Development of Renewable Energy Modules with Contextual Teaching Learning Helpful Augmented Reality (AR) Integrated Al-Qur'an Class X SMA/MA

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ABSTRACT

This research was motivated by the limited teaching materials used by educators in the learning process. The only teaching materials available are textbooks and handouts, but there are no learning modules yet. The research was conducted on renewable energy material for class X SMA/MA. Augmented Reality (AR) is needed for renewable energy materials to be able to change images into three dimensions. Research conducted at Madrasah Aliyah strongly supports modules that integrate verses from the Koran. Therefore, it is necessary to develop a Renewable Energy module with Contextual Teaching Learning assisted by Augmented Reality (AR) integrated with the Koran. The type of development research used is the 4-D model (Define, Design, Development, Dissemination). However, the development of this AR-based integrated physics learning module for Al-Qur'an verses only uses three stages, namely Define, Design, and Development. The instrument used in this research is the validation sheet. The research results show that the module developed is valid and very practical for use by educators and students in learning.

INTISARI

Penelitian ini dilatarbelakangi karena terbatasnya bahan ajar yang digunakan pendidik dalam proses pembelajaran. Bahan ajar yang ada hanya buku paket dan handout, namun modul pembelajaran belum ada. Penelitian dilakukan pada materi energi terbarukan kelas X SMA/MA. Augmented Reality (AR) dibutuhkan pada materi energi terbarukan untuk dapat mengubah gambar menjadi tiga dimensi. Penelitian dilakukan di Madrasah Aliyah sangat mendukung modul yang terintegrasi ayat Al-Qur'an. Oleh karena itu, perlu adanya pengembangan modul Energi Terbarukan dengan Contextual Teaching Learning berbantuan Augmented Reality (AR) terintegrasi Al-Qur'an. Jenis Penelitian pengembangan yang dipakai yakni model 4-D (Define, Design, Development, Dissemination). Namun, pengembangan modul pembelajaran fisika terintegrasi ayat Al-Qur'an berbasis AR ini hanya menggunakan tiga tahapan saja yakni Define, Design, and Development. The instrument used in this research is the validation sheet. Hasil penelitian menunjukkan modul yang

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dikembangkan valid dan sangat praktis digunakan oleh pendidik dan peserta didik dalam pembelajaran.

A. Introduction

The Advances in science and technology, especially information technology, have a major influence on the construction and implementation of learning strategies. With these advances, educators can use various types of media according to learning needs and objectives. Apart from facilitating and maximizing the learning process, media can also make learning more interesting. Based on the results of interviews with educators and students at MAN 2 Tanah Datar, researchers found several problems in the learning process, especially physics. Students find physics material difficult because there are a lot of calculations and it seems monotonous. This is due to the lack of teaching materials used by educators in the learning process and educators often use the lecture method in delivering the material so that students are less interested and feel bored in following the lesson.

Teaching materials generally used in learning are textbooks and handouts. Apart from textbooks, the teaching materials available at the school also include handouts. However, the inadequate number of printed books available is not balanced with the number of students so that not all students have printed books. Students can only borrow printed books from the library to read in class while studying. There are also handouts, made by educators themselves, which contain a summary of the material and practice questions. However, handouts were not distributed to students. Therefore, learning activities become one-way centered on educators (teacher centered). In line with that, according to Daryanto [1] teaching materials that make it easier to achieve specific learning objectives are modules.

Modules are teaching materials designed in a comprehensive and structured manner, which contain learning experiences created to master specific learning objectives [1]. A module is a book designed with the intention that students can learn it individually even without a teacher [2]. The advantages of the module in general are that it can overcome time constraints, various methods can be used, students are more active in learning, this module does not only consist of material but also has practice questions.

Based on the independent curriculum, learning must be in accordance with the context of a contextual approach, one of which is the Contextual Teaching learning model. As explained by Amelia [3] this model allows learning to occur in contexts that are relevant to students' daily lives, creating meaningful and relevant learning experiences. The advantage of Contextual Teaching and Learning is that learning becomes more meaningful and real. This means that students are required to be able to grasp the relationship between learning experiences at school and real life. The use of this module is so that students can more easily understand material that is difficult to understand.

In previous research, several have conducted research regarding the development of teaching materials, one of which was teaching modules using AR and the results of this research showed that there was an increase in students' understanding of the material being taught and helped educators in delivering learning material easily. The swift progress of technology in today's revolutionary era, particularly its growing incorporation into educational settings, marks a substantial transformation in teaching and learning methodologies on a global scale [4]. Technology-based learning can ignite students' enthusiasm for learning, because it is facilitated by the inclusion of animated elements, graphical explanations, and a variety of colors, all of which enhance the learning experience and make it more immersive [5]. Based on Firdaus's research [6], learning modules based on Augmented Reality (AR) integrated with Al-Qur'an verses can increase students' motivation and interest in learning. Integration is a model of unification between scientific values with spiritual values and other things so as to have complete uncertainty and avoid separating them within a scientific discipline [7]. The creation of this integrated module for Al-Quran verses aims to assist in the learning process, so that the learning process can be made interesting because it has Islamic nuances, and can increase students' interest in learning.

Physics is a subject whose application uses learning modules to make it easier for educators to convey the subject matter. One of the materials that requires a module to apply is renewable energy material, because this material contains theories that are difficult to visualize, making students less interested and bored of learning. To make it easier for students to understand the concept of learning material, educators use the CTL method in teaching so that students can make direct connections between learning material at school and students' daily lives. CTL is a learning concept that helps teachers relate learning material to students' real-world situations and conditions, and encourages students to apply it in everyday life [8]. To attract students' attention in learning, it would be better if this renewable energy material was visualized in 3D.

The difference between 2D modules and 3D modules is in their appearance. In ordinary modules there are only 2D images which do not attract students' attention. To make the module more interesting, technology is needed to view the images in the 3D module. One way to display module images in 3D is by using AR technology. AR is a visual technology that can combine virtual objects into real form. This technology can be applied as an innovative learning medium by implementing it on smartphones [9]. In various fields including AR technology education has been applied. AR Learning Media can visualize abstract concepts for understanding and the structure of an object model, making AR an effective medium in accordance with the objectives of learning media. Science is one field that applies the development of AR technology. Three-dimensional (3D) objects can be displayed on Android Smartphones with the help of AR Technology.

The advantages of AR are that it is fun, can create 3D objects and animations as if they were in a real environment, and should be used as an alternative learning medium. The application used to create AR is the Assembler Edu application. Assembler Edu is an application that converts objects into 3D and AR. This application allows users to create interactive learning materials. The advantages of the Assembler Edu application are that it is easy to use, has an attractive appearance, provides the necessary materials and is virtual based. In this application, objects can be used to visualize learning material. In this application, users can work in creating learning materials. Not only can you design it yourself, this application also contains several materials that can be used directly by educators.

MAN 2 Tanah Datar is an Islamic school based on the Qur'an. MAN 2 Tanah Datar has the vision "a Ministry of Religion that is professional and reliable in building a pious, moderate, intelligent and superior society, to create an advanced Indonesia, one that is sovereign, independent and has a personality based on mutual cooperation." Islamic schools can integrate learning with verses from the Koran, but at MAN 2 Tanah Datar there are no teaching materials that integrate the Koran. By having material that integrates the Qur'an, it can strengthen the bond between the Physics module and the clear life stated in the Qur'an and strengthen religion. This is in line with research conducted by Chandra et al. [10], Integrating the Al-Qur'an in the development of science, especially physics, is very important for an educator to do. Therefore, now we see many people who are smart, but use any means to achieve their success. Therefore, integrating the Koran into learning is very important. Based on this background description, it is necessary to develop teaching materials in the form of a Renewable Energy Module with Contextual Teaching Learning Assisted by Augmented Reality (AR) Integrated with the Al-Qur'an for Class X SMA/MA."

B. Method

The research carried out used research and development (R&D) methods with the aim of developing a Renewable Energy Module with Contextual Teaching Learning help Augmented Reality (AR) Integrated Al-Qur'an. The development model used in this research is the model proposed by Thiagarajan in Sutarti & Irawan [11], namely the 4D model. The 4D model consists of 4 development stages, namely: definition (define), planning (design), development (develop), as well as the spread (disseminate). At the level of define Observations and interviews were carried out with educators, analyzing CP, TP and material, analyzing the learning media used and material obstacles that were difficult to understand. At stage design done product planning. At the level of development Validation of the module and practicality testing of the module is carried out. The instrument used in this research is the validation sheet. Data analysis techniques are obtained from quantitative data, data obtained quantitatively comes from validation instruments.This data analysis

technique is carried out quantitatively. This quantitatively processed data comes from several instruments, namely:

Validation Sheet

The validation sheet is based on data obtained from the validator, so the validation results can be searched using the equation:

$$P = \frac{\sum score\ per\ item}{maximum\ score}\ x\ 100\% \tag{1}$$

With validation categories in Table 1 [12]:

Table 1 Validation Categories

Interval	Category
0 – 20%	Invalid
21 – 40%	Not valid
41 – 60%	Fairly valid
61 – 80%	Valid
81 – 100%	Very valid

Practicality Sheet

This practicality sheet is filled in by educators and students to obtain information that will be used as a reference. After that, the existing information is collected and grouped, so that it can be calculated using the equation (1). As a result of the data obtained, each range is categorized as follows in Table 2 [12].

Table 2 Practicality Categories

Interval	Category
0 – 20%	Impractical
21 – 40%	Not practical
41 – 60%	Quite practical
61 – 80%	Practical
81 – 100%	Very practical

C. Result and Discussion

At the level of Define Observations and interviews have been carried out with educators and students. From these interviews, information was obtained that in the learning process educators use teaching materials such as textbooks and handout, there is no use of modules yet. The appearance of printed books is less attractive and the use of language that is difficult to understand, this becomes an obstacle for

students in understanding the learning material. Apart from that, the learning process is still centered on educators who still use the systemteacher centered, learning is still centered on educators.

At the level of Design A module design is carried out consisting of several stages referring to Sutarti & Irawan [11], namely: a) creating a Media Program Outline (GBPM) as seen in Table 1, b) creating flowchart or flow chart of the program to be created from opening to closing, c) create storyboard to explain parts the part that's inside flowchart which contains writing, images, audio as seen in Figure 1, d) collect the objects to be designed, all the necessary materials are collected first such as materials, 3D images created using the application Assemblr Edu, e) combine all materials into a developed module, f) finishing, At this stage, a review of the module is carried out by conducting trials before it is validated. Testing was carried out on the AR barcode whether it could run smoothly or not. An overview of the appearance of this product can be seen in Figure 2.

Table 3. Media Program Outline (GBPM)

No	Aspect	Description
1.	Title	Renewable Energy Module with Contextual Teaching Learning Helpful Augmented Reality (AR) Integrated Al-Qur'an Class X SMA/MA
2.	Education Units	High School (SMA)/Madrasah Aliyah (MA)
3.	Class/ Semester	X/2
4.	Subjects	Physics
5.	Learning materials	Renewable energy
6.	Learning objectives	a. Classify the basic forms of energy b. Identify forms of energy, their changes in everyday life c. Analyze the application of the Law of Conservation of Mechanical Energy to events that occur in everyday life d. Find the problem of energy availability in the environment around where you live e. Find potential energy sources in the environment around where you live f. Plan a design for making a simple energy producing prototype device as a solution to the problem of energy availability g. Make a simple energy producing prototype device, and h. Improve the design of a simple energy producing device or prototype that has been tested
7.	Media	Print and cellphone modules

Rancangan	Visual	Audio	Keterangan
Tampilan cover modul	1. Lambang kurikulum 2. Gambar integrasi Al-Qur'an 3. Lambang UIN Mahmud Yunus Batusangkar 4. Judul modul 5. Nama Penyusun 6. Identitas siswa 7. Untuk siswa SMA/MA kelas X		1. Lambang kurikulum merdeka 2. Gambar Al-Qur'an 3. Lambang UIN Mahmud Yunus Batusangkar 4. Judul modul :"Modul Energi Terbarukan Berbasis *Augmented Reality* (AR) Terintegrasi Al-Qur'an" 5. Nama Penyusun : Mella Karlina 6. Identitas siswa (nama, kelas, sekolah alamat) 7. Untuk siswa SMA/MA kelas X
Kata Pengantar	1. Kata Pengantar 2. Nama Penulis		1. Uraian kata pengantar terdapat kalimat rasa syukur, judul modul yang dibuat 2. Nama Penulis : Mella Karlina
Daftar Isi	1. Judul "Daftar Isi" 2. Judul sub bab materi		Pada daftar isi berisi susunan apa saja yang terdapat di dalam modul mulai dari kata pengantar, judul sub bab materi hingga daftar Pustaka. Pada daftar isi ini kita bisa melihat halaman-halaman yang ada di dalam nya

Figure 1. Example Storyboard

As seen in Figure 1, the material in the Renewable Energy module shows that the module has distinctive design characteristics cover module with a Renewable Energy image like a pinwheel as seen in Figure 1.a. Apart from that, it's about designcover Added an image of the Al-Qur'an which is a characteristic that this module is integrated with the Al-Qur'an. This module uses CTL syntax. This module is equipped with content Augmented Reality (AR) as seen in Figure 2. which is unique to this module in that the AR display is made into a barcode that can be scan and can display 3-dimensional images.
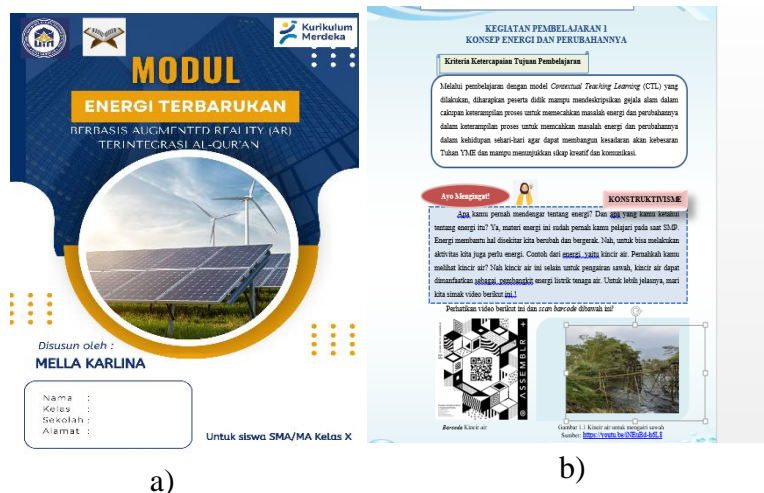
a)   b)

Figure 1. Module Product

At the Development stage (Development) validation of the modules developed is carried out. The validation process is carried out by material expert validators, media expert validators, and interpretation expert validators using validation sheet instruments. The aspects discussed in the material validation instrument are appropriateness of content, appropriateness of presentation, quality of language. Aspects discussed in the instrument. media expert validation, namely graphic aspects and language aspects. Meanwhile, the aspects assessed in interpretation validation are the quality of the content, appropriateness of presentation, quality of language. Each aspect consists of several indicators that support the creation of modules that are valid and suitable for use in learning activities. At this stage the validator provides input and suggestions to support the creation of an interesting module that can be used as a reference in learning. Some of the suggestions given by the validator are: a) correct writing errors, b) improve the background, cover and color combination to make it more attractive, c) improve the image size and formula formulation. Product validation results in the form of a Renewable Energy Module with Contextual Teaching Learning Assisted by AR Integrated Al-Qur'an Class X SMA/MA by material experts is shown in Table 4.

Table 4. Results of product validation by material experts

No	Aspects	Validator				Sum	Max	(%)	Category
		1	2	3	4				
1.	Eligibility content	47	48	51	51	197	224	87,94	Very valid
2.	Feasibility presentation	19	17	19	20	75	80	93,75	Very valid
3.	Quality Language	23	19	19	22	83	96	86,45	Very valid
	Average					355	400	88,75	Very valid

Based on Table 4, it can be concluded that the material validation results obtained a final result of 88.75% with a very valid category. Details of the material validation results can be seen in Appendix 7. Based on the results of this validation, it is concluded that the material in the Module is contained in accordance with the Learning Outcomes.

Product validation results in the form of a Renewable Energy Module with Contextual Teaching Learning Helpful Augmented Reality (AR) Integrated Al-Qur'an based on media experts is described in Table 5.

Table 5 Media Expert Validation Results

No	Aspects	Validator				Sum	Max	(%)	Category
		1	2	3	4				
1.	Graphics	60	55	63	57	235	272	86,39	Very valid
2.	Language	10	9	9	10	38	48	79,16	Valid
	Average					273	320	85,31	Very valid

Based on Table 5, it can be seen that the graphic aspect obtained 86.39% in the very valid category and the language aspect obtained 79.16% in the valid category so that an average of 85.31% was obtained in the very valid category. Based on the results of the media validation of this module, it can be concluded that the module can be used by students.

Tabel 6 Interpretation Expert Validation Results

No	Aspects	Validator		Sum	Max	(%)	Category
		1	2				
1.	Content quality	11	15	26	32	81,25	Very valid
2.	Feasibility of presentation	8	7	15	16	93,75	Very valid
3.	Language Quality	18	23	41	48	85,41	Very valid
	Average			82	96	85,41	Very valid

Based on Table 6, it shows that the content quality aspect obtained 81.25% in the very valid category and the presentation feasibility aspect obtained 93.75% in the very valid category, the language quality aspect obtained 85.41% in the very valid category so that an average of 85 was obtained 41% with a very valid category. Based on the results of the expert validation of this module, it can be concluded that the integration of the Al-Qur'an contained in the module can be used. The results of AR-based module development research carried out by Ilhamsyah et al. [13] also showed good results. Himawan & Ariswan [14] stated that using modules as standalone instructional materials offers the advantage of enabling students to assess their comprehension of learning content and gauge the extent of their skill absorption. To ensure a positive learning experience, the utilization of technology should align with a student-centered approach, placing the learner at the forefront of the educational process [15].

D. Conclusion

Based on the results of the research that has been carried out, it can be concluded that the Renewable Energy Module with Contextual Teaching Learning Helpful Augmented Reality (AR) Integrated Al-Qur'an was declared very valid with a percentage based on material experts of 88.75%, media 85.31% and interpretation 85.41%. So overall the validation of this module has a percentage of 86.49% with a very valid category. Thus, it can be concluded that the module developed is very valid and can be continued to the practicality stage.

Acknowledgements

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