



Guided Discovery-Based Module Development on Disaster Mitigation Materials to Improve Student's Critical Thinking Ability of 11th Grade Students at SMA Negeri 5 Surakarta Indonesia

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Abstract

Guided Discovery learning module provides opportunities for students to improve optimal learning activities, appropriate with the level of ability and progress of students during the learning process. The purpose of this research is to examine the need for guided discovery-based modules, to develop modules with guided discovery characteristics, to test the feasibility of guided discovery-based modules, and to test the effectiveness of guided discovery-based modules on disaster mitigation materials in order to improve critical thinking skills of 11TH grade students of SMA Negeri 5 Surakarta. This research is a research and development which aim at developing a Geography module based on guided discovery learning model on respiratory system material. In short, based on the results of the analysis that has been done, it shows that the use of guided discovery-based module on disaster mitigation materials is more effective in improving student's critical thinking skills. The result of this research in line with the statement of Arjunan (2012), which states that learning that involves guided discovery activities can generate student interest in the lesson, increase their ability to pose problems and improve their learning ability. Similarly, Gholamian (2013), stated that guided discovery is an instrument to develop and strengthen critical thinking skills. Guided discovery is also meaningful for teaching critical thinking skills and many students need an early structure of steps in learning that provide students with critical thinking.

Keywords: *Module; Guided Discovery; Critical Thinking Ability; Guided Discovery-Based Module*

Introduction

Disaster mitigation is a material related to everyday life problems. However, many disaster mitigation materials have abstract concepts. Therefore, the learning must begin from the related facts that are often faced by students. Taking into account these various conditions, the Guided Discovery model is an appropriate model for developing student's critical thinking skills.

Discovery learning model is a learning model that regulates the teaching of students to acquire knowledge that students do not know without being told, some or all of the knowledge is discovered by

the students themselves. The discovery learning activities are designed in order to make the students can discover concepts and principles through their own mental processes. (Herdian, 2010)

The guided discovery model emphasizes the discovery of previously unknown concepts or principles. The guided discovery model trains students to find concepts for themselves by providing problems that students must solve through a critical analytical thinking process. Applying the guided discovery model, the teacher acts as a mentor by providing opportunities for students to learn actively, the teacher guides and directs student learning activities based on the objectives.

The guided discovery learning model has the advantage which can help students to improve their cognitive processes and skill. The knowledge which is gained through this model is very personal. It also strengthens student's understanding and creates a sense of pleasure in students because it raises a sense of investigating and a sense of finding concepts.

The module has the characteristics of self-instruction, self-contained, stand-alone, adaptive, and user friendly. The advantages of the module focus on students' individual abilities, empower themselves in learning, develop students' abilities in interacting directly with the environment and learning resources, so that they can learn independently according to the speed of thinking of each student.

The development of guided discovery-based modules on disaster mitigation materials consists of a student module and a teacher module. The two products are developed in the form of printed media containing the main material for disaster mitigation for 11th grade of SMA/MA (High School). The activities in the module are packaged in stimulating activities, giving phenomena, giving problems, planning activities, presenting and structuring exercises related to materials that allow students to develop their critical thinking skills.

Disaster mitigation material presented in the form of a Guided Discovery-based module is expected to encourage students to learn through practical problems based on facts in everyday life, which are related to the subject matter as a context for students to learn about problem-solving skills, as well as to acquire knowledge and essential concepts of the subject matter. Students who are accustomed to being involved in problem-solving activities will sharpen their critical thinking skills. Students are trained to identify problems and to find solutions based on their own understanding, therefore, they could practice to build their thinking skills independently. Students know how to find data and sources of information needed in order to solve problems and find solutions of their problems. Learning using this module provides opportunities for students to increase optimal learning activities, according to the level of ability and progress obtained by students during the process.

Glaser in Fisher (1994:3) defines critical thinking as: (1) an attitude of being disposed to consider in a thoughtful way the problems and subjects that come within the range of one's experience; (2) knowledge of the methods of logical enquiry and reasoning; and (3) some skills in applying those methods. Critical thinking requires a great effort to examine each belief or assumptive knowledge based on the supporting evidence and the further conclusions that result.

Indicators of critical thinking skills derived from critical activity no. 1 is able to formulate the main points of the problem. Indicator derived from critical activity no. 3, 4, and 7 are able to reveal the facts needed in solving a problem. Indicator derived from critical activity no. 2, 6, and 12 are able to choose logical, relevant and accurate arguments. Indicator derived from critical activity no. 8, 10 and 11 are capable of detecting bias based on different point of views. Indicator derived from critical activity no. 5 and 9 are able to determine the consequences of a statement taken as a decision.

Conceptual Framework

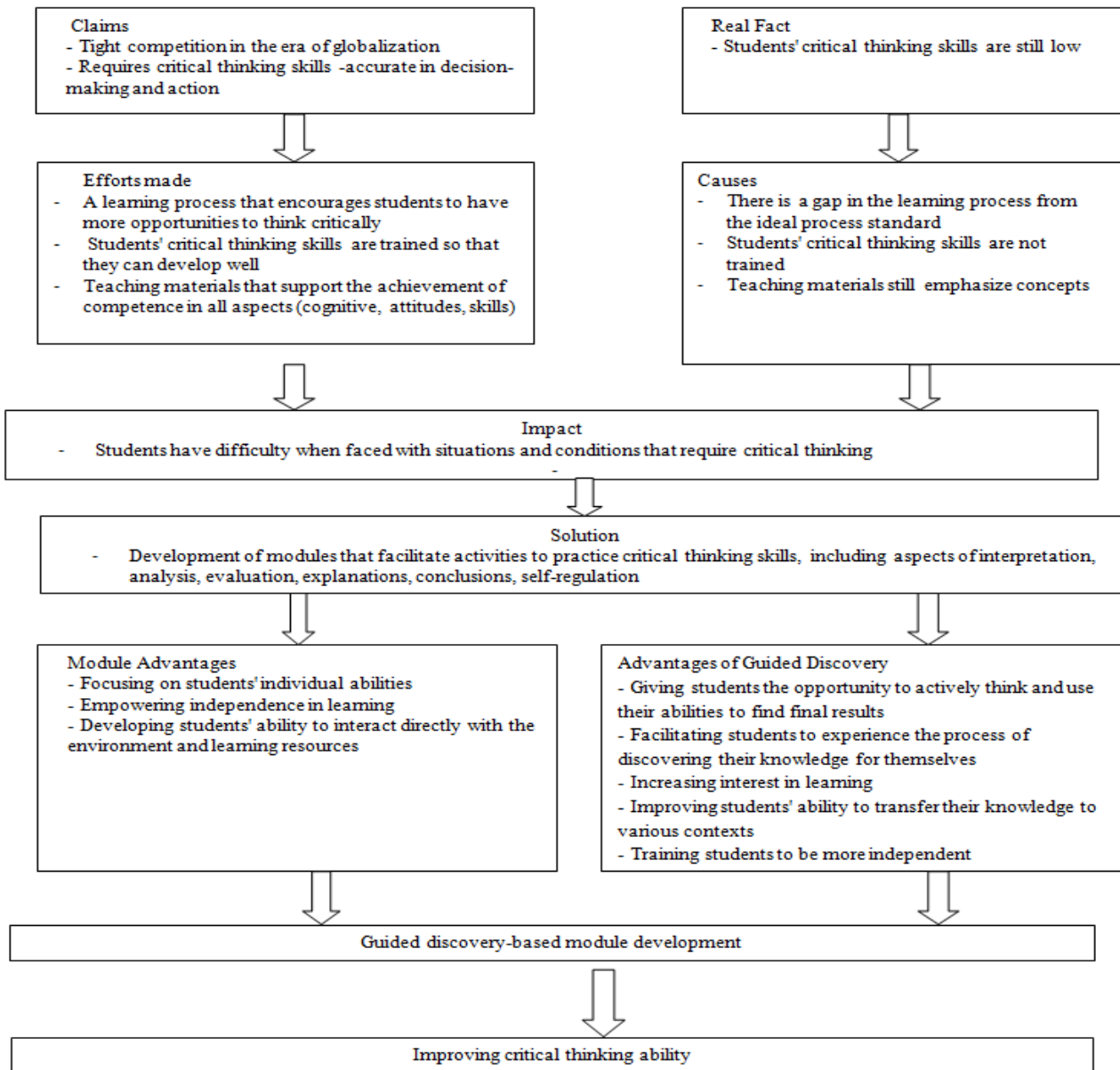


Figure 1.1 The Conceptual Framework

Research Method

1. Model Development

This research is research and development which aim at developing a Geography module based on guided discovery learning model on respiratory system material. The development is conducted using a procedural model by adapting the Borg and Gall development model.

2. Research Procedure

The research steps use with the workflow on the R&D method by Borg & Gall (1983) in Suyono & Hariyanto, (2017). The R&D method steps are research and information collecting, planning, primary form of product developing (primary draft), operational field testing.

The results of the expert validation test that are analyzed are descriptive qualitative for opinions and suggestions data and descriptive quantitative for analysis of the assessment scores of each expert with the following formula:

$$P = \frac{\sum Xi}{\sum X} \times 100\%$$

Description:

P = Rating Percentage

$\sum Xi$ = Number of answers from validator

$\sum X$ = Highest number of answers

How to calculate the percentage of the overall subject/component according to Suwastono (2011) used the formula:

$$P = \frac{\sum p}{n}$$

Description:

$\sum p$ = Total percentage of all components

N = How many components

The results of the calculation of the percentage of all components in order to give meaning and decision-making, it is used determination, as shown in table 3.1

Table 3.1. The Revision of Decision-Making

Achievement Level (Mark Range)	Qualification	Description
81-100	Excellent	No Revision is needed
61-80	Good	No Revision is needed
41-60	Sufficient	Revision is needed
21-40	Insufficient	Revision is needed
0-20	Very Insufficient	Revision is needed

The improvement of student's critical thinking skills is reviewed based on the N-gain comparison, as follow;

$$N-gain = \frac{S_{post} - S_{pre}}{S_{max} - S_{pre}}$$

Description:

N-gain = average normalized gain

\bar{S}_{post} = postscore class averages

\bar{S}_{pre} = prescore class average

\bar{S}_{max} = maximum score

Table 3.3 N-gain Criteria

N-gain	Criteria
$g \geq 0,7$	High
$0,7 > g > 0,3$	Medium
$g \leq 0,3$	Low

Discussion

1. Research and Information Collecting

The data result of preliminary study stage can be seen in Table 4.1

Table 4.1 The Result of Preliminary Study Stage

Stage	Activity	Result
Preliminary Study	Mapping of eight National Education standards	From eight national education standards is mapped, the process standard (standard 2) with a gap score of 4, 27% is the biggest contributor to the gap score from the ideal score.
	Analyzing the material from the average acquisition score	From the indicators of the level of student mastery on disaster mitigation materials, the percentage of student mastery is 62.70%
	Giving necessity analysis questionnaires to teachers	Teachers want modules that are interesting, easy to understand, train thinking skills, train students' independence in learning, material that is more complete than existing teaching materials and the time allocation for implementation can be in accordance with the syllabus.
	Giving necessity analysis questionnaires to students	Based on the analysis of student's necessity questionnaire, information is obtained that the teaching materials used are less attractive, less able to stimulate curiosity and further thinking, the materials is difficult to understand and there is a few activities to support learning activation

Source: Appendix 1 to appendix 4.

Preliminary studies are also conducted by analyzing the preliminary profile test of critical thinking skills using material that had been taught by the teacher and the results are obtained as shown in Table 4.2 and the complete data are in Appendix 5.

Table 4.2 The Results of Preliminary Profile Test Analysis of Critical Thinking Ability

11 TH Grade SMAN 5 Surakarta		
Critical Thinking Aspect	Score Test %	Criteria
Interpretation	58,47%	Sufficient
Analysis	58,18%	Sufficient
Evaluation	61,67%	Sufficient
Conclusion	42,16%	Very Insufficient
Explanation	44,23%	Very Insufficient
Self-Regulation	25,77%	Very Insufficient

Analysis of the need for teaching materials used in schools using critical thinking indicators in Disaster Mitigation materials, it shows that, the average fulfillment of critical thinking aspects for teaching materials 1 is 41.79% and for teaching materials 2 is 34.02%, as presented in table 4.3. The complete data can be found in Appendix 7.

Table 4.3 The Analysis of Printed Teaching Materials at SMA Negeri 5 Surakarta

Using Critical Thinking Indicators		
Critical Thinking Aspect	Teaching Materials 1 (%)	Teaching Materials 2 (%)
Interpretation	50	52,5
Analysis	63,45	57,68
Evaluation	48,07	44,22
Conclusion	40,9	38,63
Explanation	44,44	11,11
Self-Regulation	3,85	0
Average	41,78	34,02

Based on the data of a preliminary study which is conducted at SMA Negeri 5 Surakarta, it shows the fulfillment of learning process standards has not been maximized, the potential of teaching materials available in schools in attracting students' interest in learning and in developing student's critical thinking skills through analysis of the fulfillment of aspects of critical thinking skills is still low, and the critical thinking skills that are analyzed based on the results of tests given to students is low.

2. Planning

Table 4.4 Module Matrix Based on Guided Discovery on Disaster Mitigation Materials

Learning Syntax of Guided Discovery	of	Learning Stage	Material	Module Activity	Student Activity	Potential Towards Thinking	Activity Critical
Phase Stimulant	1	Observing	Type and characteristic of natural disasters	Indonesia is prone to disasters. One of the contributing factors is geological conditions. Geologically, the territory of Indonesia is located on the border of the collision of tectonic plates which is the epicenter zone of the earthquake. Earthquakes often cause tsunamis. Earthquakes and tsunamis occur side by side and often cause natural disasters. Disasters can cause property losses, human casualties, and psychological impacts. We will observe more about the types of disasters, open the video link below, look at the types of disasters, and disaster-prone areas in Indonesia!	Students observe the video presented	The purpose of presenting the video is to provide a stimulus to students about the initial concepts related to the learning to be carried out. Students are expected to be able to interpret by understanding the geological conditions of Indonesia and their impact on disasters that often occur in Indonesia	

Phase 2 Problem Identification	Asking		<p>1. Make a question related to the picture presented!</p>  <p>2. Analyze the questions that arise and make the existing hypotheses</p>	<p>1. Students in groups discuss to identify the picture and make questions related to the picture presented</p> <p>2. Students analyze and exchange questions, and make hypotheses on existing questions</p>	Students are expected to come up with questions that can arouse curiosity to analyze this and make hypotheses on the existing questions
Phase 3 Data Collecting	Collecting Data		Analyze the map of disaster-prone areas in Indonesia	Students discuss with their friends in a group, with the guidance of the teacher	It is expected that students strengthen analytical skills by managing information through discussion and looking for references to complement the media that will be their presentation.
Phase 4 Data Processing	Associating		Conduct analysis and group discussions to answer questions that arise relating to subject	Students conduct analysis and group discussion	It is expected that students conduct evaluations and examinations carefully to prove whether or not the hypotheses previously set with alternative findings are related to the results of data processing.
Phase 5 Verification			Write down the results of your group's analysis and discussion	Each student writes down the results of the analysis and discussion in his group	
Phase 6 Module development conclusion	Communicat ing		Present the results of your group discussion!	Students make presentations, then conclude the results of their work	The purpose of the presentation is to monitor the concepts that have been obtained by students, improve, and strengthen the concepts students have built during the discussion. Through presentation activities students make conclusions and provide explanations for important things related to concepts that must be mastered.
			Answer the following questions to test your learning achievement.	Students answer the evaluation questions.	The purpose of student evaluation activities is to find out deficiencies in learning that need to be improved. By assessing their own abilities, students are expected to be able to develop self-regulation to improve further learning.

3. Primary Product Design (Primary Draft)

At the primary form of product developing stage, a guided discovery-based module is created on Disaster Mitigation material. The development of the early-stage module is conducted by referring to planning objectives, sub-topics, guided discovery learning models, formats and visualization of module contents, formats of learning tools and procedures related to module development.

The primary product design of the guided discovery-based module is developed based on a grid of indicators on a matrix that is adapted with the guided discovery syntax which trains aspects of critical thinking skills.

4. Preliminary Field Trial Test

a. The results of the student module product validation

1) Material Validation

The results of the complete student module material validation can be found in Appendix 11, and briefly presented in table 4.5

Table 4.5 The Validation of Material Aspect

Rated aspect	Percentage of Module Average Score (%)	Qualification	Category
Material accuracy	100.00	Excellent	No Revision is needed
Up-to-date material	100.00	Excellent	No Revision is needed
The development of thinking ability skills material	100.00	Excellent	No Revision is needed
Scientific systematics material	75.00	Good	No Revision is needed
Basic material concept	100.00	Excellent	No Revision is needed
Sub-topic concept	100.00	Excellent	No Revision is needed
Visual Concept	100.00	Excellent	No Revision is needed
Systematics of material delivery	75.00	Good	No Revision is needed
Materials that improve critical thinking skills	100.00	Excellent	No Revision is needed
Relevant with everyday life	100.00	Excellent	No Revision is needed
Average	95.00	Excellent	No Revision is needed

Based on Table 4.5, the average of all aspects of material assessment by experts is 95.00% with excellent qualifications. It means that the material presented in the student module has been suitable the criteria and is eligible to continue with a limited field test.

2) The Validation of Module Development

The complete validation results of student module development can be found in Appendix 11 and briefly presented in Table 4.6

Table 4.6 The Validation of Module Development Aspects

Rated Aspect	Percentage of Module Average Score (%)	Qualification	Category
General presentation organizing	87.50	Excellent	No Revision is needed
Syntax model presentation	83.33	Excellent	No Revision is needed
Considerations of meaning and usefulness presentation	100.00	Excellent	No Revision is needed
Active student involvement	100.00	Excellent	No Revision is needed
General view	75.00	Good	No Revision is needed
The way information delivery variation	100.00	Excellent	No Revision is needed
Anatomy textbook	100.00	Excellent	No Revision is needed
Code of ethics and copyright attention	100.00	Excellent	No Revision is needed
Average	93.23	Excellent	No Revision is needed

Based on Table 4.6, it shows that the average of all aspects of module development by experts is 93, 26% with excellent qualifications. It means that student module development has fulfilled with the criteria and is eligible to be continued with limited field tests.

3) The Validation of Learning Instrument

Validation of learning instrument validates learning instruments from the syllabus, lesson plans, assessments to evaluation questions. This validation is to obtain data in the form of assessments, opinions, and suggestions on the suitability of the learning process, assessment and activities that support learning using the developed module. The results of the complete validation of the learning device aspects can be found in Appendix 11 and briefly presented in Table 4.7 below:

Table 4.7 Validation of Learning Instrument Aspects

Rated Aspect	Percentage of Module Average Score (%)	Qualification	Category
Teaching material	100.00	Excellent	No Revision is needed
Learning process	100.00	Excellent	No Revision is needed
Syntax learning guided discovery model	88.00	Excellent	No Revision is needed
Support learning activity	81.00	Excellent	No Revision is needed
Student's competence improvement material	90.00	Excellent	No Revision is needed
Critical thinking aspect	75.00	Good	No Revision is needed
Average	89.00	Excellent	No Revision is needed

Based on Table 4.7, it is known that the average of all aspects of the assessment of learning instrument by experts is 90.57% with excellent qualification. It means that, the learning instrument presented in the student module has fulfilled the criteria and is eligible to continue with limited field tests.

Readability

4) The Validation of Readability

Validation of readability aims to obtain data in the form of assessments, opinions, and suggestions on the accuracy of language and readability of module content. The results of the complete student module readability are contained in Appendix 11 and briefly presented in table 4.8

Table 4.8 The Aspect Validation of Readability

Rated Aspect	Percentage of Module Score (%)	Average	Qualification	Category
The right and correct of Bahasa Indonesia	75.00		Good	No Revision is needed
Terminology	100.00		Excellent	No Revision is needed
Language Clarity	100.00		Excellent	No Revision is needed
Language Compatibility	100.00		Excellent	No Revision is needed
Average	93.75		Excellent	No Revision is needed

Based on Table 4.8, It is clearly seen that, the average of all aspects of readability is 93.75% with excellent qualifications. It means that the language accuracy and readability of the student module content has fulfilled with the criteria and are eligible to continue with limited field tests.

b. The Result of Teacher Module Product Validation

The material expert validation of the teacher module is conducted by the material expert validation results are presented in Appendix 12 and briefly presented in Table 4.9

Table 4.9 The Validation of Material Aspect

Rated Aspect	Percentage of Module Average Score (%)	Qualification	Category
Material accuracy	100.00	Excellent	No Revision is needed
Up-to-date material	100.00	Excellent	No Revision is needed
The development of thinking ability skills material	100.00	Excellent	No Revision is needed
Scientific systematics material	75.00	Good	No Revision is needed
Basic material concept	100.00	Excellent	No Revision is needed
Sub-topic concept	100.00	Excellent	No Revision is needed
Visual concept	100.00	Excellent	No Revision is needed
Systematics of material delivery	75.00	Good	No Revision is needed
Materials that improve critical thinking skills	100.00	Excellent	No Revision is needed
Relevant with everyday life	100.00	Excellent	No Revision is needed
Average	95.00	Excellent	No Revision is needed

Based on Table 4.9, it can be seen that, the average of all aspects of material assessment by experts is 95.00% with excellent qualifications. It means that, the material presented in the teacher module has fulfilled the criteria and is eligible to continue with limited field tests.

5. The Revision Preliminary Product

In order to improve the preliminary product of the guided discovery-based module, product revisions are conducted on the material, module development, learning instrument and readability. Each revision is for the student and the teacher module. The suggestions given in Appendix 13 and those are presented briefly in the following table 4.13:

Table 4.13 Result of Revision and Recommendation

No.	Validator		Recommendation		Revision
1.	Material	a.	Addition of general understanding of mitigation material	a.	Addition of the meaning of mitigation material in general
		b.	Correction of sentence redaction in certain parts	b.	Editorial in some parts of the module fixed
2.	Module Development	a.	The less consistent in using word "kalian"	a.	The use of pronoun for student is revised so that it becomes consistent.
		b.	The less of spacing setting in the information of Geography at chapter	b.	Fixed spacing.
		c.	The use of "proses" terminology in the stimulant picture is less acceptable	c.	The use of "proses" terminology is replaced into "gejala"
		d.	The unity of the image layout and its description	d.	Image layout settings and captions are on one page
3.	Learning instrument	a.	The use of source learning and textbook terminology	a.	Revised based on recommendation
4.	Readability	a.	The book writing has to be appropriate with EYD (Bahasa Indonesia Improved Spelling)	a.	The book writing is revised according to EYD (Bahasa Indonesia Improved Spelling)

6. The Test of Limited Field

a. The Validation of Education by Practitioner

The validation by educational practitioners is conducted by the Chair of the Surakarta City MGMP (Subject Teacher Associations) and two geography teachers at SMA Negeri 5 Surakarta which aims to obtain qualitative data in the form of opinions, criticisms and suggestions on the presentation, learning materials, evaluation questions, module content, module display, language accuracy and legibility, depth of material and the suitability of guided discovery-based modules on Disaster Mitigation materials. The complete validation results can be found in Appendix 14 and briefly presented in Table 4.14

Table 4.14 The Validation of Education by Practitioner

No.	Aspect	Presentation Score (%)			Qualification
		Practitioner 1	Practitioner 2	Average	
1.	Module Development	97.92	100	98.96	Excellent
2.	Learning Material	98.12	100	99.06	Excellent
3.	Readability	93.75	100	96.88	Excellent
	Average			98.30	Excellent

Based on table 4.14 the result of the assessment of education practitioners 1 on the aspect of module development 97.92% is excellent qualified. Aspects of learning materials obtained a score of 98, 12% with excellent qualification and readability aspects obtained 93.75% is also excellent qualified. The results of the assessment from practitioner 2 on the three aspects, from module development, learning materials to aspects of readability, each obtained a score of 100%. The average value of the overall aspects of the two educational practitioners is 98.29% with excellent qualifications. It means that, the module has fulfilled the criteria and is eligible to be continued in the next stage that is operational field testing, but it still needs some improvements based on the suggestions of the two practitioners.

a. Small Group Test

The small group test is conducted by 15 students of 11th grade IPS (Social Sciences) SMA Negeri 5 Surakarta which aims at collecting data related to the suitability of the content, presentation and readability of the developed module. The results of the complete assessment by students can be found in Appendix 15 and briefly presented in Table 4.15 below:

Table 4.15 The Assessment of Module by Student

Student	Aspect	Qualification	Description
1.	91.67	Excellent	No Revision is needed
2.	95.00	Excellent	No Revision is needed
3.	95.00	Excellent	No Revision is needed
4.	98.33	Excellent	No Revision is needed
5.	91.67	Excellent	No Revision is needed
6.	81.67	Excellent	No Revision is needed
7.	93.33	Excellent	No Revision is needed
8.	75.00	Good	No Revision is needed
9.	80.00	Excellent	No Revision is needed
10.	96.67	Excellent	No Revision is needed
11.	91.67	Excellent	No Revision is needed
12.	76.67	Good	No Revision is needed
13.	88.33	Excellent	No Revision is needed
14.	80.00	Good	No Revision is needed
15.	86.67	Excellent	No Revision is needed
Average	88.11	Excellent	No Revision is needed

Based on Table 4.15, it shows that, the results of trials conducted on students on a small scale obtained an average level of achievement in the range of 75.00% - 98.33% which indicates good and excellent qualifications. The average achievement of all aspects assessed by 15 students is 88.11% with excellent qualifications. It is also described that there is no need for revision. Based on the results of the product trial in the limited field test, it can be concluded that the guided discovery-based module does not need to be revised, but improvements are needed according to the suggestions of practitioners and students.

7. The Revision of Second Product

The second product revision is conducted based on the results of the validation of educational practitioners and the results of small group tests therefore, there are a lot of materials for consideration to improve the preliminary revised module product in order to make it more suitable for use in operational field tests (effectiveness tests). Suggestions given by practitioners are presented in table 4.16 as follows:

Table 4.16 The Result and Result Revision from Education Practitioners

No.	Validator	Suggestions	Revision
1.	Practitioner 1	Glossary doesn't exist yet	The Glossary has already existed
2.	Practitioner 2	a. There are only a few technical errors (printing) in the part of the image and the lack of word "sumber" and the frame is a little less large, so the writing is cut off b. Need to give a clear score on the post test	a. Revised based on suggestions b. Revised based on suggestions

Suggestions from practitioners are not carried out in their entirety due to time considerations. Scoring on all evaluation questions already exists in the teacher module. Based on the questionnaires that have been distributed and filled out by students in the limited field test, suggestions are also obtained. The results of the revision suggestions from students are presented in table 4.17 below:

Table 4.17 Suggestions and Revised Results from Students

No.	Suggestion	Revision
1.	In typing section, the space should be bigger, therefore, it does not look complicated.	-
2.	Many assignments make students think critically	-
3.	The concept map section, needs to be cleaned up	Improvements are made by tidying up the concept map section
4.	More questions and discussions	

Suggestions from students, additional questions and discussions are not carried out due to limited time. The typing space of module is wide enough, the tasks given are intended to train student's critical thinking skills so that it is in line with the purpose of using the module. The questions given has fulfilled with the designed indicators.

8. Operational Field Test

a. The Data of Guided Discovery Learning Model Syntax Implementation

Data on the implementation of the syntax of the guided discovery learning model are obtained based on the data of two observers during the learning process. The data on the implementation of the guided discovery syntax are obtained during the learning process for four meetings. Data on the implementation of guided discovery syntax during the learning process are presented in table 4.18 below:

Table 4.18 Syntax Implementation by Teacher

Learning Activity	% Meeting			
	I	II	III	IV
Stimulating	75.00	87.50	87.50	87.50
Problem Identifying	81.25	81.25	93.75	93.75
Data Collecting	81.25	87.50	87.50	93.75
Data Processing	75.00	87.50	93.75	93.75
Verifying	75.00	87.50	87.50	87.50
Concluding	87.50	87.50	93.75	93.75
Average	79.17	86.46	90.63	91.67

Table 4.18 shows that at each meeting the syntax implementation has increased. At the first meeting the average obtained from teacher activities was 80.00%, the second meeting was 86.25%, the third meeting was 91.25%, and the fourth meeting was 92.50%. Overall, the implementation of the syntax by the teacher is 87.50%. The complete data can be found in Appendix 17.

Tabel 4.19 The Syntax Implementation by Students

Learning Activity	% Meeting			
	I	II	III	IV
Stimulating	75.00	75.00	87.50	87.50
Problem identifying	87.50	81.25	87.50	93.75
Data collecting	81.25	87.50	93.75	93.75
Data processing	81.25	87.50	87.50	93.75
Verifying	75.00	87.50	87.50	87.50
Concluding	75.00	87.50	93.75	93.75
Average	79.17	84.38	89.58	91.67

Table 4.19 shows that at each meeting the syntax implementation has increased. At the first meeting the average obtained from student activities is 80.00%, the second meeting is 85.00%, the third meeting is 90.00%, and the fourth meeting is 92.50%. Overall, the implementation of the syntax by the students is 86.87%. Complete data can be found in Appendix 17

a. Descriptive Analysis of Pre-test and Post-Test scores 11TH Grade of IPS (Social Sciences) 3 and 4

Table 4.20 Descriptive Statistics of Pre-test and Post-test 11TH Grades of IPS 3 and IPS 4

Class	Score	Range	Minimum Score	Maximum Score	Mean
Module (11 TH Grade of IPS 3)	Pre-test	29.04	19.35	48.39	32.79
	Post-test	32.26	67.74	100.00	84.73
Control (11 TH Grade IPS 4)	Pre-test	38.71	19.35	58.06	35.05
	Post-test	35.48	61.29	96.77	79.35

Based on table 4.20 statistical descriptive data, the pre-test score of the module (11TH Grade of IPS 3) with the number of respondents 30 students, the average score is 32.79, the maximum score is 48.39 and the minimum score is 19.35, so the range is 29.04. The pre-test score for the control (11th Grade of IPS 4) obtained an average score of 35.05, a maximum of 58.06 and a minimum score of 19.35, so that the range is 38.71.

The descriptive post-test score obtains an average score of 84.73, a maximum score of 100.00 and a minimum score of 67.74, so that the range between is 32.26. The control class post-test score (11th Grade of IPS 4) obtains an average score of 79.35 with a maximum score of 96.77 and a minimum score of 61.29 so that the range is 35.48. These data indicate the average control class, but after learning the average score of the module class is higher than the control class. The complete statistical descriptive analysis of pre-test and post-test scores can be found in Appendix 18.

b. Critical Thinking Ability Analysis Test

Tabel 4.21 Summary of Normality and Homogeneity Critical Thinking Ability Test

Treatment	Test	Type of Tests	Result	Decision	Conclusion
Module (11 th Grade of IPS 3)	Normality	<i>Kolmogorov-Smirnov test</i>	<i>Sig pre-test</i> = 0,380	H ₀ accepted	Score is normally distributed
			<i>Sig post-test</i> = 0,122	H ₀ accepted	Score is normally distributed
Control (11 th Grade of IPS 4)	Normality	<i>Kolmogorov-Smirnov test</i>	<i>Sig pre-test</i> = 0,697	H ₀ accepted	Score is normally distributed
			<i>Sig post-test</i> = 0,442	H ₀ accepted	Score is normally distributed
Module class and Control class	Homogeneity	<i>Levene's test</i>	<i>Sig pre-test</i> = 0,342	H ₀ accepted	Score is normally distributed
			<i>Sig post-test</i> = 0,053	H ₀ accepted	Score is normally distributed

Based on Table 4.21 shows the normality test with the Kolmogrof-Smirnov type of test on the pre-test and post-test scores of critical thinking skills for the module class, the significance level is 0.380 for the pre-test and 0.122 for the post -test, while the control class has a higher significance level. greater than = 0.05 so that H₀ is accepted, which means the pre-test and post-test scores for the module class and control class are normally distributed. Homogeneity test with Levene's test type obtains a significance of 0.342 for the pre-test score and 0.053 for the post-test score, which shows a greater significance than = 0.05, so H₀ is accepted which means the variance of each sample is homogeneous. The prerequisite tests for normality and homogeneity are fulfilled, so that it can be continued with the Independent Samples T Test parametric test. The complete analysis of normality and homogeneity of pre-test scores is in Appendix 18.

c. Independent Sample T Test Critical Thinking Ability

Table 4.22 Summary of Statistical Analysis Test of Critical Thinking Ability

Score	Mean	Std. Deviation	Sig	Decision	Conclusion
<i>Pre-test</i> Modul class	32.79	6.29	0.286	H ₀ accepted	There is no difference in the pre-test scores between the module and control classes
<i>Pre-test</i> Control class	35.05	8.46		H ₀ accepted	
<i>Pre-test</i> Modul class	84.73	8.59	0.009	H ₀ accepted	There is a difference in post-test scores between the module and control classes
<i>Pre-test</i> Control class	79.35	6.81			

Based on the test results listed in Table 4.22 for the pre-test score obtains a significance score of $0.286 > 0.05$ then H_0 is accepted, which means there is no difference between the pre-test scores for the module class and the control class, while for the post-test the significance score is obtained. $0.009 < 0.05$ then H_0 is rejected, which means there is a significant difference in the post-test scores in the module class and control class. Statistical analysis of independent samples T Test of the complete pre-test and post-test scores can be found in Appendix 18.

The improvement of student's critical thinking skills is reviewed based on the N-gain comparison. Based on the calculations carried out, the results of the average increase in students' critical thinking skills after learning in the module class are higher than the control class. The average increase in the module class is 0.77 with high criteria, while in the control class the average increase is 0.68 with moderate criteria, as presented in Table 4.23, and the complete N-gain calculation is in Appendix 19.

Table 4.23 N-gain Scores of Critical Thinking Ability
Module and Control Class Students

Class	Minimum	Maximum	Average	Criteria
Module	0.52	1.00	0.76	High
Control	0.48	96.77	0.68	Medium

d. Supporting Data

Supporting Data is data in the form of student learning outcomes during the learning process and at the end of learning, learning outcomes refer to the 2022 Curriculum itself for four competencies including: spiritual competence, attitude competence, knowledge competence, and skill competence. Student learning outcomes are presented in Table 4.24

4.24 Data Score of Student's Knowledge, Attitudes and Skills

Aspect	Average			
	Cycle I	Cycle II	Cycle III	Cycle IV
Knowledge	84.67	86.73	90.17	97.87
Attitude	79.17	80.56	83.61	86.39
Skill	80.00	80.95	86.19	90.95

Based on Table 4.24, it can be explained that, student learning outcomes aspects of knowledge, attitudes, and skills using guided discovery-based modules have increased from cycle I to cycle IV. Complete data can be referred to in Appendix 20.

9. Final Product Revision

Final product revisions are made based on considerations after conducting field trials. The revision made a writing error.

Discussion

a. Characteristics of Guided Discovery-Based Geography Modules to Improve Critical Thinking Skills for 11th Grade Students of SMA Negeri 5 Surakarta.

Guided discovery-based modules on disaster mitigation materials are developed based on Borg and Gall's (1983) development procedures which are divided into 9 stages. The use of the module aims to

train students' critical thinking skills. The discovery-based module which is developed based on the results of the analysis of teaching materials used in schools shows that the contents (objectives, materials, activities, and evaluations) do not fulfill the 6 aspects of critical thinking that refer to Facione's opinion (2011) as a whole as presented in table 4.3. Therefore, it is necessary to develop teaching materials that support the fulfillment of 6 aspects of thinking. The module is chosen to be a solution for teaching materials that are packaged in a complete and systematic way that contains a series of experiences that are planned and designed to help students master more specific learning objectives (Daryanto, 2013). Guided discovery-based module product developed based on Basic Disaster Mitigation Competencies

Guided discovery-based modules provide opportunities for all students, both those with upper-level abilities and students with lower-level abilities, to jointly build concepts in learning, through the learning syntax that is the basis for developing this module. The module aims to train students' critical thinking skills and can bring positive impacts on their learning outcomes. Aspects of critical thinking skills that are trained refer to the opinion of Facione (2011) which includes aspects; 1) interpretation, 2) analysis, 3) evaluation, 4) inference, 5) explanation, 6) self regulation.

The characteristics of the module based on the guided discovery model begin with the provision of stimulation that can provide stimulants to students about the primary concepts related to the learning that to be carried out. Through the stimulus provided, students can interpret in the form of problem identification. It creates questions that can arouse curiosity, to analyze and make hypotheses on the questions at hand. The next step is to collect and process data, through these activities, students can strengthen their analytical skills by managing information through discussion and looking for references to complement the media that will be their presentation. Then students test the results by conducting evaluations and examinations carefully to prove the previously established hypothesis is true or not with alternative findings, by connecting the results of data processing. The results of all activities and discussions in groups will be presented, to monitor the concepts that have been obtained by students, improve, and strengthen the concepts that have been built during the discussion. Through presentation activities, students provide explanations and make conclusions about important things related to concepts that must be mastered.

The module development format refers to the module content format according to Mulyasa (2006), namely 1) the introduction; 2) learning objectives; 3) learning experience; 4) learning resources; and 5) final test. Systematically the content of the module prioritizes student activities which are given at the front of the module, then followed by a description of the material. It is intended that students become more active and effective in constructing their knowledge. Each sub-subject is made systematically according to the activities carried out by students referring to the competency indicators that must be mastered by students. At the end of each sub-topic, practice questions are given related to the activities and materials that have been studied previously with the aim of measuring the mastery of the material by students, while the evaluation questions given at the end of the material as a whole aim to measure the level of mastery of the material by students as a whole.

b. The Feasibility of the Guided Discovery-Based Geography Module to Improve Critical Thinking Skills of 11TH Grade Social Sciences at SMA Negeri 5 Surakarta

The feasibility of guided discovery-based modules on disaster mitigation system materials is tested through the validation stage, assessment of practitioners and students as a small group of field users and operational field tests or effectiveness. The validation results show that the module is fulfilled with the developed objectives. Based on the material assessment, the module has achieved an average percentage score of 95%, the module development assessment has reached an average score percentage of 93.26%, the module learning device assessment has reached a percentage of 90.57%. Revision of the first module product is conducted based on suggestions from experts including: a) addition of material, b) editorial improvements in several parts of the module; c) the use of designations for students is improved so that it becomes consistent; d) editing of images so that the focus of the image is line with the material in question; e) fixed spacing; f) use of more precise terms; g) setting the image layout and its description

on one page; h) changing the color of the letters (font), from light green to blue; i) the use of the term module as a learning resource is improved into teaching materials; and j) the writing is corrected according to the EYD (Bahasa Indonesia Improved Spelling).

The results of the preliminary product revision are then followed by a limited field test involving educational practitioners and students as a small group. The results of the assessment of education practitioners and students as a small group of users indicate that the revised module of the preliminary product has fulfilled with the objectives developed because it has excellent qualifications, with details based on the assessment of the education practitioner the module has reached an average score of 98.29% and student assessments require improvement according to the target obtained through the revision of the second module. The second revision of the module includes correcting printing technical errors so that the source data is listed as complete and no words are cut off and tidying up the concept map so that the presentation is better.

The second revised module is then tested through operational/effectiveness field tests and proved to be effective in improving student learning outcomes, but still requires improvement according to the suggestions of several students through the third product revision. Revision made a writing error. After going through several stages of expert validation, assessment of educational practitioners, operational field tests/effectiveness tests and improvements that have been made, the results of the third product revision (final product revision) are finished products that are suitable for use.

c. The Effectiveness of Using Guided Discovery-Based Geography Modules to Improve Critical Thinking Skills for Class XI Social Sciences Students at SMA Negeri 5 Surakarta.

The effectiveness of guided discovery-based modules on disaster mitigation materials is based on the results of statistical tests using the independent samples T-test. It shows that there is a difference in post-test scores between the experimental class, which uses guided discovery-based modules, and the control class, which uses the module in the learning process. which is commonly used in schools, then an analysis of the N-gain score is carried out to determine its increase/effectiveness. Analysis of increasing students' critical thinking skills using Hake's (1999) criteria.

Modules are teaching materials with the aim that students master the competencies taught in learning activities as well as possible (Purwantoro, 2007). In line with its function, the module is an independent learning instrument, thus students can learn independently according to their respective speeds (Daryanto, 2013). Learning using modules has several advantages focusing on students' individual abilities, controlling learning outcomes through the use of competency standards in each module that must be achieved by students, and students knowing the relationship between learning and the results to be obtained (Mulyasa, 2006). The module developed is a guided discovery learning model-based module that improves students' critical thinking skills. It means, compiling learning activities based on the syntax of the guided discovery model and activities can train critical thinking skills which aspects adapt from the opinion of Facione (2011).

The selection of the development of module teaching materials are proved to be more effective in the learning process. The characteristics of the module which are self-instruction, self-contained, stand alone, adaptive, and user-friendly provide opportunities for students to be more flexible in learning effectively and efficiently either inside or outside the school environment and with or without being accompanied by a teacher. The guided discovery model which is used as the basis for the module in the implementation of syntax, provides guidance to students in the form of stimulation and direction, instructions, and encouragement at the beginning of learning. It provides more time and opportunities for students to construct their knowledge, because the length of learning in schools has been determined. This makes students who still need basic concepts to find something tend to rush to draw conclusions, and not all students can find something on their own, so it takes a long time (Widdiharto in Sutrisno, 2012). Along with the ongoing learning process and experience, the longer students can take over responsibilities independently.

Guided discovery-based module has fulfilled with the characteristics of disaster mitigation materials that have a broad scope and are directly related to everyday life. Understanding of disaster mitigation can start from knowledge and awareness in disaster-prone areas, which then develops on matters related to disaster mitigation therefore, it creates curiosity to identify problems, formulates problems and hypotheses, collects information or data, processes data and verifies to draws conclusions. These steps are in line with the syntax stages of the guided discovery learning model.

Based on operational field test data, the average score obtained by the class using guided discovery-based modules during the pre-test was 32.79 and the post-test average value was 84.73, this indicates an increase in the average score with the difference in value is 51.94. The average score obtained by the control class during the pre-test was 35.05 and the post-test average was 79.35, so there was an increase in the average score with a difference of 44.30. The average value of the module class is higher than the control class.

The result of the independent Simple T Test at a significance level of 0.05 obtains a sig value of $0.286 > 0.05$, so there is no significant difference between the pre-test value of the module class and the control class, while the post-test score obtains a sig. $0.009 < 0.005$, so it can be concluded that the post-test value data of the two classes show a significant difference.

The improvement of students' critical thinking skills can be seen from the comparison of N-gains obtained by each class. The comparison module class of pre-test and post-test scores reached an average N-gain of 0.77, while in the control class is 0.68. The N-gain value of the module class is categorized in the high criteria and the control class is categorized in the medium class Hake (1999).

Overall, based on the results of the analysis that has been done, it shows that the use of guided discovery-based modules on disaster mitigation materials is more effective in improving students' critical thinking skills. This is in line with the statement of Arjunan (2012), which states that learning that involves guided discovery activities can generate student interest in the lesson, increase their ability to pose problems and improve their learning ability well. Similar, Gholamian (2013), also stated that, guided discovery is an instrument to develop and strengthen critical thinking skills. Guided discovery is also meaningful for teaching critical thinking skills and many students need an early structure of steps in learning that provide students with critical thinking.

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