DEVELOPMENT OF MODIFIED E-MODULES AUGMENTED REALITY ANDROID BASED TO IMPROVE STUDENT'S INTEREST AND LEARNING OUTCOMES

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DOI: https://doi.org/10.33394/bioscientist.v12i2.13966
Submit: 26-11-2024; Revised: 24-12-2024; Accepted: 28-12-2024; Published: 30-12-2024

ABSTRACT: Scientific and technical advancements have intensified efforts to incorporate technological results into the teaching and learning process. As a result, new advancements in learning systems are required, such as the creation of Augmented Reality-based e-modules. In colloidal material research, Augmented Reality on an Android tablet is employed in modified Chemistry E-modules to increase student engagement and learning outcomes. The objectives of this research are to create e-modules, evaluate their use, and analyze the impact of chemistry e-modules on learning outcomes and student participation. The feasibility of e-modules is determined through the validation test of 9 validators consisting of media experts, linguists and teaching practitioners. While the e-module was tested on 3 scales, namely limited scale, medium scale and wide scale on respondents, namely grade XI students at SMA Islam Terpadu Baitul Muslim, SMA Teladan, SMA TQ Al Mannan in East Lampung Regency. Based on the research, the academic results and attention spans of grade XI pupils are impacted by chemistry e-modules with customized Augmented Reality on colloid material, A 0.005 significance level has been set. Furthermore, the N-gain value indicates a difference in the attention and learning outcomes of grade XI pupils before and after utilizing the program. Students who do not study the material through e-modules have N-gain values in the low category, while students who study the material through e-modules have N-gain in the high category. In the validation test by validators, it is known that the Aiken coefficient value (V-count) is greater than 0.8 with a very good Likert scale interpretation.

Keywords: e-modules, augmented reality, student's interest, learning outcomes.

INTRODUCTION

The rapid development of the times has led to the development of better education. In Indonesia, almost every educational institution seeks to develop and improve the quality of education in their respective areas. The development of education quality is accompanied by the use of technology and information to support the efficiency of education delivery (Yani, 2021). Based on the results of previous research, most of the students did not have representative knowledge and skills which caused students to have difficulties in learning chemistry (Yani, 2021). The real impact of this problem is that students often have misconceptions about science, especially chemistry. Therefore, students really need a holistic approach to learning chemistry at the submicroscopic, symbolic, and mathematical levels (Ramadani, Ramlawati, & Arsyad, 2020).

The solution that can be used to overcome this problem is to develop learning modules. The module is a teaching material that can be used by students to study independently anywhere and anytime. The module also functions as an evaluation tool to measure the level of mastery of the material in students. Modules can help teachers to minimize teacher-based orientation in the process of learning and prioritizing student-based orientation to form independent learning in students (Yanuar, 2021). The appearance of a monotonous learning module will not increase the effectiveness and efficiency of the student learning process. Students will tend to get bored easily and increasingly do not understand chemistry lessons if the presentation of the module is too monotonous and uninteresting. Therefore, with the development of technology and information, the addition of features augmented reality in the module will provide a new, attractive and updated appearance (Ramadani et al., 2020).

Augmented reality is a technology that combines virtual objects in 3 (three) dimensional (3D) form into a real environment in 3 (three) dimensional (3D) form. Augmented reality is used to visualize images or objects in a three-dimensional (3D) form that can move according to the desired design (Schmalstieg & Hollerer, 2016). AR/MR also presents an ideal environ-ment for 3D visualization, in which existing real-world objects can be combined with computer-generated objects (c.f. VR, in which the environment is fully virtual withno real-world components) (Hockett & Ingleby, 2016).

The development of augmented reality-based chemistry e-modules is indispensable as a learning medium that can increase the efficiency of classroom learning activities. With the addition of three-dimensional (3D) animation, it will make students feel enthusiastic in learning the material in the chemistry e-module (Schmalstieg & Hollerer, 2016). By combining the chemical e-module with augmented reality technology, all materials and sub-materials can be visualized from two-dimensional (2D) to three-dimensional (3D) forms (Yanuar, 2021).

This research aims are: Developing Augmented Reality-based chemistry modules to increase student interest and learning outcomes in colloid material; Testing the feasibility of an android-based augmented reality modified chemistry e-module to increase student interest and learning outcomes in colloidal materials in terms of validity; and Testing the effectiveness of Augmented Reality-based chemistry modules to increase student interest and learning outcomes in colloidal material.

METHOD

The development research carried out aims to obtain an Android-based augmented reality modified chemical e-module which can be tested for its feasibility and effectiveness in increasing student interest and learning outcomes in colloidal materials (Sudaryono, 2016). Three schools in East Lampung are the targets for applying modified augmented reality technology in creating chemistry e-modules for colloidal materials. The categories for selecting the three schools are: 1) based on the representation of low, medium and high schools, and 2) the average school exam scores over a period of approximately the last 5 (five) years.

Students from class XI Science took part in this research. This research will be conducted at high schools in the 2023/2024 academic year at Baitul Muslim Integrated Islamic High School, Teladan High School, TQ Al Mannan High School in East Lampung Regency. The steps for developing an Android-based Augmented Reality e-module include (Aka, 2019):

1. **Preliminary Steps**

   This stage begins with data collection and literature studies in developing an Android-based augmented reality modified chemistry e-module.

   a. Preliminary study and data collection: The aim of carrying out this study is to help researchers find out the problems faced in the three schools. The activity at this stage is analyzing the selected curriculum and using it as a basic reference for developing a modified augmented reality chemistry e-module.

   b. Field study: The field investigation was designed to obtain information about problems in the field by interviewing chemistry teachers from East Lampung Regency High Schools, and their responses provided insight into the difficulties they faced.

2. **Planning**

   a. Selection of Learning Media: The process of selecting learning media involves needs analysis which includes curriculum analysis, material analysis, learning objective analysis, questionnaire response analysis, and interview findings.

   b. Selection of Presentation Form: Learning materials are prepared, teaching methods and learning resources are selected which are then presented in an attractive format, easy to understand and use and useful in the learning process.

   c. Preliminary Design Making: The conceptual foundations of the media and learning models are built and delivered in multimedia form.

3. **Develop Preliminary Form of Product**

   This effort aims to produce an Android-based augmented reality modified e-module which is a product suitable for use for chemistry learning. Products will be assessed by experts and practitioners who are considered to have value, experience and expertise in that field.

4. **Limited Trial**

   Trials are carried out to obtain data that shows the use of the product after improvements based on validator suggestions and comments.

5. **Phase II Product Refinement**

   Recommendations and feedback obtained from limited-scale testing are applied to correct product deficiencies.

6. **Medium Scale Trial**

   In the medium scale trial, the respondents used were 45 students from three schools consisting of 15 students from SMAIT Baitul Muslim, 15 students from SMAT Teladan, and 15 students from SMAT TQ Al Mannan.

7. **Product Improvement of Medium Scale Test Results**

   Suggestions and comments obtained from medium-scale trials are used as a reference for making improvements to product deficiencies to then be tested again in wide-scale trials.

8. **Wide Scale Trial**
   This trial was carried out to obtain an assessment of the effectiveness and reliability of the final product.
9. **Product Improvement Results from Wide-Scale Trials**
   Field test results are analyzed and applied to improve the product being developed.
10. **Product Distribution**
   The chemical e-module modified with augmented reality, which has been tested for its effectiveness, is then distributed to chemistry subject teachers in high schools in East Lampung district. The target school is a school with the same characteristics as the school where the research took place (Aka, 2019).
11. **Data Analyze**
   Data analysis using anova test and manova test with the help of the SPSS application (Santoso, 2016).

RESULT AND DISCUSSION

Baitul Muslim Integrated Islamic High School, Teladan High School, and TQ Al Mannan High School in East Lampung Regency were implemented learning based on the 2013 curriculum. The 2013 curriculum, graduate competency standards (SKL) have been explained as a criterion that should cover the graduate's qualification abilities, involving attitudes, knowledge and skills (Panginan & Susianti, 2022). Field data states that as many as 79.5% of students still do not use their smartphones for their chemistry learning needs. One effort to facilitate students through learning media is the development of technology-based learning modules such as Augmented Reality. This is supported by 88.6% of students agreeing that learning media should be developed that are innovative, interesting and easy to understand. In the initial analysis, as many as 81.8% of students would feel enthusiastic about studying chemistry if there were interesting and innovative chemistry learning modules.

Evaluation from experts and practitioners is very helpful in determining the suitability of the media being developed. 6 practicing teachers, 1 media expert, 1 material expert, and 1 language expert will validate the Chemistry e-module modified with augmented reality. The assessment results from the validator are analyzed by measuring the Aiken value to determine its validity. The Aiken V coefficient value ranges from 0-1. The lower the value of the Aiken coefficient, the lower the validity (Aryanto, Hariono, & Pahalawidi, 2018). In the assessment results from the validator, it is known that the V value has an average of 0.8 so it is included in the high category. All aspects are considered valid based on the assessment results from the validator.

Trials were carried out on three scales, namely limited, medium and broad. On a limited basis, e-module trials were carried out on 5 class XI students each from Baitul Muslim Integrated Islamic High School, Teladan High School, and TQ Al Mannan High School in East Lampung Regency. The results of the medium scale test questionnaire from 45 respondents are in Table 1 as follows.

Table 1. Results of Respondent Questionnaires in Intermediate Trials

No.	Aspects	Average	Category
1	Media	3.81	Very good
2	Learning materials	3.71	Very good
3	Learning	3.71	Very good
	Average	3.74	Very good

Regarding interest in learning, there are several questions that students will answer based on a Likert scale. The pretest and posttest results for each XI student in the three schools will be measured by N-gain. The results of the N-gain analysis of students' learning interest are in Table 2 as follows.

Table 2. N-gain Value of Student Learning Interest

Treatment	N-gain	Add. information
Control		
BM High School	25	Not effective
Teladan High School	17.9	
Al Mannan High School	20.6	
Experiment		
BM High School	70.6	Quite effective
Teladan High School	70.5	
Al Mannan High School	73.7	

The N-gain value is a measure used to evaluate the increase in student understanding or performance after participating in a learning intervention (Farell, Ambiyar, Simatupang, Giatman, & Syahril, 2021). The N-gain value measures the extent to which students experience improvement after taking part in certain learning or treatment, such as providing learning materials, learning methods, or certain interventions (Wahab, Junaedi, & Azhar, 2021). The results of the N-gain test analysis for learning outcomes are shown in Table 3. which shows that the control N-gain has a lower value compared to the experimental N-gain.

Table 3. N-gain Value of Student Learning Results

Treatment	N-gain	Add. information
Control		
BM High School	25	Not effective
Teladan High School	55.7	Less effective
Al Mannan High School	25.7	Not effective
Experiment		
BM High School	79.4	Effective
Teladan High School	71.4	Quite effective
Al Mannan High School	79.7	Effecttive

The prerequisite tests in this research include the normality test and the variance homogeneity test. The significance level used in the analysis prerequisite test is 0.05. The normality test was carried out using the Shapiro Wilk test because the number of samples for each class was less than 50 (Apriani, Wijayanti, & Widyastutik, 2018). Based on the results of the normality test, it was found that the significance value was ≥ 0.05, which indicated that the data in the study had a normal distribution. This data can be seen in the Table 4 as follows.

Table 4. Normality Test

Class	Normality Tets	Sig.	Add. information	
Learning Interest	BM High School	0.623	H_0 accepted	Normal Data
	Teladan High School	0.973	H_0 accepted	Normal Data
	Al Mannan High School	0.075	H_0 accepted	Normal Data
Learning Result	BM High School	0.063	H_0 accepted	Normal Data
	Teladan High School	0.053	H_0 accepted	Normal Data
	Al Mannan High School	0.087	H_0 accepted	Normal Data

The homogeneity test is carried out to determine whether the variants of a number of samples are the same or not. The homogeneity test results are displayed in Table 5 as follows.

Table 5. Homogenity Tes

Normality Tets	Sig.	Add. information	
Learning Interest Post Test	0.266	H_0 accepted	Homogen Data
Learning Result Post Test	0.649	H_0 accepted	Homogen Data

Multivariate statistical analysis is a statistical method that allows research on more than two variables simultaneously (Sya'adah, Sutrisno, & Happy, 2023). By using this technique, the influence of several variables on other variables can be analyzed simultaneously (Lasaiba, 2022).

Table 6. Manova Test Result

Post Test	Sig.	Add. information
Learning Interest and Learning Results	0.012	H_0 rejected

Based on the MANOVA test on learning interest and learning outcomes simultaneously, an n = significance value < 0.05 was obtained, which is actually 0.012. This shows that H_0 is rejected and there is a significant difference from the use of the modified augmented reality e-module on colloidal materials. Meanwhile, based on the test of between-subject effects, it is known that there are differences between learning outcomes and interest in learning from the learning models provided at the three high schools, where the significance level is indicated by a value smaller than 0.05. This shows that there are differences in learning outcomes and interest in learning between classes that use the modified e-module learning method, and classes that do not use e-modules at Baitul Muslim Integrated Islamic High School, Teladan High School, TQ Al Mannan High School.

CONCLUSION
Based on the results of research and data analysis, several conclusions were obtained in this research, namely: (1) A chemical electronic module modified with Android-based augmented reality has been developed and tested at the limited stage, medium stage and extensive stage with good results and influencing interest and Student learning outcomes at Baitul Muslim IT High School, Teladan High School and TQ Al Mannan Class XI High School in colloidal chemistry subjects; (2) The chemical electronic module modified with Android-based augmented reality was declared feasible by the validator with a very good category in terms of appearance, appropriateness of content, appropriateness of presentation,

implementation and appropriateness of language with Aiken's V > 0.8; (3) The electronic chemistry module modified with Android-based augmented reality influences the interest and learning outcomes of class XI students at SMA IT Baitul Muslim, SMA Teladan and SMA TQ Al Mannan with a significance value of <0.05.

RECOMMENDATION

The author hopes that further researchers can develop e-modules by perfecting existing e-modules to support the chemistry learning process to run better and more enjoyable.

ACKNOWLEDGMENTS

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