

The Development of Augmented Reality (AR) Based Learning Modules in Office Technology and Correspondence Subjects

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Abstract

This study aims to describe the development of learning modules based on Augmented Reality (AR), determine the feasibility of modules for office technology and correspondence subjects, and determine student responses to the development of learning modules. This research is a Research and Development (R&D) type of research with a 4-D development model from Thiagarajan which consists of 4 stages of development namely define, design, develop, and disseminate. The advantages of learning modules have been adapted to an Merdeka curriculum based on Augmented Reality (AR) technology. The research instrument used was a closed questionnaire. Research on the development of this learning module uses two data analysis techniques, namely descriptive analysis techniques and quantitative analysis techniques. The results of the development of Augmented Reality (AR) based office and correspondence technology learning modules are in accordance with the Alur Tujuan Pembelajaran (ATP) and BNSP criteria. The results of the validation of learning modules from material experts, linguists, and graphics experts amounted to 95% with the proper category. The results of the trial were limited to 20 students obtaining a percentage of 85.9% in the very good category. Based on this explanation, the learning module for class X MPLB office technology and correspondence subjects that has been developed is feasible and very good for use in learning activities.

Keywords: Augmented Reality (AR); Development; Learning Modules.

INTRODUCTION

Education is an important aspect in creating quality human resources to advance the nation and improve people's welfare. The world of education is a part of national development as stated in the Law of the Republic of Indonesia Number 20 of 2003 concerning the National Education System Article 1 Paragraph 1 which explains that education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop his potential to have religious spiritual strength, self-control, personality, intelligence, noble character, and skills needed by himself, the community, the nation and the State. The curriculum is the arrangement and plan of content, objectives, and learning materials as well as the methods used as guidelines in managing learning activities to achieve educational goals. This statement is contained in the Law of the Republic of Indonesia Number 20 of 2003 concerning the National Education System Article 1. Curriculum development is carried out by referring to national education standards to achieve national education goals (Triwiyanto, 2021).

The Merdeka curriculum is the idea of updating the curriculum in response to advances in technology and information in the era of the industrial revolution 4.0. In line with the opinion of Purwanto & Risdianto (2022) merdeka learning education is the answer to the needs of the industrial revolution 4.0. The impact of the industrial revolution 4.0 can be seen in changes in learning aspects such as changes in curriculum, technology and media (Rahayu et al., 2022). The merdeka curriculum has various demands in its implementation, namely producing students who are able to responsively explore every concept given by the teacher will not only remember the material provided, but are also expected to be able to use technology in each lesson to the fullest (Indarta et al., 2022).

The use of technology in learning is supported by the use of technology-based teaching materials in an merdeka curriculum. This is in line with Fitriana's (2021) opinion that teaching materials that use

information technology such as video, interactive e-learning make learning effective and efficient. Teaching materials are defined as tools designed to help students acquire basic skills so that they can learn and master them in their entirety which have been arranged logically and systematically (Nasruddin et al., 2022). Teaching materials can be in the form of modules, handouts, audio, video, posters, and so on. One of the uses of technology that can be used in the development of teaching materials is Augmented Reality (AR) technology.

Augmented Reality (AR) is a learning environment that is made integrated in real-time from digital objects to real-world objects from an environment (Kok et al., 2022). The benefits of using this learning environment include enriching experiences, increasing motivation, and being able to better involve students in learning (Wan et al., 2018). Therefore, technology-based teaching materials are needed in the implementation of the merdeka curriculum to encourage learning in the era of the industrial revolution 4.0. However, the implementation of the newly initiated merdeka curriculum led to changes in the preparation of learning tools which made it difficult for educators to develop learning tools (Rindayati et al., 2022).

Based on the results of a preliminary study conducted at SMK Krian 2, Manajemen Perkantoran dan Layanan Bisnis (MPLB) Expertise Program class X. The information obtained did not yet have teaching materials that were in accordance with the merdeka curriculum of office technology and correspondence subjects. Teachers still use power point in conveying material so that learning is teacher-centered. In addition, students do not yet have the right handbook with the curriculum used. This resulted in incomplete material so that students had to look for additional material via the internet. From these problems, teaching materials are needed in the form of learning modules that are aligned with an merdeka curriculum. The right step is to develop learning modules based on Augmented Reality (AR) in office technology and correspondence subjects.

The advantages of product development are developed to help students understand abstract material by visualizing 2D and 3D objects. Relevant research regarding the development of relevant learning modules is research by Ramadani et al., (2020) with the title "*Development of Augmented Reality-Based Chemistry Learning Modules*". The results showed that the results of the module feasibility assessment from material experts were 3.33 and media experts were 3.77 with a valid category. The results of this study concluded that the learning module is very feasible to use in learning. The purpose of this development research is to find out: 1) the process of developing AR-based learning modules in office technology and correspondence subjects; 2) feasibility of AR-based learning modules in office technology and correspondence subjects; and 3) student responses regarding AR-based learning modules in office technology and correspondence subjects.

LITERATURE REVIEW

Study

Study as a process of transitioning behavior in the form of habits, attitudes, skills, abilities, and knowledge caused by experience (Syam et al., 2022). Study is a change in an individual's mentality concerning aspects of personality with the aim of changing a person's behavior for the better through the experience and training he has received (Setiawan, 2017). From some of the definitions above, it can be concluded that learning is an individual activity with the aim of changing one's behavior for the better that lasts a lifetime.

Learning

According to Law Number 20 of 2003 concerning National Education Article 1 paragraph 20 explains the definition of learning, namely "Learning is the process of interaction of students with educators and learning resources in a learning environment". Learning is a process of educators to educate, control, support learning experiences directed at students (Ananda, 2019: 5). Based on the understanding conveyed by several experts, it can be interpreted that learning is an interaction carried out by teachers and students in a learning environment to create learning experiences for students.

Teaching materials

Teaching materials are all forms of information, tools, or writing that can be used as material and arranged systematically by adjusting the needs of students in learning which acts as planning and learning the application of learning (Prastowo, 2018: 51). Using teaching materials in learning helps the teacher's task because the material to be delivered is available to make it easier for students to learn inside and outside of school (Nidhom et al., 2020: 150). Based on some of the opinions above, it can be concluded that teaching materials are a collection of materials in the form of information arranged systematically to help teachers convey material to students as a support for the teaching and learning process.

Preparation of Teaching Materials

The use of teaching materials during learning must pay attention to the rules for preparing teaching materials as follows (Widodo & Jasmadi, 2008: 42): 1) The preparation of teaching materials must lead to the needs of students during teaching and learning activities, 2) The existence of teaching materials is expected as a reference for changing the attitude of students 3) Development must adapt to the needs and characteristics of students, 4) The preparation must be adjusted to the lesson plan used, 5) Teaching materials must include specific learning objectives and detailed subject matter, 6) Contains a measure of student success in the form of evaluation.

Based on the description above, the concept of preparing teaching materials must adapt to the needs of students, have a role as a reference for changes in student attitudes, its development must be adjusted to the character and needs of students, adapted to lesson plans, contain specific learning objectives, and contain student evaluations.

Learning Module

Learning modules are types of teaching materials that are arranged briefly, specifically, and coordinated with materials and media to support student learning activities (Triyono, 2021: 41). Modules are learning tools with printed writing that are arranged systematically and contain learning components to provide opportunities for students to train themselves through exercises contained in the contents of the module (Fahrurrozi & Mohana, 2020: 77). Based on the understanding that has been conveyed by several experts, it can be concluded that the learning module is a tool that is arranged systematically in the form of printed writing with attention to the components of the lesson plan to facilitate independent learning for students (self-instructional) so as to achieve certain competencies.

Preparation of Learning Modules

The procedure for compiling learning modules must be adjusted to the established rules. The following is the procedure for preparing learning modules, including (Fahrurrozi & Mohana, 2020: 80): 1) Determine the title of the module, 2) Prepare reference sources such as books, journals and so on, 3) Assessing the basic competencies used, reviewing the materials and designing the learning models used, 4) Identify indicators of achievement of competence, and make the form and type of assessment used, 5) Designing the writing structure, and 6) Perform module preparation.

Augmented Reality (AR)

Augmented Reality (AR) is a technology that can integrate two-dimensional and three-dimensional virtual objects by projecting them into real-time (Nasution et al., 2022: 2). Augmented Reality is a variation of Virtual Reality (VR) which allows users to see the real environment with the addition of virtual objects incorporated into it (Rizky, 2020:1). Based on the above opinion, it can be concluded that Augmented Reality is a system or technology that combines real and virtual objects in the user's environment in real-time in 2D and 3D form.

METHOD

Researchers used the 4-D development model because the stages of the 4D model are more appropriate for the development of learning tools because they have a more complete and systematic description of the stages (Abrar, 2022: 76). This research went through several stages, namely define, design, develop and disseminate.

The define stage aims to determine and define learning requirements by analyzing the objectives of the material boundaries developed in the learning module. The goal at the design stage is to prepare a learning module design. At the develop stage it aims to produce AR-based learning modules that have been revised based on input from experts. While the disseminate stage is the stage of using learning modules that have been developed on a wider scale, for example in other schools, other teachers, and in other classes. The aim at this stage is to test the effectiveness of using teaching materials in the form of learning modules in the learning process.

In this study, three experts were involved, namely material, language and graphics experts. As for the test subjects, it was conducted on 20 students of class X MPLB 1 by using a random sampling technique. The data collection instrument uses a validation sheet to assess the feasibility of the learning module given to the validator. There are 4 feasibility assessments, including content feasibility, presentation, language and graphics. Student response questionnaire sheets are used to find out student responses regarding the learning modules developed. The learning module validation criteria table can be seen in table 1 below.

Table 1.
VALIDATION ELIGIBILITY CRITERIA

Information	Score
Very suitable	5
Suitable	4
Quite suitable	3
Not suitable	2
Very unsuitable	1

Source: (Riduwan, 2012)

Information from filling out the validation sheet in the form of quantitative data is analyzed by the formula:

$$\text{Eligibility Percentage} = \frac{\text{Total score of all validators}}{\text{Highest score}} \times 100\%$$

Source: (Riduwan, 2012)

Information:

1. Total score = total score obtained from all respondents
2. Highest score = highest score from the questionnaire multiplied by the number of respondents

In the table of interpretation score assessment criteria can be seen in table 2 as follows.

Table 2.
INTERPRETATION CRITERIA

Information	Score
Very feasible	0%-20%
Feasible	21%-40%
Feasible enough	41%-60%
Not feasible	61%-80%
Very unfeasible	81%-100%

Source: (Riduwan, 2012)

As for the questionnaire assessment of student responses using the Likert scale criteria, it is very suitable to get a score of 5, suitable to get a score of 4, quite suitable to get a score of 3, not suitable to get a score of 2, very unsuitable to get a score of 1 (Riduwan, 2012). The following is the formula used for learning module validation analysis.

$$\text{Eligibility Percentage} = \frac{\text{Total score of all validators}}{\text{Highest score}} \times 100\%$$

Source: (Riduwan, 2012)

Information:

1. Total score = total score obtained from all respondents
2. Highest score = highest score from the questionnaire multiplied by the number of respondents

If the results of the learning module assessment obtain a percentage value of $\leq 60\%$, then the evaluation criteria are very inappropriate, less feasible or sufficiently feasible, while the learning module can be categorized as very feasible or feasible with a percentage result of $\geq 61\%$.

RESULTS AND DISCUSSIONS

The Process of Developing Augmented Reality (AR) Based Learning Modules in Office Technology and Correspondence Subjects

This research produced a product in the form of learning modules for office technology and correspondence subjects. The development process is carried out according to the 4D model from Thiagarajan which consists of four stages, namely define, design, develop, and disseminate. The modules are developed in accordance with the ATP independent curriculum and contain seven elements regarding organizational information and communication systems.

First, the define stage where the researcher determines the learning requirements includes 5 steps: 1) Front end analysis, in the front end analysis found the main problems in learning, namely class X majoring in MPLB SMK Krian 2 does not yet have teaching materials that match the independent curriculum. Therefore, students need teaching materials in the form of learning modules that are in accordance with the applicable curriculum to support teaching and learning activities optimally. As Manalu et al., (2022) said that the independent curriculum has a demanding concept; 2) Analysis of students, aims to determine the abilities, uniqueness and knowledge of students that are adapted to the development of teaching devices. the characteristics of students in class X MPLB 1 SMK Krian 2 are actively using smartphones in class learning, and liking technology-based learning so that they are able to operate smartphones, computers, and laptops that can assist learning activities; 3) Task analysis. At this stage, the researcher identified tasks that were adapted to the seven elements of the independent curriculum. In the learning module developed there are three assignments given in the evaluation exercise, namely multiple choice, case studies, and AR questions; 4) Concept analysis. At the stage of concept analysis the researcher observes the Learning Objective Flow (ATP) to identify material so that it can be adopted in the learning module. AR-based learning modules can make it easier for students to

understand abstract material through 2D and 3D objects. In addition, the developed AR displays objects in real-time so as to make learning interactive and interesting. This shows that AR can bring students to be actively involved in learning (Wan et al., 2018); 5) Formulation of learning objectives. At this stage the researcher formulates the stages that have been passed so that a product development goal is obtained through the assignments given in the learning module.

The second stage is design. The design of this textbook product uses the Microsoft Word 2013 application in making the cover and content design views. Meanwhile, to create 2D and 3D images using the assemblr studio web platform. The format for the preparation of the textbook developed is: front cover, preface, table of contents, list of images, module components, scope of competence, instructions for use, description of book contents, AR markers, evaluation exercise, reflection, glossary, answer key, bibliography, biography compiler, as well as the back cover which contains general information of the module. Print size format using B5 book paper 70 gsm size 18.2 cm x 25.7 cm.

The third stage is develop. The product was then given an expert assessment and validation including 1 material expert, 1 graphic expert, 1 linguist expert. The validator calculation includes aspects of content feasibility, graphic feasibility, language eligibility, and presentation eligibility. Material expert validation was carried out by Ms. Stevani Rozalin K, S.Pd., M.M as a teacher majoring in MPLB at Krian 2 Vocational School. Anas Ahmadi, M.Pd as a lecturer in the Indonesian Language and Literature Education Study Program, Faculty of Languages and Arts, Unesa. While the graphic expert was carried out by Mrs. Khusnul Khotimah, M.Pd as a lecturer in the Educational Technology Study Program, Faculty of Education, Unesa.

Research and development products that have gone through the validation stage will be continued in the limited trial stage for 20 students of class X MPLB 1 on May 17, 2023 with an allocation of 4JP x 45 minutes. AR-based learning modules have advantages, namely being able to display 2D and 3D objects regarding the implementation of the activities of each chapter in daily life according to the material presented, users can access AR technology in their respective learning environments, and display AR-based videos. This shows that AR learning modules can make material clearer in meaning, so that it can be more easily understood by students (Hapsari & Ayu Wulandari, 2020). Meanwhile, the weakness of this learning module is that the application supporting AR objects is slow when used.

The final stage of this development research model is disseminate. In this study, dissemination was not carried out because the aim of the research was to produce a prototype module and to find out the feasibility and responses of students.

The development research carried out by researchers is in line with the research of Ramadani et al., (2020) with the title "Pengembangan Modul Pembelajaran Kimia Berbasis *Augmented Reality*" using 4D models with valid, practical and effective results for learning. Khomaria & Durinda Puspasari (2022) in their research entitled "Pengembangan E-Modul Berbasis Model *Learning Cycle* Pada Materi Media Komunikasi Humas Kelas XI OTKP" used the 4D development model and was declared very worthy of the validator's assessment results. In addition, other relevant research from Damayanti & Durinda Puspasari (2018) with the title "Pengembangan Modul Mata Pelajaran Administrasi Umum Berbasis *Scientific Approach* Pada Kelas X OTKP di SMK YPM 3 Taman Sidoarjo" using the 4D model and obtaining criteria very suitable for use in learning. Another study by Fauziah & Wulandari (2022) with the title "Pengembangan E-Modul Berbasis *Flipbook* Untuk Pembelajaran Materi Ruang Lingkup Administrasi Kepegawaian" with valid results and very feasible to use. This study uses a 4D model.

Feasibility of Developing Augmented Reality (AR) Based Learning Modules in Office Technology and Correspondence Subjects

The feasibility of learning modules was obtained from an assessment of the validation sheet which was guided by BNSP (2014) which included content feasibility, presentation feasibility, language feasibility, and graphic feasibility. The learning modules developed were validated by validators including material experts conducted by Office Technology and Correspondence teachers from SMK Krian 2, then linguists conducted by Unesa Faculty of Languages and Arts lecturers, and graphic experts conducted

by Unesa Faculty of Education lecturers. the results of the feasibility analysis of the developed learning modules can be seen in table 3.

Table 3.
FEASIBILITY VALIDATION ANALYSIS OF LEARNING MODULES

Validation	Percentage	Information
Materials Expert	94%	Very suitable
Linguist	94%	Very suitable
Graphic Expert	96%	Very suitable
Average	95%	Very suitable

Source: Researcher Data (2023)

Based on the scores obtained from the validators, the average total score is 95% so that the learning modules developed by researchers are suitable for use as teaching materials to support student learning. To find out the feasibility of learning modules in assessing the development of learning modules, a study by Widiani & Rosy (2021) was carried out with the title " Pengembangan E-Modul Berbasis *Flipbook Maker* Pada Mata Pelajaran Teknologi Perkantoran". The e-module used is very suitable for use in learning activities. This is evidenced by the results of the validation of material experts obtaining a percentage of 85%, media experts 92%, linguists 88%. Then this is supported by previous research by Bakri et al., (2020) with the title "Module Equipped with Augmented Reality Technology: An Easy Way to Understand Concepts and Phenomena of Quantum". The developed module shows very good criteria and is feasible to be used as teaching material by obtaining a score of 95.9% from material experts and 84.2% from media experts.

Student Responses to the Development of Augmented Reality (AR) Based Learning Modules in Office Technology and Correspondence Subjects

To find out the number of students who are interested in the learning module, it is necessary to have a student response questionnaire. Questionnaires are several questions written to be addressed to respondents in order to obtain the information needed by researchers, both personal and other information (Hermawan, 2019: 75). Researchers took 20 students to do trials on the developed learning modules. The limited trial was carried out on May 17, 2023. The researcher started by introducing himself and explaining the research objectives. Then the researcher distributed learning modules and student response sheets in printed form. Furthermore, the researcher instructed the procedure for filling out the response sheet. The researcher gave 4JP time to observe and read and fill out the learning module response sheet developed by the researcher. The ratings obtained were analyzed based on a questionnaire and analyzed using quantitative. Student responses can be categorized as good or very good by getting a percentage of $\geq 61\%$. The acquisition of the interpretation value from the results of the student response questionnaire is equal to 85.9%, the learning module developed can be said to be very good from the students.

Research by Hidayat & Rosy (2019) with the title " Pengembangan Buku Ajar Pada Mata Pelajaran Otomatisasi Tata Kelola Sarana dan Prasarana Pada Kelas XI OTKP Di SMK Kawung 1 Surabaya". In this study, testing the response to the development of teaching materials was carried out through limited trials to find out students' responses to the developed textbooks by obtaining a percentage of 92.3% with very suitable criteria so that they were categorized as "very interesting" for learning. Oktaviara & Pahlevi (2014) conducted an assessment of student responses to module development assessment with the title "Pengembangan E-modul Berbantuan *Kvisoft Flipbook Maker* Berbasis Pendekatan Saintifik Pada Materi Menerapkan Pengoperasian Aplikasi Pengolah Kata Kelas X OTKP 3 SMKN 2 Blitar ". This study used student responses consisting of four aspects of the BSNP and limited trials were carried out on 20 students with a score of 94.4% with very strong criteria.

CONCLUSION

Based on the description of the research results above, the following conclusions can be conveyed. The process and stages of developing the learning module used the 4D model, namely define, design, develop, disseminate, but at the disseminate stage it was not carried out because the researcher was only limited to getting a prototype and wanted to know the response or responses from students.

The feasibility of the learning modules was assessed by experts, namely material experts scored 94%, linguists scored 94%, and graphic experts scored 96%, thus the Development of Augmented Reality (AR) Based Learning Modules in Office Technology and Correspondence Subjects was declared very appropriate as supporting teaching materials in teaching and learning activities.

Students' responses were collected through a limited trial of 20 students in class X MPLB 1 at Krian 2 Vocational School. The response sheet contained 15 questions. Obtained an average value of 85.9% with a very good interpretation value. So that the developed learning module is stated to be very good for use in Office and Correspondence Technology learning activities at Krian 2 Vocational School.

Through an explanation of the research results that have been carried out by researchers, the following are suggestions put forward by researchers: 1) Further research can use other AR developer platforms to avoid application slowdowns; 2) Future researchers can add elements that did not exist before and can test the product further to measure effectiveness; 3) Researchers can then compile student response questionnaires using psychological indicators.

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