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Development of an Integrated Physics Learning Module Using Augmented Reality (AR) with Al-Qur'an on Fluid Material for Senior High School

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Abstract

Teachers' Teaching materials are still limited, such as simple worksheets or textbooks. The available teaching materials are not yet integrated with the verses of the Qur'an and are not technology-based. One of the technologies currently being developed is Augmented Reality (AR) which can convert 2D images into 3D ones. AR is an innovation used to reduce the weaknesses of books and e-learning and can assist in visualizing things. Therefore, developing an integrated physics learning module using Augmented Reality with Al-Qur'an verses on fluid material is necessary. The type of development research used was the 4-D model, namely definition, design, development, and dissemination. However, this study is only in the development stage with limited trials. This study aims to produce an integrated physics learning module using AR based on Al-Qur'an on fluid material for senior high school that is valid and practical. Validation was obtained from some aspects, which are contents, media, and Al-Qur'an interpretation. The results showed that this module is very valid based on these three aspects (92% for contents, 83% for media, and 92% for Al-Qur'an interpretation). Practicality was obtained by a limited trial with students and physics teachers of MAN 2 Payakumbuh. The results obtained in this study are 89% for students and 91% for teachers. It means that this module is very practical. So, this module is very valid and practical for use in learning by teachers and students. From the results of this study, it can be concluded that the integrated physics learning module uses Augmented Reality with verses of the Qur'an in fluid material that meets the requirements with very good quality and is very suitable for use as a supporting teaching material in learning. The implications of this research will positively impact the development of Physics learning media in the future; using media learning based on augmented reality (AR) can provide information for educators on how to use appropriate learning media in the learning process.

Keywords: Augmented Reality; Fluid; Integration of Al-Qur'an Verses; Modules

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INTRODUCTION

Physics is a science that studies natural phenomena and their relationship to everyday life. Unfortunately, many students still have difficulty understanding physics material because they assumed physics was a subject that was fixated on formulas. With the development of technology, it is expected that they will be able to understand the concept of physics in a real-life form.

Augmented Reality (AR) is one application used in technological developments. AR is a combination of the real world and the virtual world in the form of a dimensional world into a three-dimensional projected in a real environment at the same time (Mustaqim & Kurniawan, 2017; Eh Phon et al., 2014; Lee, 2012). This technology started to be applied to physics materials such as textbooks on various physics materials. The presence of AR technology can combine graphic, visual, and audio-visual technology (Jeřábek et al., 2014; Afifah et al., 2019), (Jeřábek et al., 2014). AR technology can be applied to teaching materials such as modules (Eh Phon et al., 2014).

According to Puspitasari (2019), a module is a printed medium that can be used in the learning process and is arranged for students. The module developed uses AR technology so that images, usually in a two-dimensional view, can be seen in three dimensions (Puspitasari, 2019).

Modules can be further developed by integrating verses from the Al-Qur'an. Based on the Education Office of West Sumatra Province issued guidelines for integrating Al-Qur'an and Minangkabau Natural Culture training in high school/MA physics learning. In the area of West Sumatra, it is known as "*Basandi Syarak Adat, Basandi Syarak Syarak Kitabullah, Syara' Mangato, Mamakai Custom, Alam Takambang Jadi Guru*". The goal is to teach students spiritual values, intelligence, nationalism, and independence (Dinas Pendidikan Sumatera Barat, 2017).

The knowledge that we learn basically comes from the Al-Qur'an and Hadith. Everything that exists on this earth has been listed in the Qur'an. Human beings with a mind must study Allah SWT's creation and teach mankind to love and be proud of the Qur'an, which will never fade (Chandra et al., 2020). Physics is one of the very subjects useful in life. Physics subject not only aims to equip students with science but also aims to create students that exalt the greatness of God. Study about theoretical physics has been previously described in Al-Quran, and vice versa; the truth of the verses of the Koran can be proven by the theory of physics. The link between the Al-Quran and Physics can be proven through the verses of kauniyah. Kauniyah verse is a verse of the Al-Quran that contains greatness about the universe and everything in it (Mardayani et al., 2013). The module also assists teachers in delivering learning material (Kurniawan & Badiah, 2022).

In previous studies, several researchers conducted studies on developing teaching materials. One of them was developed by Purrwandari et al. (2021). The practicality test conducted on students of SMK Ma'ruf Dalopo obtained a percentage of 78.6% in the good category, and the practicality test was also carried out at SMK Cendikia Madiun with a result of 71.60% in the good category. From these two practicality tests, it can be concluded that learning modules based on Augmented Reality (AR) can help the learning process (Purwandari et al., 2021).

Fluid is one of the physics materials rich in concepts and images, so visualization in the form of 3D images is necessary. This visualization is useful in facilitating students' understanding of fluid concepts. Fluids are divided into

two categories: static fluids and dynamic fluids.

The first observation was carried out by interviewing a class XI physics teacher at SMAN 1 Batusangkar regarding the teaching materials used when teaching. The teacher only used worksheets that contained a summary of the material and sample questions. The obstacle when using this simple worksheet is that most students just cheat because of the lack of explanation of the material in the worksheet.

The second observation was made to the physics teachers in class XI MAN 2 Payakumbuh. The teaching materials used when delivering the material were only sober textbooks. Students used a limited number of textbooks borrowed from the school library. The textbooks that use image display on the material are still in 2D form and do not yet integrate the Qur'an. Physics teachers and students have not used modules and worksheets as teaching materials in the learning process.

Printed teaching modules are urgently needed as a source of learning, and coupled with current technological developments, modules can be made attractive so that students are more interested in studying physics material if they are wise in using technology (Khunaeni et al., 2020).

Based on the description above, developing physics teaching materials in modules using Augmented Reality (AR) technology integrated with Al-Qur'an verses on fluid material for senior high school is necessary.

METHOD

This type of research belongs to research and development, one of the research methods aimed at developing products used in education and learning and validating them (Sugiyono, 2014). According to Thiagarajan and Semmel in Sugiyono (2014), research and development of learning systems can be done with a 4-D model, which consists of define, design, development, and dissemination. The defining stage includes face-back analysis, student character analysis, task analysis, and concept analysis. In the concept analysis, there is an analysis of the syllabus and an analysis of teaching materials. The design phase includes making an outline, making flowcharts, compiling the overall product design (Storyboard), collecting materials to be designed, combining all materials according to the design, and the finishing stage. The development stage includes the validation stage (expert appraisal), the practicality stage (developmental testing), and the effectiveness stage. Development stage, to test the effectiveness of the module. However, the research only reached the development stage at the practicality stage.

The data collection Instrument consisted of a validation sheet and a response questionnaire. This validation sheet consists of a product validation sheet and a response questionnaire validation sheet. The product validation sheet contains items that show content and construct validity. Content validation contains items that demonstrate compatibility between product content and learning objectives. Construction validation contains items that show the product's suitability with the specified development elements. The questionnaire validation sheet is used to see whether the response questionnaire that has been made is valid or not. Three validators validated this validation sheet. Response questionnaire sheets were prepared to assess the usability of the designed product.

Data obtained from validation sheets and response questionnaires were processed quantitatively. After obtaining the data for each validation sheet from several validators and response questionnaires, a tabulation of the data is

sought using Formula 1. Based on the percentage results, each bill is categorized as shown in Table 1.

Table 1 Category validity and practicality of augmented reality-based physics teaching materials (Riduan, 2007)

Percentage (%)	Category
0-20	Invalid/impractical
21-40	Less valid/practical
41-60	Quite valid/practical
61-80	Valid/practical
81-100	Very valid/practical

RESULTS AND DISCUSSION

The development of this module uses a 4D model, which consists of Define, Design, Develop, Disseminate. The following is a discussion of each stage carried out:

1. Defining Stage (*Define*)
   The following is a description of the explanation at the definition stage.
   a. Results of face-to-back analysis
      The problem faced by class XI students in fluid material is the difficulty in understanding the concept of fluid, which contains quite a lot of material because students do not have printed books or modules that serve as guidelines in learning. In addition, difficulties are also encountered in the physical meaning of fluid material due to the many visualizations of objects that are difficult to explain. At this time, the use of mobile phones as a learning medium has increased a lot. Students also like new and interesting things related to technology. One of the technologies used is AR which can transform two-dimensional objects into 3D.
   b. Results of student character analysis
      The results of observations made by the constraints experienced by students are the lack of learning resources used during learning, especially fluid material. The character of students who like new and interesting things, as well as the previous course material, has not been integrated with the verses of the Qur'an. Therefore, the development of this learning module is carried out to add learning resources for students.
   c. Task analysis results
      The results of interviews with the physics teacher regarding the assignments carried out by the students showed that they only carried out some of the exercises given by the teacher directly because the students did not have a handbook containing examples of questions or practice questions.
   d. Concept analysis results
      In the results of the concept analysis, there are two stages carried out, namely:
      1) Results of the analysis of the physics syllabus for senior high school
         In the results of the analysis of the learning syllabus for senior high school in odd semesters, the researchers took fluid material consisting of Core Competencies, Basic Competencies, and Indicators.
      2) Analyzing physics teaching materials for senior high school
         In the learning process, the teaching materials used by the teacher are only printed books, which are very limited in number. As well as, the teaching materials used have

not been integrated with the Qur'an. The researcher hopes that with the development of an Augmented Reality (AR)-based physics learning module integrated with verses of the Qur'an in fluid material, it can add a complete source of teaching materials and cover the limitations that exist in previous sources of teaching materials (Sukardiyono & Wardani, 2013; Lee, 2012).

The results of the interviews and observations with the physics teacher in class XI SMA N 1 Batusangakar, the curriculum used in class XI is still the 2013 curriculum. In this curriculum, students are required to be more active in learning. The teacher also said that the teaching materials used were few; the students usually used simple worksheets made by the physics teacher themselves, and the absence of modules as additional learning resources made students quite difficult to learn. The worksheet contains only a little material, images that are still in 2D form, and simple experiments. If there is no worksheet, it only contains a summary of the material and sample questions.

The results of the second Interview with the physics teacher in class XI MAN 2 Payakumbuh showed that the teaching materials used were only makeshift printed books. However, students used a limited number of printed books borrowed from the school library that could not be taken home. Meanwhile, other teaching materials, such as modules and worksheets, have not been used by physics teachers in the learning process (Serevina et al., 2018; Selisne et al., 2019).

The lack of teaching materials, such as modules, is one factor in students' lack of interest in learning (Darma et al., 2019). The module does not only contain material but also contains interesting pictures (Rahdiyanta, 2016). Teaching material is used by teachers in teaching and learning activities in the classroom. So that the material is so important for teachers and students. Teaching materials contain information arranged systematically and must be learned by students to achieve learning goals (Prastowo, 2014).

Teaching materials have extraordinary functions, namely: 1) Guidelines for educators who will direct learning activities; 2) Guidelines for students in carrying out learning activities; 3) Learning evaluation tools for achieving learning goals to get good learning outcomes (Prastowo, 2015).

1. Defining Stage (*Design*)

   If the defining stage has been completed, the next stage is designing a product. The module was designed with Augmented Reality (AR) based technology. AR has existed since 1968 until now. Initially, AR was used on miniature devices and physical displays. Then, AR began to develop on mobile devices; this is a development from time to time (Arth et al., 2015).

   The following describes the design of the Augmented Reality (AR)-based physics learning module, namely:

   a. Program identity
      The program's identity was carried out at this stage as outlined in the outline.
   b. Creating a Flowchart
      A flowchart is a program flow that is made from opening, content to closing (evaluation), or it can also be called the product design to be made. It described the overall product design (Story Board).
   c. Making Storyboard
      The storyboard explains what is contained in the Flowchart, which contains writing, audio/visual, and picture explanations for each flow. The storyboard explains the appearance of the module.

d. Gather the materials that will be needed to complete the media that will be designed.
   At this stage, the researchers collected the materials needed to design Augmented Reality (AR) based physics learning module products, starting from material images to barcodes that can be visualized in 3D form.
e. Combine the materials that have been collected according to the design that was made.
   In this stage, after all the materials needed in designing the Augmented Reality (AR)-based physics learning module were collected as a whole, all the materials were combined according to the design that was made before.
f. Finishing

After combining all the materials needed and having produced a physics learning module product based on AR, the last stage is finishing, which is carried out at this stage by reviewing by testing the module before being validated, especially in the AR section. Figure 1 shows that the results of the 3D design made using AR are barcodes in 2D form. Figure 2 displays the 3D after the barcodes are scanned using the Assembler Edu application.

Figure 1 Barcode shape in two dimensions

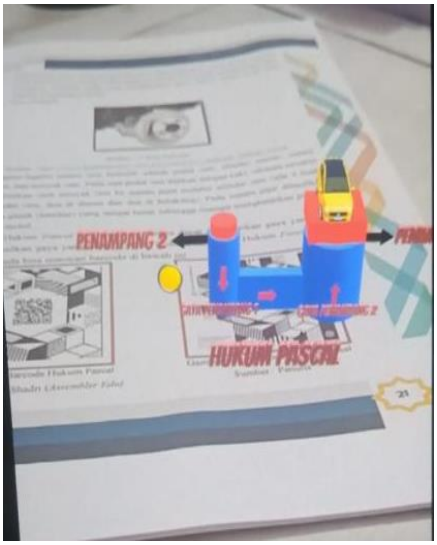

Figure 2 3D form of Pascal's Law material

At the design stage, the integrated fluid modules of the verses of the Qur'an based on AR were designed properly and correctly. This learning module was designed using Assembler Edu, Canva, and Microsoft Word 2013. Canva was used to design the cover design for the module, Microsoft Word 2013 was used to edit the contents of the module. It made the background and decorations on the module to make the module more attractive, and Assembler Edu was used to design 3D designs.

The development of AR was very sophisticated, which can overcome visual limitations in the form of 2D images so that they can be converted into 3D form (Sharma et al., 2020).

2. Development Stage
   a. Validation stage
      Validation was carried out using the validation sheet instrument by the media, material, and interpretation validator. The validation results can be seen in Tables 2, 3, and 4.

Table 2 Material validation results for AR-based physics learning module

No	Aspect	Amount	Max Score	Score (%)	Category
1.	Content eligibility	167	192	86%	Very valid
2.	Presentation eligibility	64	72	88%	Very valid
3.	Language quality	63	72	87%	Very valid
	Amount	311	336	92%	Very valid

Table 3 Media validation results for AR-based physics learning module

No	Aspect	Amount	Max Score	Score (%)	Category
1.	Graphics	172	204	84%	Very valid
2.	Language	29	36	80%	Valid
	Amount	201	240	83%	Very valid

Table 4 Interpretation validation results for AR-based physics learning module

No	Aspect	Amount	Max Score	Score (%)	Category
1.	Content eligibility	45	48	93%	Very valid
2.	Presentation eligibility	22	24	91%	Very valid
3.	Language quality	66	72	91%	Very valid
	Amount	133	144	92%	Very valid

Table 2 shows that the validation results of the integrated fluid module verses of the Qur'an using the Augmented Reality (AR) application on the material validation results are valid, namely 92% with a very valid category. In Table 3, the media validation results obtained are valid, namely 80% with a very valid category. In Table 4, the interpretation validation is very valid, namely 92% of the very valid category.

Based on the results of research conducted before that, a validation test was carried out on MA FIA, which obtained percentage results of 92%, 94%, 95%, 93%, and 92%, with an average category of very valid in each aspect namely aspects of learning, material, media, language, abstract thinking skills (Yovan & Kholiq, 2021; Saidin et al., 2019; Suprapto et al., 2021).

The Practicality of Students and Teachers from Each Aspect of the AR-Based Physics Learning Module is shown in Table 5.

Table 5 Result of practicality of students and teachers from each aspect of the AR-based physics learning module

No.	Aspect	Students	Teachers	Category
1.	Ease of use	90%	95%	Very Practical
2.	Benefit gained	88%	91%	Very Practical
3.	Effectiveness of learning time	89%	85%	Very Practical
	Averages	89%	91%	Very Practical

Based on Table 4, the practicality test results for students are 89%, and the practicality test for educators obtained 91% results, categorized as very practical.

a. Module Validation Results

1) Material Validation
The overall result of material validation is 92% with a valid category.
2) Media validation
The overall result of media validation is 83%, with a very valid category.
3) Validation of the interpretation
The overall result of the interpretation validation is 95%, with a very valid category.

b. Module Practicality Results

At the practicality stage, researchers had problems when they wanted to do research at SMAN 1 Batusangkar, so because of these obstacles, researchers looked for other schools that had almost the same problems as before. Therefore, researchers carried out product practicalities in different schools, namely in MAN 2 Payakumbuh.

1) The practical results of students
a) Aspects of ease of use
From the aspect of ease of use, 90% is obtained in the very practical category.
b) Aspects of the benefits obtained
The results of practicality in the benefits obtained are 88% in the very practical category.
c) Aspects of the effectiveness of learning time
The practicality results on effectiveness in learning are 89% in the very practical category.
2) The results of the practicality of educators
a) Aspects of ease of use
In the aspect of ease of use, based on the practicality test questionnaire that was carried out, it was obtained with a very large percentage of 95% in the very practical category.
b) Aspects of the benefits obtained
A practical result of 91% is obtained from the benefits obtained in the very practical category.
c) Aspects of the effectiveness of learning time
In obtained results, 85% were in a very practical category.

Based on the results of the research conducted, the practicality test results obtained a very good percentage of 85%, barcodes that were originally 2D can change to 3D displays so that AR can function properly with a scan time of 1-1.5 seconds at a distance of 10-15 cm so that the module can be used (Firmansyah et al., 2020; Kesim & Ozarslan, 2012; Elmqaddem, 2019). This is in line with research conducted by researchers.

Learning by using Assemblr Edu media can increase students' learning enthusiasm. This is because the Assemblr Edu application has an editor feature where teachers and students can make their own designs in the form of Augmented Reality (AR) or 3D. In this application, hundreds of 3D objects have been provided. This feature is provided for users who want more freedom to be creative in developing materials that will be designed in the Assemblr edu application. Students will be more enthusiastic about participating in learning because they use technology they are already familiar with, such as Android. Besides that, using an integrated Al-Quran module will be very effective in instilling the values of Al-Quran verses in students. Overall results get a percentage of 73.2% (Dewi et al., 2022; Jamali et al., 2015; O'Shea, 2011; Saidin et al., 2015).

CONCLUSION

The resulting Augmented Reality (AR)-based Al-Qur'anic Verses Integrated Physics Learning Module is very valid and very practical. The results of material validation were 92%, media validation was 83%, and interpretation validation was 92%. Thus, overall, it was obtained in a very valid category. The results of

the practicality test for students at MAN 2 Payakumbuh were 89%, and the practicality test for educators obtained 91% results in the very practical category. This means that the module used can support the learning process; besides that, augmented reality can connect the virtual world and the real world.

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