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DEVELOPMENT OF SCIENCE MODULE BASED ON INQUIRY SCIENCE ISSUES TO IMPROVE STUDENTS' CRITICAL THINKING SKILLS

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Abstract

This study aims to 1) know how to develop modules, 2) know the feasibility of the module, and 3) know the effectiveness of the IPA module with an approach of Inquiry Science Issues on Climate Change Materials to improve the critical thinking skills of students in grade VII junior high school. The development model used in this study is ADDIE (Analysis, Design, Development, Implementation, and Evaluation). Data collection techniques using observation methods, interviews, as well as documentation. Quantitative analysis techniques for analyzing data have been validated by experts and module assessments by practitioners and students. In contrast, the analysis of qualitative descriptive data to analyze the resulting module data. The results of the study concluded that 1) Modules developed based on the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation) with inquiry science issues that use critical thinking indicators. 2) Module eligibility in terms of validation results Material Expert Module got the same result of 90.27% with categories Excellent, media expert validation of 89.06% and 88.43% respectively with excellent category, practitioner ratings of 88.33% and 87.91% respectively with excellent categories, student ratings of 81.05% with very categories good. 3) The effectiveness of the module analyzed using the N-gain test obtained a result of 0.5014; 0.3 g ≤ ≤ 0.7, so the module is said to be effective with a moderate category.

Keywords: Science, module, inquiry science issues, critical thinking

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INTRODUCTION

Education is a process that an individual must go through to develop his or her abilities which include skills, cognitive or knowledge, and character to become a quality person (Khoirunnisa et al, 2020). Quality education is needed to realize the formation of a quality person. Quality education can be achieved through the role of professional teachers and the role of active and critical learners in the learning process (Lubis, 2022).

In the learning process, the teacher has a learning design that is made and adapted to the applicable educational curriculum, namely the 2013 curriculum. Implementation of the 2013 curriculum in Indonesia requires students to be more active and think critically (Khoirunnisa et al, 2020). The 2013 curriculum requires students to gain individual and group learning experiences through a scientific approach, from observing to being able to communicate learning outcomes (Selviani, 2019). The junior high school education curriculum contains one of the science subjects. Science is a discipline that applies a scientific approach(Octavia, 2019).

As educators, one of the challenges faced by educators is the lack of teaching materials to support students during learning (Rezky et al., 2020). Based on the results of observations in schools, it was found that the available teaching materials had not maximized critical thinking skills. So, to improve the quality of learning, it is also necessary to develop media or teaching materials so that the teaching and learning process is more effective and efficient.

The teaching materials themselves consist of a variety of learning resources. Teaching materials are a collection of materials that are packaged and written systematically in the form of printed media or non-printed media that can be applied in the teaching and learning process (Jamaluddin, 2017). Teachers or students use teaching materials as a reference in achieving competency in learning. This statement is supported by research conducted by (Indrawini et al., 2017) that the existence of teaching materials plays an important role in achieving student competence. One of the teaching materials is a module (Puspita, 2019). The module is a structured teaching material that is structured and designed in a language that is easily understood by students and is adjusted based on the level of knowledge and age so that students can learn individually under the supervision of a teacher (Prastowo, 2014). Using the module has several advantages and disadvantages. The advantages of modules in learning include (Rahayuningsih, 2018): 1) Provide immediate and continuous feedback. Feedback. This requires students to know the extent of their understanding. As for the teacher to find out how the effectiveness of the module in learning. 2) The suitability of the module with the ability of individual students can be adjusted by providing flexibility about form, speed of learning, or study materials. 3) Provide more practice questions for students to overcome deficiencies in understanding. 4) The module provides a little learning material and then immediately gives it an assessment so as to enable the provision of formative tests for students.

Inquiry learning is learning which uses all student resources to systematically research logically, analytically, and critically to inform students about their findings (Ahmadi et al., 2011). While, issues are problems that are put forward (to be responded to and so on). While, science is none other than Natural Sciences (IPA). So, inquiry science issues are a learning approach that presents science problems in an inquiry approach; therefore, the learning steps are modifications of the learning steps with an inquiry approach (Palupi, 2017). The inquiry science issues-based learning module is a module that investigates a science issue or problem in everyday life using an approach (Fatimah et al., 2017).

Critical thinking is one of the skills needed in 21st-century learning (Arnyana, 2019). Critical thinking skills are also needed because critical thinking is a capital for students to develop their knowledge widely. According to Fachrurrazi (2011), critical thinking is a process that provides opportunities for students to design and evaluate the problems they face. Based on the statement above, it is necessary to develop a module based on inquiry science issues on climate change material, so this research is entitled Development of a Science Module Based on Inquiry Science Issues to Improve Students' Critical Thinking Skills. The purpose of this study was to determine the development of the ISI-based science module, determine the feasibility of the module, and determine the effectiveness of the ISI-based science module in grade VII SMP on climate change material.

METHOD

Research design

This research is a research and development research using the ADDIE model (analysis, design, development, implementation, evaluation) by Robert Maribe Branch in Sugiyono (2019). However, this research was only carried out until development.

Research Target

The research subjects were 51 grade 7 students in junior high school. The research was conducted in January-October 2022 at SMP IT Logaritma, Karanganyar.

Data Collection and Analysis Techniques

Data collection techniques are carried out by interviewing to identify the problem to be studied through the interview data collection process, which is located in the preliminary study. Student response questionnaires collect data by asking statements or questions so that answers are obtained from respondents, and documentation for data collection purposes in the form of photos, videos, sound recordings, and documents during the research.

Technical analysis of the data in this study was carried out with quantitative and descriptive qualitative analysis to analyze data that had been validated by two experts in the field of learning media and module development, module assessments by practitioners, module assessments by students, and effectiveness test using the T-test and N-gain score.

RESULTS AND DISCUSSION

1. Development Stage
   a. Needs analysis

The needs analysis stage is carried out to find out the learning problems that exist in schools and the hope that they can overcome the problems that occur in schools. The needs analysis stage consists of 2 stages, namely preliminary analysis and module design. The preliminary analysis was conducted by interviewing two teachers and five students at SMPIT Logarithma offline (outside the network) and online (in the network) via WhatsApp. Interviews were conducted to evaluate the implementation of learning and the availability of teaching materials in schools.

Based on the results of interviews with teachers and students in the field, it was found a problem that the learning media available in schools were only textbooks and worksheets, which according to students, there were still some shortcomings. Teachers and students think that it is necessary to develop modules that can facilitate teaching and learning activities. Besides that, students are also more interested in learning that exposes them to problems that occur in real life. Therefore, innovation is needed, namely the development of a module based on inquiry science issues that can assist teachers in providing additional learning resources and assist students in improving critical thinking skills.

Based on the results of interviews with teachers and students, it was found that the inquiry science issues-based learning module needs to be developed because it can help students in facilitating learning and teaching activities. The module can be obtained by students in the form of soft files (PDF/Portable Document Format), which can be accessed anytime and anywhere so that students' gadgets are more useful. The module can also be obtained by students in hard files if students do not have a gadget.

b. Design analysis

The next stage after carrying out the needs analysis stage is designing modules to be developed. The module is divided into three parts, viz introduction, body, and closing section. Module writing uses several model fonts and colors so that they are not monotonous and can attract students' attention so they do not get bored during the lesson. The design stage is the activity of designing products according to what is needed (Sugiyono, 2019). module to be compiled contains climate change material in class VII at KD 3.9. The approach used in the module is an inquiry science issues approach that aims to improve critical thinking skills in students.

c. Generated module

The resulting module consists of three layouts, namely introduction, content, and closing. The introductory or opening page consists of a module cover, module identity, introduction, table of contents, module usage guide, concept map, and learning objectives. The content page consists of let's practice, subject matter, activities, competency tests, inspirational figures, and practice writing essays. While, the closing of the module includes a summary, answer key, and bibliography.

The cover page is a page that describes the material and the module approach. The module identity is a page that describes the module label. The foreword is a page that describes the purpose of compiling the module and the approach used succinctly. The table of contents is a page that aims to make it easier for users to find the page they want to study. Instructions for using the module are a page that provides information to users about the activities contained in the module. A concept map is a part that provides an overview of the concept of the material to be studied. Learning objectives are a page that provides information to students about the objectives in learning to be achieved.

The learning material is climate change material in KD 3.9, which includes the greenhouse effect, definition, causes, impacts, and efforts to overcome global warming. Let's

practice is the initial activity in the module before students enter the material. A competency test is an activity at the end of the material that contains practice questions to determine students' abilities. Activities are simple and practical activities that are carried out by students. Inspirational figures are pages that provide students with a source of insight about figures who play a role in the discovery of global marketing. Practice writing essays is an activity that aims to train students' writing and analysis skills.

A summary is a page that contains a summary of the material that has been contained in the module. The answer key is a page that contains answers from the let's practice and competency test activities. The bibliography is a page that contains a list of references used in developing the module.

2. Module Feasibility Test

The feasibility of the module was tested using the validity test of material experts and media experts, module assessment by practitioners, and module assessment by students during a limited trial. The following table a. Material Expert Validation Test.

Table 1. Material Expert Validation Test

Aspect	Score		Category
	V1	V2	
Content quality	100%	91.66%	Very good
Inquiry Science Issues	100%	79.16%	Well
Critical thinking skills	70.83%	100%	Well
Average	90.27%	90.27%	Very good

Note:: V1=Validator 1; V2=Validator 2

Based on Table 1. the results show that the content quality aspect by validator I got a score of 100% and validator II was 91.66% with a very good category. Aspects of Inquiry Science Issues by validator I obtained a score of 100% and validator II of 79.16% with a good category and suitable for use after revision. While the aspect of thinking skills critical by validator I obtained a score of 70.83% and validator II of 100% with good categories. The average validation results of the two validators obtained the same score of 90.27% with a very good category and the module was feasible to use. Media expert validation results obtained from calculations using the formula: Score = (score obtained / max score) x 100%

b. Media Expert Validation Test

Table 2. Media Expert Validation Test

Aspect	Score		Category
	V1	V2	
Language	100%	100%	Very good
Display/layout	100%	85 %	Very good
Presentation technique	81.25%	93.75%	Very good
Attention to the code of ethics and copyright	75%	75%	Well
Average	89.06%	88.43%	Very good

Note:: V1=Validator 1; V2=Validator 2

Based on Table 2, the results obtained that the language aspect by validator I and validator II obtained a score of 100% with a very good category. Aspects of appearance or layout get a score of 100% by validator I and 85% by validator II with a very good category. In the aspect of presentation technique, validator I obtained a score of 81.25% and 93.75% by validator II, with a very good category. While on the aspect of attention, the code of ethics and copyright obtained 75% results by both validators with good categories and suitable for use after revision. The average validation result of validator I am 89.06% and validator II is 88.43%, with a very good category and feasible to use. Media expert validation results were obtained from calculations using the formula: Score = (score obtained / max score) x 100%.

c. Practitioner's Assessment

Table 3. Practitioner's Assessment

Aspect	Score		Category
	P1	P2	
Attractiveness	91.66%	88.33%	Very good
Suitability	75%	95%	Very good
Usability	87.5%	81.25%	Very good
Inquiry science issues	87.5%	100%	Very good
Critical thinking	100%	75%	Very good
Average	88.33%	87.91%	Very good

Note: P1=Practitioner 1; P2=Practitioner2

Based on Table 3. it is found that the attractiveness aspect scores 91.66% by practitioner I and 88.33% by practitioner II with a very good category. The suitability aspect obtained 75% results by practitioner I and 95% by practitioner II with a very good category. The usability aspect obtained results of 87.5% by practitioner I and 81.25% by practitioner II in the very good category. Aspects of inquiry science issues obtained results of 85.7% by practitioner I and 100% by practitioner II with a very good category. Meanwhile, the critical thinking aspect obtained 100% results by practitioner I and 75% by practitioner II with a very good category. The average result of the assessment by practitioner I was 88.33% and practitioner II was 87.91%, with a very good category and the module was feasible to use. The results of the assessment by practitioners are obtained from calculations using formulas: Score = (score obtained / max score) x 100%.

d. Student Assessment

The module assessment by students was carried out during a limited trial of 10 students. The results of the module assessment by students obtained results with a sufficient category of 1 student with a score of 72.2%. While, the good category was obtained from 7 students with each score of 79.1%, 80.5%, 79.1%, 80.5%, 79.1%, 79.1%, and 77.7%. In the very good category, it was obtained from 2 other students with scores of 88.8% and 94.4%, respectively. The average result of the module assessment by students is 81.05% with a very good category and the module is feasible to use.

3. Module Effectiveness Test

The results of the Independent Samples T-test showed results of 0.017 <0.05. These results state that there is a significant difference between critical thinking skills in terms of cognitive learning outcomes in the experimental class and the control class. The difference is caused by the high difference in the range of pretest and posttest scores in the two classes. After testing the Independent Samples T-test, the next step is to test the Normalized Gain (N-gain) Score to determine the effectiveness of the module.

Table 4. T-test and N-gain test results

No	Class	T-test	Average N-gain
1.	Experiment	0,017	0,5014
2.	Control		0,3278

The results of the N-gain test show that the N-gain value in the experimental class is g = 0.5, 0.3 < g < 0.7. These results state that the learning module applied to the experimental class has been effective in the medium category. While in the control class, the value of N-gain score of 0.3, g < 0.3, which means learning in the control class has low effectiveness. The N-gain value in the experimental class was higher and obtained a medium category, so the module could be said to be effective. These results were obtained by quantitative analysis using the SPSS 25 application.

This is in accordance with the theory of White et.al. (2011) that students can improve critical thinking skills by applying learning that is student-centered, one of which is inquiry learning. In inquiry-based learning activities, students do a scientific experiment, and the teacher instructs them to act as researchers in a formal research environment. In this case, students must be able to identify the system and identify the dependent and independent variables, including control and treatment variables. Therefore, the learning process is centered on students, and the teacher acts as a facilitator and mediator (Wenning, 2011, p.5).

CONCLUSIONS AND SUGGESTIONS

Conclusion

The science module on climate change material was developed based on the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model with the inquiry science issues

stage using critical thinking indicators. The feasibility of the module in terms of the validation results by material experts, both validators are the same, namely 90.27% with a very good category. The feasibility of the module in terms of the results of the validation of the media experts of the two validators are 89.06% and 88.43%, respectively, in the very good category. The feasibility of the module in terms of the results of the assessment of the two practitioners, namely 88.33% and 87.91%, respectively, with a very good category. Meanwhile, if viewed from the student's assessment or limited trial of 81.05% with a very good category. The effectiveness of the module in terms of the results of the pretest and posttest analyzed using the N-gain test. The experimental class g value was 0.5014; $0.3 < g < 0.7$, so the module is said to be effective in the medium category.

The implications of this study are learning using the IPA module with an inquiry science issues approach can be applied to climate change material. Science modules with an inquiry science issues approach can be used as an alternative to developing modules or learning media. Practicum activities regarding the greenhouse effect and global warming that occur in everyday life can help students understand the concept of climate change.

Suggestions

1. For Teachers
   Teachers are expected to be able to apply the modules that have been developed as additional references in learning so that students can have new learning experiences.
2. For School
   Schools are expected to be able to facilitate teaching and learning needs by following per under the development of science and technology to improve the quality of education.
3. For Other Researchers
   Future researchers are expected to develop more interactive modules.

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