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Development of Digital-Based Interactive Modules in Senior High School

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Abstract: *This study aims to produce a valid and practical interactive module. The research uses the Research & Development (R&D) type of development using the ADDIE model which includes five stages, namely the Analysis, Design, Development, Implementation and Evaluation stages. The sample in this study consisted of two types of samples, the first trial I (limited trial) in class X MIPA 3 and trial II (overall trial) in class X MIPA 4 and X MIPA 5. validation test and practicality test. The results of this study are: 1) The interactive module developed in this study is valid, it can be seen from the validation results in the material and media test. The data from the validation test results showed that the results of material validation obtained an overall average validity of 82.8%. While the validation results on the media test obtained an overall average validity of 88.5% so based on this value, the digital-based interactive module product is in the very valid category because it is in the 81-100% interval. 2) This study uses student response sheets to measure the practicality of the interactive module, as many as 94 students of class X MIPA with a level of practicality that is practical. This means that the interactive modules developed are practically used by students. Based on the results of this study, it can be concluded that the digital-based interactive module on ecosystem materials to improve scientific attitudes and students' cognitive learning outcomes developed is valid and practical to use in learning.*
Keywords: *Interactive Module; Digital Based.*

1. INTRODUCTION

The development of Science and Technology (IPTEK) is very rapid in this era and has a positive influence on the field of education and provides a challenge for education graduates to create learning media that can improve the quality of education better (Muyaroah & Fajartia. 2017). The use of the right media will provide the right learning experience to students, so that they can build their own knowledge of a concept and in this era the development of biology is entering a new stage whose global trend is experiencing a transition from the use of physical and chemical technology to now entering the biological era. (Airlanda, 2016).

According to Prastutiana (2018) the process in learning biology emphasizes giving direct experience to students, this can develop competencies so that they explore and understand scientifically. Knowledge is important for learning, because biology is needed in everyday life to meet human needs through solving identifiable problems. Masnur (2010) learning will be more meaningful if students discover the concepts themselves through the scientific process, a scientific attitude is an attitude that must exist in a scientist or academician when dealing with scientific problems.

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According to Prastutiana (2018) students really need a scientific attitude in learning because it can motivate learning activities because scientific attitude is a factor that needs to be considered in the learning process to improve student learning outcomes. In a scientific attitude there is a picture of how students should behave in learning, responding to a problem, carrying out a task, and developing themselves. This of course greatly influences the results of student learning activities in a positive direction.

The learning outcomes are changes in student behavior both in cognitive, affective and psychomotor aspects after learning. The change in behavior in question is a situation where students have understood the subject matter that has been taught and are able to achieve competency standards and the minimum completeness criteria (KKM) that are applied, learning outcomes can be measured by conducting evaluation tests. Learning outcomes in the cognitive aspect according to the revised bloom taxonomy are divided into six dimensions, namely remembering (C1), understanding (C2), applying (C3), analyzing (C4), evaluating (C5) and creating/creating (C6) (Wulandari, *et al.* , 2020). Learning outcomes are students' abilities obtained after completing the exercises in learning. Changes that occur from students both involve cognitive, affective, and psychomotor aspects (Nugraha, 2020). Biology learning will be able to take place effectively with the application of appropriate teaching materials to be able to influence scientific attitudes and cognitive learning outcomes of students to be more increased. According to Wulandari, *et al* (2020) one of the effective teaching materials used for learning is modules. Modules are teaching materials that are arranged practically and systematically based on a specific curriculum, contain a set of experiences or learning activities to support the learning process and are designed so that students are able to achieve specific learning goals independently. Along with the development of science and technology, modules have been further developed, namely they can be made in the form of electronic modules (E-Modules).

According to Awwalina & Indana (2022) the use of E-modules takes advantage of increasingly rapid technological developments, so as to create interactive learning. Interactive learning patterns are created through interactive between teachers and students, the environment, learning resources or media. The combination of various media can be used as a means of communication between students and the media. According to Wiratama & Margunayasa (2021) interactive e-modules are learning materials that contain material, methods, limitations, and ways of evaluating that are designed systematically and attractively to achieve the expected competency.

In the era of the industrial revolution and big data at this time, making it a way to make it easier to carry out learning activities, namely through the use of the internet and digital based. So that learning activities are increasingly sophisticated, more fun and interesting. E-Modules are an appropriate learning alternative for students, because e-modules help students to learn in a systematic and interesting way to achieve competencies that are presented in a digital format and can be accessed offline and online (Munandar, *et al* 2021). So that students more easily understand the material presented. The development of teaching materials is important to be carried out by educators so that learning is more effective, efficient, and does not deviate from the competencies to be achieved and is able to improve scientific attitudes and cognitive learning outcomes of students. Given the importance of the module's role in improving the quality of the learning process in high school, the teacher as the person most responsible for the success of the learning process, is required to be able to understand the meaning, characteristics, principles, provisions and procedures for module development. Learning using interactive modules does not only focus on the teacher but students can do it independently. One of the science learning materials is ecosystems in the interaction of living things with their environment where the material is contextual or can be observed in everyday life. However, it is difficult to observe directly, so learning must use technology to make and apply teaching materials (Putri & Amrizal, 2020). So the researcher is interested in carrying out the research "Development of Digital-Based Interactive Modules on Ecosystem Materials to Improve Scientific Attitudes and Cognitive

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Learning Outcomes at SMA N 05 North Bengkulu".

2. RESEARCH METHOD

This development research uses the ADDIE method (Analyze, Design, Development, Implementation, and Evaluation) developed by Branch (2009). Through this research, a learning media was developed in the form of digital-based interactive modules on ecosystem materials to improve scientific attitudes and learning outcomes at SMA N 05 North Bengkulu.

Research Locations

The research location for the development and testing of digital-based interactive module teaching materials in this study was carried out at SMA N 05 Bengkulu Utara.

Research Time

This research was conducted in the period March - April 2022. During that period, researchers will carry out development and design and then conduct trials.

Research Subjects

The research subjects in trial I (limited trial) were 1 (one) class X MIPA 3 at SMA N 05 North Bengkulu. Trial II (overall test) on class X MIPA 4 and MIPA 5 SMA N 05 North Bengkulu even semester of the 2021/2022 academic year.

The following are the stages of the ADDIE research (Analysis, Design, Devlopment, Implementation, Evaluation) which will be described as follows: 1. Analysis Phase (Analysis) This stage includes needs analysis, competency analysis and student instructional analysis. 2. The Design phase relates to learning objectives, assessment instruments, exercises, content, subject matter analysis, lesson planning and media selection. At this stage the researcher begins to design modules that will be developed according to the analysis carried out previously. 3. Development Stage The Development stage is the product realization stage which aims to produce a theoretically feasible module. Module development is carried out according to the design, then the module will be validated by content experts (2 biology lecturers) and media experts (teachers). 4. Implementation Stage (Implementation) At this stage the researcher will conduct trials on the module product. Modules that have been developed are implemented in real or actual situations in students. 5. Evaluation Stage At this stage the researcher will evaluate each stage, namely needs analysis, design, development, and implementation. learning that is being built is successful and in accordance with initial expectations or not.

Research instruments are tools or facilities used to collect research data. Some of the research instruments used for this development research are: 1. Validation Sheet (Module), 2. Practicality sheet (Module), 3. Scientific Attitude Questionnaire, 4. Cognitive learning outcomes test.

Data collection techniques carried out in this development research are by means of validation tests and practicality tests (response).

Technical data analysis, the following is explained technical data analysis in research, namely:

Validity Data Analysis

The validity of research products is assessed by several validators, namely validators who are experts in the preparation of modules. Calculating the validity score from expert validation results using a formula, described by Fatmawati (2016).

$$\text{Validity (V)} = \frac{\text{Total Earned Score}}{\text{Total Maximum Score}} \times 100\%$$

Percentage known validity results can be matched with validity criteria as presented in Table 3.1. proposed by Sugiono (2017).

Table 1. Validity Assessment Criteria

Valuation	Interpretation Criteria
81 - 100%	Very Valid
61 - 81%	Valid
41 - 61%	Enough
21 - 41%	Invalid
0 - 21%	Totally Invalid

Practical Data Analysis

The modules used and expressed in their practicality can be seen from the criteria for categorizing the practicality of using modules as follows table 3.2, which is stated by (Syamsu, 2017).

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$$P_{praktis} = \frac{X}{X_{maks}} \times 100\%$$

Description:
Practical = Percentage of device practicality
X = Number of Scores obtained
Xmax = Number of Maximum Scores

Table 2. Practicality Assessment Criteria

No	Practicality Criteria	Criteria Level
1	90% - 100%	Very Practical
2	80% - 89%	Practical
3	65%- 79%	Pretty Practical
4	55% - 64%	Less Practical
5	0% 54%	Impractical

3. RESULTS AND DISCUSSION

Learning tools can be said to be suitable for use if they are valid and practical.

RESULT

The process of developing this interactive module refers to the ADDIE model developed by Robert Branc, 2009 which consists of 5 stages, namely the Analysis, Design, Development, Implementation, and Evaluation stages.

This development research has been carried out in accordance with the stages in the ADDIE design model. The following are described the stages that researchers do:

Stages of Analysis

The initial stage carried out by researchers by analyzing the need for the development of digital-based interactive modules through needs and problems analysis in the form of the availability of textbooks or references that support learning activities. Researchers conduct an analysis of conditions in the field through interviews with subject teachers and students. The discussion of the interview conducted was about the availability of teaching materials used in biology learning activities. Researchers consider it very important to develop digital-based interactive modules for scientific attitudes and cognitive learning outcomes of students.

Design Stages

After a needs analysis, the next step is design (designing products). There are several things that are done in the product design stage, the development of digital-based interactive modules on ecosystem materials to improve scientific attitudes and cognitive learning outcomes of students. The steps for preparing the product design of this module, including adjusting learning activities based on the curriculum and syllabus/learning implementation plan (RPP).

Development Stages

The development stage is the product realization stage. Module development is carried out according to the design, then the module is validated. Module validation is carried out by lecturers and teachers, material experts, and media/design experts.

Module Validity

Module validation is carried out by 2 validators consisting of lecturers / teachers material experts, 1 media / design expert. Criteria for determining expert subjects, namely: 1) experienced in their fields, 2) status as lecturers / teachers.

a. Product Validation Interactive Modules by Material Experts

The results of validation by material experts can be seen in the table below:

Table 3. The results of material expert validation of digital-based interactive modules.

No	Assessed Aspects	Assessment Results	Criterion
1.	Content eligibility component	82	Very valid
2.	Linguistic component	94	Very valid
3.	Compatibility of questions with indicators	72,5	Valid
Sum		**248,5**	
Average total assessment		**82,8 %**	**Very valid**

The table above shows that the value of all aspects of the observations assessed, namely the content feasibility component, language component, compatibility of the questions with those given by validators on the validation sheet

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is in the very valid category, so that from the values given by the two validators, the overall average validity is 82.8% so that based on these values, digital-based interactive module products are in the very valid category because are at intervals of 81-100 %.

b. Product Validation Interactive Modules by Media Experts

The results of validation by media experts can be seen in the table below.

Table 4. Results of media expert validation of digital-based interactive modules.

No	Assessed Aspects	Assessment Results	Criterion
1.	Graphic components	82	Very valid
2.	Serving components	95	Very valid
Sum		**177**	
Average total assessment		**88,5 %**	Very valid

The table above shows that the values of all aspects of the observations assessed, namely the graphic component and the presentation component with those given by the validator on the validation sheet are in the very valid category, so that from the value given by the validator, the overall average validity is 88.5% so that based on these values, digital-based interactive module products are in the very valid category because they are in the interval 81-100 %.

Implementation Stages

After the interactive module is validated, the interactive module is tested, at this stage the interactive module is given in two stages, namely trial I (limited) and trial II (broad / whole). The practicality of the module is obtained from the practicality sheet given to students after the end of learning using digital-based interactive modules that have been developed. After the interactive module is tested then we can only see the response or practicality of the interactive module developed.

Practicality Test

After studying the material in the interactive module, students are asked to fill out a response questionnaire, namely class X MIPA students to the module developed to find out the practicality of using the module, the student response questionnaire consists of 8 statements that students must fill in. Practicality tests or student response questionnaires are given after the entire learning process is complete so that students can provide a complete picture of the learning activities that have been carried out.

a) Trial I

Trial I was conducted in 1 class, namely class X MIPA 3 with a total of 30 students. The scoring of each statement item is given a minimum score of 1 and a maximum of 5. The results of the practicality questionnaire of trial I can be seen in the following table:

Table 5. Practical Results of Trial I Interactive Module

Number of Students	Total Score	Overall Average	Level of practicality
30	2.514	84%	Practical

From table 5. above obtained the overall average in the interactive module trial I is 84% with a level of practicality, namely practical, with an interval of 80% - 89% (practical). Based on the student response questionnaire, several comments and suggestions were obtained as follows: The average student stated that this digital-based interactive module is interesting, easy to understand, and more practical to carry everywhere because this interactive module is already available on each student's android. However, there are obstacles in some students because internet / network access is limited and there are also some students whose mobile phones cannot open this digital-based interactive module application. Overall, it can be concluded that digital-based interactive modules have been practically tested in the field, with several improvements.

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b). Trial II

Trial II was conducted in class X MIPA 4 (32 students) and X MIPA 5 (32 students). The results of the practical questionnaire of trial II can be seen in the following table:

Table 6. Practical Results of Trial II Interactive Module

Number of Students	Total Score	Overall Average	Level of practicality
64	5.407	84,5%	Practical

From table 6. The overall average in the interactive module is 84.5% with a practical level, with an interval of 80% - 100% (practical).

Based on the responses of students above, digital-based interactive modules determine that students have a positive response to learning activities by using digital-based interactive modules on ecosystem materials to improve scientific attitudes and cognitive learning outcomes of students at SMA N 05 North Bengkulu.

Evaluation Stages

The evaluation phase is the last stage in the ADDIE model. Evaluation is carried out to analyze data on module validity, practicality and effectiveness of the modules developed. At this stage, the researcher made the final revision of the module developed based on input obtained from response questionnaires and field notes on observation sheets. This is so that the modules developed are really appropriate and can be used in the subjects of ecosystem material biology.

4. DISCUSSION

Module Validity

The development of interactive modules that have been processed in this research goes through the validation test stage by validators consisting of material experts and media experts. Material validation is declared valid by validators if the interactive modules developed are in accordance with the material that should be presented. Media validation is valid by validators if it matches the components on the media validation sheet. Sugiyono (2017) said that every product resulting from research and development (research and development) needs to be validated by validators who are experts in their fields before the product is tested en masse. This aims to guarantee that the products made are really trustworthy, used, and have met the standards.

Based on the assessment results of 2 validators, it can be seen that the learning media developed is included in the category of "very feasible/valid" with a percentage of material expert assessment results of 82.8%. The average validity of the aspect module material is that the content feasibility component is 82% very valid, the language component is 94% very valid, and the conformity of the questions with the indicator is 72.5% valid. This data is obtained from the calculation of the average validity of module 2 material expert validators. And the results of media expert assessment amounted to 88.5%. As for the average validity of the aspect module material, that is, the graphic component is 82% very valid and the presentation component is 95% very valid. At this validation stage, there are several suggestions for improvement given by validators, namely language/media communicative, adding and subtracting material, correcting unattractive designs, correcting incorrect writing, repairing the front cover (cover) to make it more attractive and good. This is in line with the researcher.

The material developed in the module must pay attention and adjust to the learning objectives. So that the material presented is in accordance with the level of thinking of students. In line with Pastowo (2015) in formulating material, it is very important to pay attention to the intended target audience, so that the limits of material knowledge can be known. According to Ervina & Nanik (2021), in addition to paying attention to the material for the intended reader, this module must also pay attention to the design format developed systematically so that it is easy to read and understand by students. Good module design really needs to pay attention to the design format in question including writing style, layout, and design characteristics that are tailored to the needs of readers.

Therefore, from these results that digital-based interactive modules are feasible / valid to be used and need to be revised by researchers to improve scientific attitudes and cognitive learning

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outcomes, meaning that they can be tested on students. The material that has been described in the module is in accordance with the learning indicators listed in the curriculum and learning implementation plan (RPP). According to Arimadona (2016) the module has reached content feasibility if the material described in the module already refers to the curriculum, the formulation of learning objectives in the module already uses operational verbs, and the material has also been systematic, logical, and intact. In line with Silvi's opinion (2016) which says the module has met the feasibility of the content if it includes conformity with the curriculum, scientific structure, actual, and breadth of material. The preparation of modules adjusts topics in accordance with the demands of the basic competencies that have been formulated. In the preparation of the material, this module refers to.

Practicality of modules

The practicality of digital-based interactive modules is seen through the responses given by students. The modules developed have been examined for practicality in product trials. In research, the development of digital-based interactive modules to improve students' scientific attitudes and cognitive learning outcomes. This study used student response sheets to measure the practicality of the module, data from student responses was used to see the practicality of the module obtained an average percentage of trial I in class X as much as 1 class, which is 84% of student response sheets with an interval of 80% - 89% practicality. Similarly, trial II in class X as many as 2 classes obtained an average percentage of 84.5% with an interval of 80% - 89% practicality, namely practical. This means that this interactive module is practically used by teachers and learners.

In line with the opinion of Ervina &; Nanik (2021), good teaching materials are teaching materials that are not only valid, but also practical to use and practical in understanding them. According to Hobri (2010) the practicality of the module is measured through student response questionnaires, then analyzed and the results follow predetermined criteria. According to Arifin (2017) that practicality refers to the condition of learning modules that are developed easily used by users (teachers and students) so that the learning carried out is meaningful, interesting, fun and useful for students' lives, and can increase their creativity in learning.

With this digital-based interactive module, students are easier to use in learning activities, hassle-free, efficient, and easy to understand. In line with Alfiriani & Hutabri (2017), the modules developed are said to be practical if they are easy to use. Easy to usewhat is meant is easy to use by students when learning, so that learning that is done independently becomes easy to do, interesting, fun, and can increase creativity. According to Farida & Triani (2021), From the results of the analysis of student responses to the interactive e-modules assisted by flipbooks developed, it was found that the e-modules developed made it easier for students to learn. With the presentation of interactive questions, it raises reading interest and student interest in learning statistics. Flipbook-assisted interactive e-modules are also very practical to carry everywhere because students can easily learn and use them anytime and anywhere just by opening.

According to Putri & Amrizal (2013) stated that in a presentation of material arranged together with images and videos, this will have its own appeal for readers. By utilizing digital technology in learning as a reference source for the teacher. In addition, the interest of learners in this E-module is very enthusiastic. And the school is equipped with supporting facilities such as computers and internet networks even almost all students also have mobile phones or laptops at home.

5. CONCLUSION

Based on the results of the study, it can be concluded that, digital-based Interactive modules are declared very valid based on the assessment of 3 validators. And the digital-based Interactive module is stated to be practical from the results of student responses to ecosystem materials to improve scientific attitudes and cognitive learning outcomes of students at SMA N 05 North Bengkulu.

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