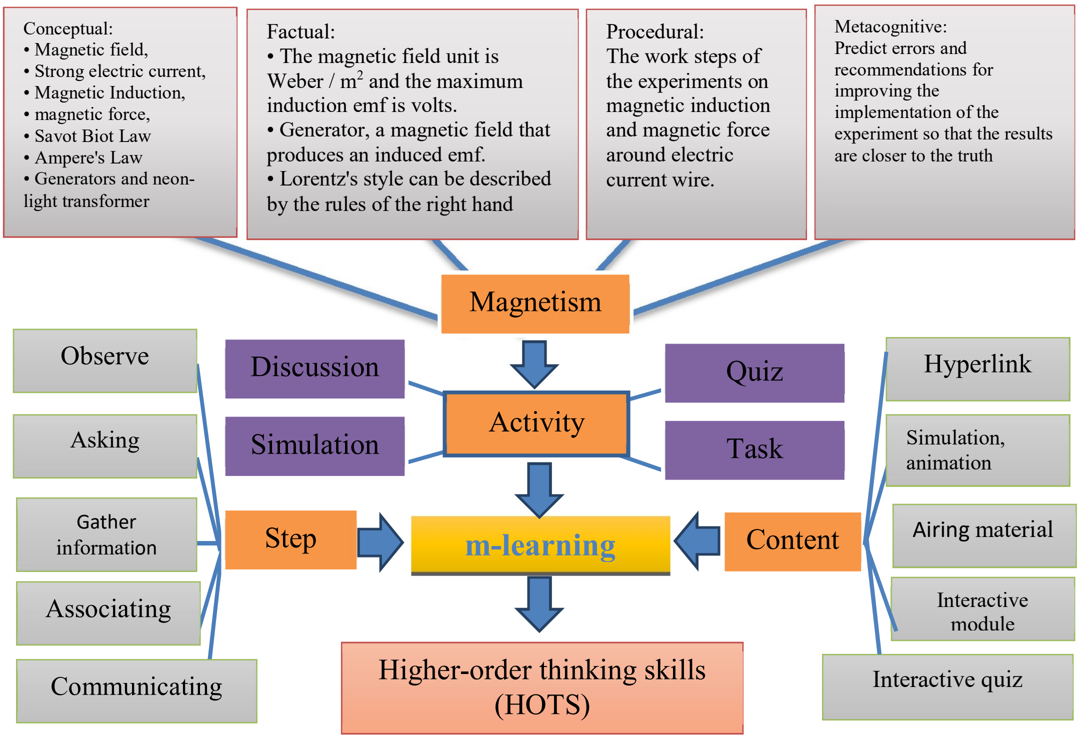

Figure 1. The chart of m-learning design.

4. Conclusion

Android smartphone ownership among high school students reached 100%. This supported the creation of mobile-based learning media. M-learning could help optimize the utilization of android smartphones in the learning process. In line with the application of k-13 which was ideally carried out with a scientific approach could not be implemented optimally because of limited face-to-face learning. Magnetic material that was felt difficult by students needs media that could describe the abstract of the material. The m-learning design was designed with an interactive display, equipped with scientific learning stages, and could be used at any time without space and time restrictions. M-learning design with scientific approaches as a supplement to magnetic learning materials was interactive, had learning objectives, interactive modules, material, video and animation, simulation experiments, summary material, hyperlinks to other learning resources, and interactive quizzes. Learning activities including teaching material studies, simulation experiments, assignments, quizzes, and discussion forums. Stages of learning activities including observing, asking, trying, associating, communicating. Synchronous learning activities were carried out for discussion forums, asynchronous for others.

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Acknowledgements
Thank you to the director of research and community service (DRPM) who has funded this research.