Radiasi: Jurnal Berkala Pendidikan Fisika
Vol. 17 No. 1 (2024) pp. 29 - 37
http://jurnal.umpwr.ac.id/index.php/radiasi/index
p-ISSN: 2302-6111 e-ISSN: 2549-0826

Development of a Physics Module for Measurement Material Assisted by Augmented Reality (AR) Using the Assemblr Edu Application

Fitria Handayani ✉,Hadiyati Idrus, Artha Nesa Chandra, Frans Rizal Agustiyanto

UIN Mahmud Yunus Batusangkar
Jalan Sudirman No. 135 Lima Kaum Batusangkar, 27211, West Sumatra, Indonesia
|handayani14fitria@gmail.com ✉ | DOI: https://doi.org/10.37729/radiasi.v17i1.4270 |

Abstract
The background to this research is the lack of student interest in physics, with various underlying factors. Starting from the unavailability of learning modules in schools to the absence of measuring instruments, which results in students having difficulty calculating measurement results using measuring instruments that have never been seen or used before. Therefore, it is important to develop valid and practical modules, one of which is by using technology in teaching and learning activities, which is one of the steps in increasing the effectiveness of learning, with the help of Augmented Reality using the Assemblr Edu application and focusing on measurement material in class X. This research is research and development (R&D) using the 4D model (Define, Design, Development, Dissemination). However, this research only reached development at the practicality stage. Based on the results of data analysis, validation from material, media and interpretation experts was found to be 94.5%, 83.3% and 91.6%, respectively, in the very valid category. And the practicality of the module by teacher and students was obtained at 98.6% and 86.4% in the very practical category.

Article Info:
Recieved:
22/02/2024
Revised:
26/03/2024
Accepted:
05/04/2024

Keywords: *Development, Module, Al-Qur'an integration, Augmented Reality*

1. Introduction

There are several important points underlying this research. Starting from the lack of interest or attraction of students towards physics lessons. Students view that physics is only material that involves memorizing formulas and concepts. This view applies to all physics material studied, one of which is measurement material. This happened not without reason. The unavailability of measuring instruments is an inhibiting factor in learning and increasingly diminishes students' interest in learning, because measurement material certainly puts pressure on students to be able to apply and calculate measurement results using measuring instruments. However, in fact, many students have never previously seen or used some of the measuring instruments that will be studied, which results in their not understanding when calculating measurement results using these measuring instruments.

Another factor that is the focus of this research is that there is no variation in the materials/sources provided by educators to students, such as learning modules. Many educators still rely on book packages available in libraries. However, based on the observations made, it is known that there are many weaknesses in using this package book, such as the existing books can only be used during class hours, and must be returned to the library when class hours are over.

This package book also still has a 2D image display which may not close, as it is used the images will fade and no longer appear optimally. Apart from that, book packages generally contain a collection of material that students will study for 1 year. Of course, in terms of thickness, the book packages are quite burdensome for students [1]. Plus, the book package only focuses on explaining the material and makes it even more difficult for students to understand it [2]. Of course, this package book is not integrated with the Al-Qur'an or technology-based, even though the school where this research is based in religious [3]. Affirming the obligation to integrate the Al-Qur'an with learning in order to create students who have spiritual values, intelligence, nationalism and independence. Apart from that, religious values can also be inserted into learning materials [4] which actually has many positive effects if applied.

The technology-based nature of existing books is also one of the factors in students' lack of interest in physics, even though if one of the technologies such as Augmented Reality (AR) is applied, it can overcome problems starting from the appearance of 2D images in books that can be displayed in 3D [5], providing visualization of measuring instruments to students who have never seen or used measuring instruments, and of course technology creates a sense of interest in students. Apart from that, the use of AR can stimulate students' mindsets to think critically about problems that occur in everyday life [6]. Learning modules are teaching materials that are arranged systematically and interestingly including materials, methods, and evaluations that can be used independently by students [7]. Another opinion stated [8] a learning module is the smallest learning program unit that students can study independently. It can be concluded that learning modules are a form of independent teaching material for students, containing the material studied, the methods used in learning and evaluation. It is also integrated with the Qur'an and technology-based play a role.

Teacher generally teach by explaining the material in a lecture and the students pay attention to the explanation, after that the students take notes on what the teacher explains, without having time to understand what is being recorded. Apart from modules, an appropriate approach also supports student learning outcomes. One thing that can be applied is a contextual approach which focuses on students' activeness in seeking knowledge related to the material being studied. The contextual approach also begins with real examples that are seen directly in everyday life [9]. Another definition states that the contextual learning approach is connecting the material being discussed to real conditions, so that students can learn and directly relate newly acquired knowledge and apply it in students' real lives [10]. By implementing this approach, it is hoped that learning will feel more meaningful and can be remembered for a long time. Because students discover and experience for themselves what they learn, it is not limited to just knowing [11]. Based on the previous explanation, it was stated that the learning module with a contextual approach assisted by Augmented Reality in measurement material was very well implemented in schools.

This is reinforced by research [12] which produces an integrated module of the Al-Qur'an with a CTL model on optical material, resulting in validity in the very valid category from all aspects and practicality results in the very practical category. In other research [13] which helps overcome learning difficulties in fluid material through AR-based Al-Qur'an integrated learning modules. The aim of making the module was achieved with high validity and practicality results, students were also very interested in using the module in the learning process. A similar product was also developed in the form of an AR-based learning module that integrated the Al-Qur'an. Through the developed module, it is able to increase students' learning motivation. The aim of making the module was also achieved when participants saw the results of validity and practicality which stated that the module was very valid and practical in increasing students' scientific literacy [14],[15].

From this research, it can be seen that the module that has been developed has obtained good results, however, it has not completely covered the existing problems. Although it has succeeded to produce integrated modules with a contextual approach but it has not included a technology-based, and has not implementing the right approach. Therefore, researchers maximize all aspects to cover existing problems by producing modules on material that is difficult to understand, following regional regulations by integrating them with the Al-Qur'an, providing an approach that is in line with the hope of helping improve learning outcomes and designed based on Augmented Reality technology. to produce 2D images into 3D. Through this research, we can produce a class X SMA/MA physics module with measurement material that integrates the Koran with a contextual approach assisted by AR.

2. Methods

The type of research in this study is Research and Development (R & D) by adapting the 4D development model. The result of product development in this research is a learning module assisted by Augmented Reality which was created in the Assemblr Edu application. The 4D model to developing a module, consists of defining, designing, developing and disseminating [16]. The detailed stages in 4D are described as follows: (1) Stage 1: Definition. In this stage the author defines the development requirements or is known as development needs analysis. This activity is carried out by observing and observing during the teaching process including analysis of student characteristics and material. (2) Stage 2: Design. In this stage the author creates a flow chart which consists of creating a cover design for the regulatory module and material structure in accordance with the learning objectives. There are 4 divisions of discussion in the module, namely various measuring instruments, quantities and units, measurements, measuring instruments in life and important figures. There is a final evaluation and 4 competency tests at the end of each material. (3) Stage 3: Development. This stage the aim is to modify the flow chart at the design stage into a story board module. Here validation is also carried out or assessing the feasibility of the product plan. Validation is carried out by material, media and interpretation experts. The material expert is the lecturer who teaches physics courses, the media expert is the lecturer who teaches learning media courses and the interpreter expert is the lecturer who teaches interpretation.The validation instrument uses a Likert scale. Material expert instruments include testing the suitability of the content, the suitability of the presentation and the quality of the language of the module. Media expert instruments include graphic and language aspects. Interpretation expert instruments include aspects of content quality, appropriateness of presentation and language quality. To determine the level of eligibility, assessment criteria based on percentages as 0-20: invalid category, 21-40: less valid category, 41-60: fairly valid, 61-80: legitimate, and 81-100: very valid [17].

The results of this validation will later be converted into quantitative form with a range of 1-5 and the data will be processed using the following equation (1).

$$P = \frac{\sum \text{score/ item}}{\max score} \text{ x } 100\% \quad (1)$$

Modules that have been declared valid or appropriate by material, media and interpretation experts are then tested on students. Then, practicality sheets were distributed to educators and students with assessment aspects, namely ease of use, benefits obtained and effectiveness of learning time.The results of this practicality will later be converted into quantitative form with a range of 1-5 and the data will be processed using the following equation (2). Determining this level of eligibility assessment criteria following practicality category impratcical, less practical, quite practical, practical, and very practical [17].

$$P = \frac{\sum score/item}{\max score} \times 100\% \quad (2)$$

The last stage is, Stage 4: Dissemination. This stage is carried out to promote the module with validation, packaging and diffusion testing. However, this stage will be carried out in the next stage of research to determine the effectiveness of the module in the learning process.

3. Results and Discussions

In this research, learning materials were produced in the form of learning modules for class X high school students on measurement material. This module was developed with Augmented Reality to solve the problem of unavailability of measuring instruments which results in students not understanding how to use them and how to calculate measurement results. The learning module developed was designed using a 4D model with a definition stage, design stage, development stage and dissemination stage. However, in this research, the development stage was carried out only to a trial to see the practicality of the learning module being developed.

At stage definition consists of beginning-end analysis, student character analysis, material analysis, task analysis, and designing learning objectives. At the beginning-to-end analysis stage, interviews were conducted with several class In the learning process teachers only use textbooks from the government. Students' ability to understand physics is still low, only some students can use measuring instruments and calculate the value of their measurement results. In the analysis of students distributing questionnaires, 51% of students stated that this measurement material was difficult. Many students make mistakes when using measuring instruments and calculating measurement results. At the material analysis stage, the materials to be developed are identified. In this research, the material that will be developed is measurement. On in the design stage, there are several activities that need to be carried out, such as creating an outline of the program media starting from determining the title, targets, goals and main material in the module which will be visualized using Augmented Reality, the following display of the program plan being developed shown by Table 1 . Then go into creating a flow chart, starting from the opening to the closing. Refine the plan in the Storyboard. After completing the design, collect further material from various book package sources.

Table 1. Media Program Outline

Aspect	Description
Title	Augmented Reality (AR) Assisted Measurement Learning Module
Education units	High School (SMA)/Madrasah Aliyah (MA)
Class/Semester	X/1
Subjects	Physics
Learning materials	Measurement in Scientific Work
Learning objectives	Apply measurement concepts and scientific methods by carrying out simple investigations, collecting data using measuring instruments or available technological applications, analyzing data, concluding and communicating the results of investigations both orally and in writing.
Al-Qur'an	1. Dimensions = Q.S - Fushshilat: 53 2. Measurement concept = Q.S - Al-Qamar: 49; QS. Al-Furqan: 2
Media	Print and Mobile modules

To collect of images and videos taken from several websites and YouTube channels. In the process of creating a QR code, researchers use an application that can be downloaded from the Play Store or directly visit the website called "Assemblr Edu". After all the materials are collected, then combine all the materials according to the specified plan. The resulting QR code can trigger and display AR or 3D images of the measuring instrument being studied so that it can visualize the material in the learning module. In Figure 1 shows the cover and contents of the module being developed, and the results of AR testing can be seen in Figure 2.

Figure 1. Cover and Contents Module

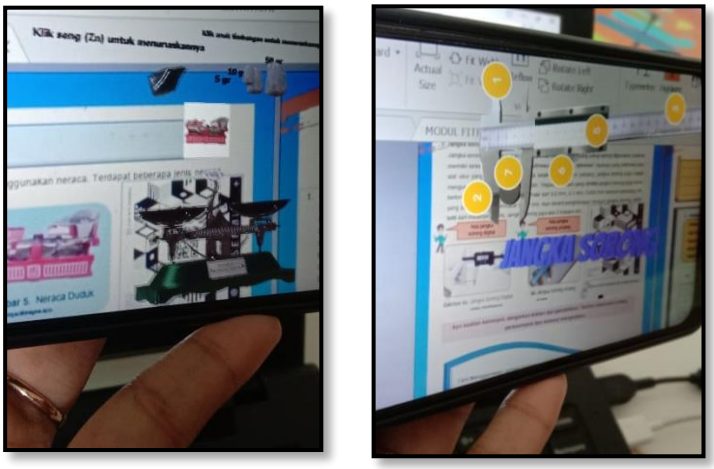

Figure 2. The AR Product

To determine the level of readability and validity of Augmented Reality-based module products, product validation tests were carried out by experts. Validation of the learning modules that have been prepared is carried out with validators and trials are carried out on the modules that have been prepared. There are 3 material validators, 3 media validators and 2 interpretation validators. The results of the revision are learning modules that have been declared; valid and tested on students. In this research, trials were carried out only in small group trials to see the practicality of the learning module being developed. This trial was conducted on 35 class X students at MAN 2 Tanah Datar. Valid or invalid results of material, media and interpretation can be seen in Table 2, media in Table 3, and interpretation in Table 4.

Table 2. Material Validation Results

Aspect	Validator			Amount	Max score	Score (%)	Category
	1	*2*	*3*				
Content Eligibility	49	53	52	154	168	91.7	Very valid
Feasibility of Presentation	19	20	18	57	60	95	Very valid
Eligibility Language	23	22	22	67	72	93.0	Very valid
Average						93.2	Very valid

Table 3. Media Validation Results

Aspect	Validator			Amount	Max score	Score (%)	Category
	1	*2*	*3*				
Graphic Aspects	74	73	75	22	240	92.5	Very valid
Language Aspects	12	9	9	30	36	83.3	Very valid
Average						87.8	Very valid

Table 4. Interpretation Validation Results

Aspect	Validator		Amount	Max score	Score (%)	Category
	1	*2*				
Content Eligibility	14	16	28	32	87.5	Very valid
Aspects of Feasibility of Presentation	7	7	14	16	87.5	Very valid
Aspects of Language Quality	22	20	42	48	87.5	Very valid
Average					87.5	Very valid

Based on the data from the results of validation by experts for these three aspects, overall results are obtained in the very valid category. This shows that the developed teaching module product can be used as one of the teaching materials for students. These results are reinforced by the results of research [18]-[20] then it can concluded that the module is designed well to be developed. Researchers also distributed practicality sheets to two educators in physics subjects, as well as 28 class X students at MAN 2 Tanah Datar. The practicality results are in the very practical category, in line with the research that has been carried out [21], [22], so the module is declared very good to use. Data results of educators' practicality is in Table 5 and students can be seen in Table 6.

Table 5. Results of Teacher Practicality

Aspect	Validator		Amount	Max score	Score (%)	category
	1	2				
Ease of use	22	24	46	48	95,8	Very practical
Benefits obtained	24	24	48	48	100	Very practical
Effectiveness of learning time	12	12	24	24	100	Very practical
Average					98,6	Very practical

Table 6. Student Practicality Results

Aspect	Amount	Max score	Score (%)	Category
Ease of use	688	784	87,7	Very practical
Benefits obtained	971	1120	86,7	Very practical
Effectiveness of learning time	285	336	84,8	Very practical
Average			86,4	Very practical

Based on the results of this research produced a very valid physics learning module (the average validity of the material obtained was 93.2 in the "Very valid" category, media was 87.8 in the "Very valid" category and interpretation was 87.5 with “Very valid” category). Thus, the learning module developed has met valid qualifications because it has achieved the minimum good criteria [23]. In line with research that has been carried out by other researchers previously [24],[25] developing a module with an integrated contextual approach to the holly Qur'an obtained very good results. So, it can be stated that this module is indeed suitable for use. Apart from valid criteria, learning modules must also meet practical criteria. The results of this research show that the physics learning module developed is very practical to use. This is reinforced by the research results which found that the average practicality of the modules for students was 98.6 and for educators at 86.4 in the "Very Practical" category. Supported by research [22],[26] which produced physics modules with a contextual approach assisted by Augmented Reality, practical results were obtained in the very practical category.

The use of physics learning modules is an alternative approach for students in solving students' learning problems so that the learning modules can be practical among teachers and students. In general, learning modules can make it easier for teachers and students to carry out learning and build effective learning communication between teachers and students [27]. This shows that the learning module developed can make it easier for teachers and students to carry out learning. with learning modules it will run more effectively and efficiently so that it can help achieve the learning objectives that have been set.

4. Conclusion

Based on the results of the research, it was concluded that the learning module had been produced with a material validity level of 94.5%, media 83.3% and interpretation 91.6%. So that the entire module obtained is in a very valid category. And the practicality of the educator module was obtained by 98.6% and 86.4% of students with the overall category being very practical. So, this Augmented Reality-assisted physics material measurement module is suitable for use as teaching material for physics learning.

Acknowledgement

The researcher would like to express his gratitude to the Head of MAN 2 Tanah Datar who has provided the opportunity to carry out this research, thanking the educators and students who participated to complete the research. The researcher also expressed his thanks to the Physics lecturer as supervisor.

References

[1] LY Yulia and B. Bakhtiar, "Teacher Obstacles in Implementing the 2013 Curriculum Package Book at SD Negeri 50 Banda Aceh. Teacher Obstacles in Implementing the 2013 Curriculum Package Book at SD Negeri 50 Banda Aceh," elements. Educate. Res., vol. 1, no. 1, pp. 204–211, 2016.

[2] Misrawati and D. Suryana, "Mathematics Teaching Materials Based on Thematic Learning Models for Early Childhood Numeracy Ability," J. Obs. J. Educator. Early Childhood, vol. 6, no. 1, pp. 298–306, 2022, doi: 10.31004/obsession.v6i1.1249.

[3] West Sumatra Provincial Education Service, Guidelines for Integrating the Al-Qur'an and Minangkabau Natural Culture in High School Physics Learning Materials. 2017.

[4] S. Fitri, "Development of an Integrated Biology Module with Islamic Values to Empower Students' Religious Character," UIN Raden Intan Lampung, 2023.

[5] LN Khunaeni, WD Yuniarti, and MA Khalif, "Development of a Physics Module Assisted by Augmented Reality Technology on Sound Wave Material for SMA/MA Class XI," Phys. Educate. Res. J., vol. 2, no. 2, p. 83, 2020, doi: 10.21580/perj.2020.2.2.6144.

[6] I. Safiah, Harmony of Media and Methods in Science Learning. Tulungagung: Academic Library, 2024.

[7] I. Anwar, Development of Teaching Materials. Bandung: UPI Directory, 2010.

[8] W. . Winkel, Educational Psychology and Learning Evaluation. Jakarta: Media Abadi, 2009.

[9] RT Astika, "Contextual Learning Videos Support Elementary School Students' Mathematics Test Results," J.Edutech Undiksha, pp. 127–136, 2020.

[10] NKD Astri, IW Wiarta, and IGAA Wulandari, "Development of Interactive Multimedia Based on a Contextual Approach in the Mathematics Subject of Flat Figures," J. Educator. and Counseling, vol. 4, no. 3, pp. 575–585, 2022.

[11] PRPI Dewi, NMW Wijayanti, and IDP Juwana, "Effectiveness of Implementing Assemblr Edu Digital Learning Media in Mathematics Subjects at SMK Negeri 4 Denpasar," J. Pengabdi. To. Sir. Widya Mahadi, vol. 2, no. 2, p. 98–109, 2022, doi: 10.59672/widyamahadi.v2i2.1961.

[12] CS Ningsih, MI Ali Umar, AA Putri, V. Haris, and AN Chandra, "Design and Development of Optical Learning Modules Based on the Al-Qur'an and Contextual Learning," AIP Conference. Process., vol. 2524, no. October 2022, doi: 10.1063/5.0112418.

[13] EY Firdaus, S. Maiyena, H. Idrus, and V. Haris, "Development of an Integrated Physics Learning Module Using Augmented Reality (AR) with the Koran on Fluid Material for High Schools," vol. 7, no. July, p. 265–275, 2023.

[14] ZF Nabil, V. Haris, H. Idrus, SK Ayop, and SN Alias, "Development of a Physics Module Based on Augmented Reality Integrated with Al-Quran Verses about Electricity," Science and Technology J. Science and Technology., vol. 15, no. August 1, 2023.

[15] PA Putri, AN Chandra, H. Idrus, P. Deswita, and M. Anaperta, "Validation of the Solar System Module Integrated PBL Al-Qur'an Model Based on Augmented Reality (AR) for Class VII SMP/MTs Students," Edusainstika J. Mathematics and Natural Sciences Learning, vol. 3, no. 1, p. 74, 2023, doi: 10.31958/je.v3i1.10134.

[16] Sugiyono, Research Methodology Quantitative, Qualitative and R&D Approaches. Bandung: PT. Alphabeta, 2016.

[17] Riduwan, Introduction to Statistics for Research. Bandung: Alfabeta, 2014.

[18] D. Agusti, H. Rahmatan, and S. Sulastri, "Development of a Reproductive System Learning Module Based on the Al-Quran/Hadith to Increase Student Motivation and Learning Outcomes," Edusains, vol. 11, no. 1, pp. 132–140, 2019, doi: 10.15408/es.v11i1.10270.

[19] BY Ilhamsyah, S. Sudarti, and S. Bektiarso, "Development of a Physics Module Based on Augmented Reality (Ar) Direct Current Circuit Material for High School Students," J. Physics Learning, vol. 11, no. 3, p. 98, 2022, doi: 10.19184/jpf.v11i3.33689.

[20] H. Idrus, W. Oktavia, V. Haris, N. Lizelwati, and Y. Putri, Development of Physics Practical Student Worksheets Based on Augmented Reality and Integrated Al-Qur'an on Electricity in High School, vol. 1, no. ICoeSSE. Atlantis Press SARL, 2023. doi: 10.2991/978-2-38476-142-5.

[21] E. Roliza, R. Ramadhona, and L. Rosmery T, "Practicality of Student Worksheets in Mathematics Learning Statistics Material," J. Gantang, vol. III, no. 1, p. 41–46, 2018, [Online]. Available: http://ojs.umrah.ac.id/index.php/gantang/index

[22] AN Chandra, V. Haris, and D. Yulita, "Development of a Physics Module Based on REACH Integrating the Al-Quran with Temperature and Heat Materials," JOSTECH J.Ilmu. Technology., vol. 1, no. 2, pp. 166–174, 2021, doi: 10.15548/jostech.v1i2.3097.

[23] R. Puji, "Validity and Practicality of Student Worksheets Based on a Contextual Approach to Flat-Side Building Material for Middle School Students," J.Ilm. Educator. Mat., vol. 3, no. 2, pp. 126–133, 2018.

[24] NB Asfuri and RY Ambarsari, "Development of Teaching Materials for Teaching and Learning Courses Based on the Three Characteristics of Student Soldiers (Patriotism, Pioneering and Independence) for UTP Surakarta Students," J. Educator. Nusant Foundation., vol. 7, no. 1, p. 202–215, 2021, doi: 10.29407/jpdn.v7i1.16101.

[25] L. Zahara, Fartina, K. Syahidi, and H. Qudsiah, "Development of Contextual Learning Modules accompanied by Concept Mapping on Elasticity Material and Hooke's Law," Kappa J., vol. 5, no. 2, p. 183–190, 2021, doi: 10.29408/kpj.v5i2.4456.

[26] BY Ilhamsyah, "Development of a Physics Module Based on Augmented Reality (AR) Direct Current Circuit Material for High School Students," J. Physics Learning, vol. 11, no. 3, p. 98–105, 2022.

[27] N. Dewara, "Validity and Practicality of Guided Discovery Based Buffer Solution Module Using Three Levels of Chemical Representation for Class XI SMA," Edu Kim. J., vol. 1, no. 2, p. 16–22, 2019.