Implementation of Guided Inquiry Learning-Based Electronic Modules to Improve Student's Analytical Skills

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Abstract: This type of research is Research and Development (R&D) with the 4D development model (Define, Design, Development, and Disseminate). The research subjects were 70 Grade VII students of SMPN, NTB. The results of the Guided Inquiry-based E-Module feasibility test ranged from 89.56% to the very feasible category. This shows that the E-Module can be used as an instrument or learning media. Meanwhile, the results of the practicality test of the E-Module based on Guided Inquiry Learning based on student responses ranged from 88.32% in the very practical category, while the teacher's responses ranged from 93.04% to the very practical category. The test results for the effectiveness of using the Guided Inquiry-based E-Module are shown by the Gain-Score obtained by students after using the E-Module. This can be seen from the Gain score obtained by the experimental class ranging from 78.03% which indicates that the media is quite effective in learning. This can be seen from the Asymp value. Sig. (2-Tailed) ranges from 0.000 <0.05, meaning that there is a significant difference in the analytic abilities of students using guided inquiry learning-based E-Modules.

Keywords: Analytic thinking skills; E-module; Guided inquiry; Inquiry learning; Interactive media

Introduction

The social and educational realities of the era of globalization have caused many science educators around the world to reconsider the essence of science education and propose new patterns for school science education. The goal of science education is not to train a small percentage of students to become the next generation of scientists. Education is a conscious and planned effort to create an effective and efficient learning atmosphere and learning process for developing students' self-competencies (Masgumelar et al., 2021). Education Building Paradigm 4 Pillars of Learning to realize a world order where students as the nation's successors to always take an important role in the school order as individualism but also become an important pillar in the social life order in the community

(UNESCO, 2009). The development of students must be trained with the same times that deliver students to computerized -based learning. This does not directly give a positive impact on the development of students to meet the learning aspects of the 21st century which requires students to think of a high level (Rahman, 2019; Miterianifa et al., 2021; Gencer et al., 2020).

High-level thinking skills such as analytical thinking skills are important aspects that have to be filled (Marzano et al., 2009). Students' analytical skills tend to be below average, which is based on survey results conducted by Trends in International Mathematics and Science Study (TIMSS) and research by the Program for International Students Assessment (PISA) that in 2018 Indonesian students' scientific abilities were ranked 71st from 79 countries. The results of a study from TIMSS in 2015 Indonesia was ranked 46th out of 51 countries. Whereas in 2019 Indonesia did

not take part in a survey conducted by TIMSS. Therefore learning orientation that is oriented towards scientific abilities and higher order thinking in Indonesia needs to be encouraged. Meanwhile, the results of observations made at Public Middle School (SMPN) 3 Belo, Belo District, Bima Regency, West Nusa Tenggara show that students' critical thinking skills are still relatively low with an acquisition percentage of around 60%. This requires optimal performance from educators to empower students' high-level abilities such as critical thinking, analytical, innovative and creative abilities.

One of the government's efforts to fulfill this aspect is to prepare quality education by designing a curriculum that can develop the potential of students to make scientific discoveries, a scientific learning process, and an international scale orientation. Therefore, Indonesia has formalized the new curriculum for 2022 as contained in Regulation of the Minister of Education, Culture, Research and Technology No. 56 of 2022, Guidelines for Implementing Curriculum in the Framework of Learning Recovery. Contains three curriculum options that can be used in educational units in the context of learning recovery along with the structure of the Independent Curriculum, rules related to learning and assessment, and teacher workload. Teachers have complete control to implement learning that is creative, innovative, fun, and meaningful lifelong learning. Therefore, the quality of teachers must guarantee the achievement of optimal learning outcomes (Har et al., 2018).

The Merdeka Curriculum is a curriculum with various intra-curricular learning where the content will be more optimal so that students have enough time to explore concepts and strengthen competence. In the learning process the teacher has the flexibility to choose a variety of learning tools so that learning can be adapted to the learning needs and interests of students. In this curriculum there are projects to strengthen the achievement of Pancasila student profiles. Then, it is developed based on certain themes set by the government. This project does not aim to achieve certain learning achievement targets, so it is not tied to subject content. The teacher must at least have a clear and accurate lesson plan, and determine appropriate learning approaches, methods and strategies for teaching certain themes (Har et al., 2018).

The core of this independent curriculum is Freedom to Learn. This is conceptualized so that students can explore their respective interests and talents. For example, if two children in a family have different interests, then the benchmarks used to assess them are not the same. Then children also cannot be forced to learn something they don't like so that it will provide autonomy and independence for students and schools. The implementation of the independent curriculum is open to all Kindergarten, Elementary School, Junior High School, Senior High School, Vocational High School, Special Education, and Equality education units. In addition, the education unit determines the choice based on a readiness questionnaire for implementing the Independent Curriculum which measures the readiness of teachers, education staff and education units in curriculum development. The most suitable choice refers to the readiness of the education unit so that the implementation of the Independent Curriculum is more effective the more it meets the needs. One of the main core components of the independent curriculum is to emphasize differentiated learning, which is learning that accommodates the learning needs of students. The teacher facilitates students according to their needs, because each student has different characteristics, so they cannot be given the same treatment. In implementing differentiated learning the teacher has complete control in using approaches, learning models, methods, strategies, techniques and tactics to support the continuity of learning.

To support optimal learning implementation and give birth to the competencies of students who have high-level thinking skills such as analytic thinking, then there is a suitable learning media. Learning Module is one of the alternative media that is suitable for increasing critical thinking skills by integrating the guided inquiry learning model. This is in line with the previous research that the module integrated with the Guided Inquiry Learning model can encourage the ability of student analytic thinking (Priem et al., 2011; Ramadani et al., 2021; Stal, 2012). However, The rapid development of technology causes print media to be abandoned, and switches to computational or technology-based learning (Pramana et al., 2020). E-Module is an alternative that can be used as a form of transformative learning to improve students' analytical thinking skills (Fadly, 2021; Ramadani et al., 2021). Computation-based learning such as the Electronic Module can be an alternative means for teachers to adapt to the times. E-Modules or E-Learning learning can be integrated with certain models to empower higher-level thinking skills such as critical thinking (Noris et al., 2021), analytic thinking (Sartika et al., 2019), problem solving abilities (Fitriani et al., 2020), and creative and innovative skills (Kurniawati et al., 2016). E-Learning or Virtual Learning-based learning is one of the benchmarks that can be used as a parameter for the success of learning in the digital and society 5.0 era (Maruf et al., 2022).

The developed e-module can be integrated with certain learning models, one of the learning models that is believed to be able to empower students' analytical thinking skills is to apply the guided inquiry learning model (Aini, 2021). The guided inquiry learning model focuses on investigative activities and explanations of the relationship between objects and events. In this

learning model students can carry out investigations and investigations of problems that occur with scientific skills. The teacher facilitates by providing direction and guidance to generate curiosity so as to encourage students' analytical thinking skills. The guided inquiry learning syntax starts from the questions posed by the teacher. Then collect ideas to solve problems with the questions given and create hypotheses to be tested or questions to be answered. Following this activity, design and carry out experiments, collect evidence, draw conclusions, and communicate results (Aini, 2021; Asnidar et al., 2018; Kristanto et al., 2015; Margunayasa et al., 2019). The guided inquiry learning model can also be integrated into the learning module so that it makes it easier for teachers to train and empower analytical thinking skills (Zulaichah et al., 2021).

Therefore, the purpose of this study is to determine the effectiveness of implementing and implementing Guided Inquiry learning based E-Modules on the analytical thinking skills of junior high school students, Belo sub-district, West Nusa Tenggara.

Method

This type of research is Research and Development (R&D) with the 4D development model by (Thiagarajan et al., 1974), namely Define, Design, Development, and Disseminate. This model is used because the research was conducted to obtain a product in the form of an Electronic Module based on Guided Inquiry learning. Products that have gone through the stages of development and validity testing are then implemented to students to obtain the results of the feasibility, practicality and effectiveness of the E-module based on guided inquiry learning. The research subjects used 70 class VII students of West Nusa Tenggara Middle School consisting of 35 control class students and 35 experimental class students who were selected by random purposive sampling. 70 students were then used as a sample in the pilot implementation of the Guided Inquiry Learning-based E-module to determine the effectiveness of the E-Module.

The research method uses a quasi-experimental method. The design of the research model used in this study is shown in Table 1.

Table 1. Nonequivalent Pretest-Posttest Control Group Design

Class	Pretest	Treatment	Posttest
Experiment Class	Q1	X	Q1
Control Class	Q2		Q2

Description:
Q1 = Pretest Before using the E-Module in the experimental class
Q2 = Pretest before using the E-Module in the control class

X = Learning using E-module based on Guided Inquiry Learning
Q1 = Posttest after using the E-Module in the experimental class
Q2 = Posttest after using the E-Module in the control class

Data analysis to determine the feasibility of guided inquiry learning based E-Module media refers to (Sudjana, 2005). The following is the formula for determining the eligibility of the E-Module, which is as follows:

$$\overline{X} = \frac{\sum xi}{n} \tag{1}$$

Description:
$\overline{X}$ = Mean score
$\sum xi$ = Total score obtained
n = Number of items

Table 2. Criteria for Determining the Eligibility Level

Range	Criteria
1.00 – 1.99	Not feasible
2.00 – 2.99	Less Eligible
3.00 – 3.49	Worth it
3.50 – 4.00	Very worth it

Data analysis on the practicality of using the E-Module based on Guided Inquiry Learning refers to the teacher and student response questionnaires which will be analyzed using a descriptive percentage of scoring scores using the following formula (Sudijono, 2004):

$$P = \frac{f}{n} \times 100\% \tag{2}$$

Description:
P = Percentage
f = Selected score
n = Maximum score

Table 3. Criteria for Teacher and Student Response Questionnaire Results

Score Range (%)	Criteria
0 – 20	Not good
21 – 40	Not good
41 – 60	Pretty good
61 – 80	Well
81 – 100	Very good

The data to determine the effectiveness of E-Module based on guided inquiry learning is in the form of score distribution data obtained from student learning evaluations. The effectiveness test was analyzed using the Paired Sample T-test by determining the N-Gain Score from the students' posttest and pretest results on

aspects of critical thinking skills. The basis for decision making in the effectiveness test is to determine the value of students' classical completeness with the acquisition of learning outcomes both cognitive aspects and students' analytical thinking skills. Results Students' analytical thinking skills were analyzed using the N-Gain Score formula. The N-gain score formula is as follows:

$$N - Gain = \frac{\text{Score Postest} - \text{Score Pretest}}{\text{Score Ideal} - \text{Score Pretes}} \quad (3)$$

The category of acquisition of the N-Gain Score according to Sulzer. The categories of N-Gain acquisition is shown in Table 4.

Table 4. Gain Score Category Acquisition

N-Gain Score	Category
g > 0.7	High
0.3 < g < 0.7	Medium
g < 0.3	Low

Gain Score Obtained results on the implementation of the use of Guided Inquiry Learning-based E-Modules become the basic reference for determining the effectiveness of the E-Module.

Result and Discussion

Result

Guided Inquiry-Based E-Module before being implemented on SMPN 3 Belo, students was tested for data normality and data homogeneity. Based on the results of the normality test, it was found that the data were normally distributed (0.216 > 0.05) for the experimental class, while the control class was < 0.05, so the data was not normally distributed. The results of the normality test is shown in Table 5.

Table 5. Normality Test Results

N-Gain Score	Class	Kolmogrov-Smirnov			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
	Cont	.155	35	.033	.908	35	.007
	Eks	.158	35	.027	.959	35	.216

Because the control class data were not normally distributed, a hypothesis test was performed using a non-parametric statistical test with the Mann-Whitney U Test. The following are the results of the Mann-Whitney U Test is shown in Table 6.

Table 6. Mann-Whitney U Non-Parametric Test

Test Statistics[a]	
	N-Gain percentage
Mann-Whytney U	101.000
Wilcoxon	731.000
Z	-6.009
Asymp. Sig. (2-tailed)	.000

a = Grouping variable: Class

The results of the Mann-Whitney U Test show the Asymp. Sig. (2-Tailed) ranges from 0.000 < 0.05, then H1 is rejected and H0 is accepted, meaning that there is a significant difference in the analytic abilities of students using guided inquiry learning-based E-Modules. The data that has been normally distributed is then tested for homogeneity. The results of the homogeneity test is shown in Table 7.

Table 7. The results of the homogeneity test

		Levene Statistic	df1	df2	Sig.
Pretest	Based on Mean	10.571	1	68	.002
	Based on Median	10.526	1	68	.002
	Based on Median and with adjusted df	10.526	1	64.500	.002
	Based on trimmed mean	10.604	1	68	.002
Posttest	Based on Mean	6.391	1	68	.014
	Based on Median	6.676	1	68	.012
	Based on Median and with adjusted df	6.676	1	56.793	.012
	Based on trimmed mean	6.576	1	68	.013

Figure 1. Display of E-module based on guided inquiry learning

E-modules based on guided inquiry learning that have met the prerequisite test are then implemented in learning at SMP Negeri 3 Belo, West Nusa Tenggara to determine the feasibility, practicality and effectiveness of using electronic modules. The E-Module that has been developed and implemented for students is shown in Figure 1. The result of the due diligence of the E-Module Based on Guided Inquiry learning is shown in Table 8.

Table 8. Guided Inquiry Learning Based E-Module Feasibility Test Results

Indicator	Percentage (%)	Description
E-Module Design Aspects	90.23	Very worth it
Aspects of Content/Material	90.12	Very worth it
Aspects of Renewal/Novelty	88.54	Very worth it
Readability Aspect	89.36	Very worth it
Average	89.56 %	Very worth it

Based on the results of the Guided Inquiry-based E-Module feasibility test, it was around 89.56% with a very feasible category. This shows that the E-Module can be used as an instrument or learning media. The developed e-module can be used as an alternative to changing the conventional learning paradigm into digital or computerized learning to obtain optimal learning outcomes. While the results of the practicality test of the E-Module based on Guided Inquiry Learning based on the responses of students and teachers are presented in Table 9.

Table 9. E-Module Practicality Test Results based on Student and Teacher Responses

| Indicator | Guided Inquiry Learning Based E-Module Practicality Test Results | | | |
| | Student | | Teacher | |
	Percentage (%)	Category	Percentage (%)	Category
E-Module Design Aspects	93.24	Very Practical	90.34	Very Practical
Aspects of Content/Material	79.23	Pretty Practical	98.35	Very Practical
Aspects of Renewal/Novelty	90.45	Very Practical	93.78	Very Practical
Readability Aspect	90.36	Very Practical	89.70	Very Practical
Average	88.32	Very Practical	93.04	Very Practical

Based on the results of the practicality test on the E-Module based on student responses ranging from 88.32% in the very practical category, while the teacher's responses ranged from 93.04% to the very practical category. This shows that the developed E-Module is very practical to use as an alternative medium in empowering students' analytical thinking skills.

While the results of the effectiveness test using the Guided Inquiry-based E-Module are shown from the acquisition of the Gain-Score of students after using the E-Module. The results of the student's Gain Score test is shown in Figure 2.

The experimental class obtained a gain score of around 78.03% which indicates that the media is quite effective in learning. This indicates that the E-Module based on guided inquiry learning is relatively effective in enhancing and empowering students' analytic abilities.
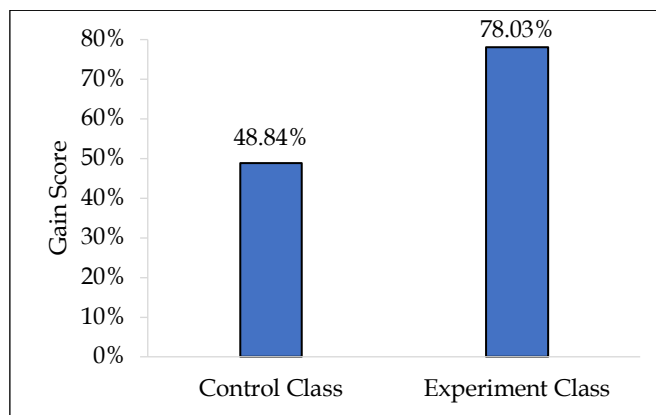
Figure 2. Graph of gain score acquisition of experimental class and control class

Discussion

Based on the results of the Guided Inquiry-based E-Module feasibility test, it was around 89.56% with a very feasible category. This shows that the E-Module can be used as an instrument or learning media. E-Modules are considered very feasible to be used as alternative or transformative learning media to improve students' analytical thinking skills (Klentien et al., 2016). E-Modules or E-Learning learning can be integrated with certain models to empower higher-level thinking skills such as critical thinking (Noris et al., 2021), Analytic thinking (Sartika et al., 2019), problem solving abilities (Fitriani et al., 2020), and creativity and innovative capabilities (Kurniawati et al., 2016).

The developed E-Module is very practical, simple, usability, reusable and flexible (Noris et al., 2021), and can be accessed at any time, does not require maintenance costs, and is relatively easy to use by teachers and students (Saraswati et al., 2019). In addition, the Guided Inquiry-based E-Module has been integrated with inquiry learning syntax which emphasizes students' higher-order thinking (González et al., 2015; Margunayasa et al., 2019). The guided inquiry learning model can empower students' high-level abilities with scientific procedural steps that must be carried out by students from formulating problems, formulating hypotheses, designing hypotheses, conducting experiments to obtain data, collecting data and analyzing it, and making conclusions (Kurniawati et al., 2016). Integrated e-Module The guided inquiry model guarantees the achievement of optimal learning outcomes. Researchers believe that the developed E-Modul can empower students' analytical thinking skills guided by inquiry learning syntax.

Integrating technology and media in the learning process will provide convenience and benefits not only for teachers but also students. Both teachers and students will be facilitated in learning that involves reading, writing, listening to a material (Sudarsana et al., 2019). The integrated e-module with the Guided Inquiry Learning Model really helps students and teachers to

empower analytical thinking skills. Analytical thinking ability is an important part of critical thinking ability and logical thinking (Facione, 2011; Lapuz et al., 2020; Noris et al., 2022; Seventika et al., 2018). The ability to think analytically is one of the skills that must be possessed by students. Analytical skills are high-level abilities that are much needed in the world of work, industry and technology. By implementing the Guided Inquiry-based E-Module, it is hoped that it will produce students who think analytically which can then be implemented into everyday life.

Based on the results of the practicality test on the E-Module based on student responses ranging from 88.32% in the very practical category, while the teacher's responses ranged from 93.04% to the very practical category. This shows that the developed E-Module is very practical to use as an alternative medium in empowering students' analytical thinking skills. The Guided Inquiry learning-based e-module that was developed received a positive response from teachers and students. The teacher considers that the developed E-Module has a practical software design, contains the truth of content concepts and constructs that are relevant to the goals and competencies that must be achieved by students, as well as media readability that is in accordance with KBBI and EYD. The appearance of E-Module is very flexible among participants, in addition to creative and innovative software designs, the layout buttons provided in E-Module are very easy for students to understand. Students are encouraged and enthusiastic to learn independently and operate the E-Module at any time. While on the material aspect, the E-Module presented also integrates an evaluation component, LKPD for students to analyze and solve conceptual problems through the procedural stages of guided inquiry learning syntax. It is proven that the developed E-Module is very practical for use in digital-based learning to improve students' critical thinking skills.

The developed e-module received a positive response from teachers and students. The advantages of learning using E-Module make it easier for teachers and students to read via laptops/androids, equipped with interesting features such as animations, videos, pictures, and audio-visuals. In addition, the E-Module becomes an interactive medium that can foster students' interest in learning (Pramana et al., 2020), honing students' critical thinking skills with contextual material dimensions (Noris et al., 2023), and provide conceptual understanding to students to be able to think logically, conceptually, procedurally, metacognitively (Marzano et al., 2009). Technological developments lead us to be literate in technology, one of the basic efforts that must be made is to adapt and improve the quality of educators and students to be aware of technological developments. Teachers and students need to try new things to carry

out a movement for change, one of those aspects is digital literacy literacy (Wahyuningtyas et al., 2022).

The test results for the effectiveness of using the Guided Inquiry-based E-Module are shown by the Gain-Score obtained by students after using the E-Module. This can be seen from the Gain score obtained by the experimental class ranging from 78.03% which indicates that the media is quite effective in learning. This indicates that the E-Module based on guided inquiry learning is relatively effective in enhancing and empowering students' analytic abilities. This is in line with several other studies (Lim et al., 2021) who say that E-Learning-based learning is very effective in improving students' analytical skills in the digital literacy era and post-pandemic. Higher-order thinking skills such as analytical thinking are abilities that need to be empowered through proper training and direction (Rahmat et al., 2021).

The developed E-Module presents concrete problems. Learning media that combines concrete experiences helps students to combine previous experiences so it is important to learn abstract concepts that are difficult to analyze and record in students' memory. Technology and media have an important role in learning. While learning is teacher-centred, technology and media play a role in supporting the delivery of learning (Rahmi et al., 2018; Sudarsana et al., 2019). This is evidenced by the results of the Mann-Whitney U Test showing the Asymp value. Sig. (2-Tailed) ranges from 0.000 < 0.05, then H1 is rejected and H0 is accepted, meaning that there is a significant difference in the analytic abilities of students using guided inquiry learning-based E-Modules. Data that has been normally distributed is then tested for homogeneity. Implementation of the Guided Inquiry-based E-Module is very helpful for teachers in empowering analytical thinking skills. Therefore, the Guided Inquiry-based E-Module is an alternative and a concrete step to build students' critical and analytical thinking paradigms to meet global challenges. This is in line with the previous research that the module integrated with the Guided Inquiry Learning model can encourage the ability of student analytic thinking (Priem et al., 2011; Ramadani et al., 2021; Stal, 2012).

The findings in the study show that e-modules are integrated with the Guided Inquiry Learning model that can encourage teachers to empower students' analytic thinking skills. This may be influenced by the factors of students who are born from a generation that is very close to the advancement of technology. Teachers need initiation to bring up and present learning-learning integrated with certain models to meet the needs of students. This gives a new paradigm for teachers to be able to always present learning that is in accordance with the needs and development of students. Guided Inquiry Learning that has been integrated into the

learning module provides an excellent cognitive understanding for students, cognitive understanding of delivering students to think more analytically (Marzano et al., 2009). The analytical ability is driven by research instruments developed with a guided inquiry learning syntax, where students are delivered to think high level (Heong et al., 2012).

The novelty of the results of this research is in the form of an electronic module based on Guided inquiry learning which can improve students' analytical thinking skills. In addition, E-Module has a distinctive character that distinguishes it from other electronic modules, namely in the form of interactive, easy-to-understand, reusable, usuability advanced features. The developed E-Module has unique characteristics in accordance with the competencies to be empowered (Sofyan et al., 2019). The most prominent characteristic of this Emodule is the process of students' analytical thinking skills empowered by guided inquiry learning models. Integrating the Guided Inquiry Learning model into the electronic module helps students to memorize facts and apply new concepts to learning (Chen et al., 2017). Learning with the Inquiry integrated E-module is very suitable for use in empowering students' analytical thinking skills.

Conclusion

The Guided Inquiry-based E-Module feasibility test ranges from 89.56% to the very feasible category. This shows that the E-Module can be used as an instrument or learning media. Meanwhile, the results of the practicality test of the E-Module based on Guided Inquiry Learning based on student responses ranged from 88.32% in the very practical category, while the teacher's responses ranged from 93.04% to the very practical category. The test results for the effectiveness of using the Guided Inquiry-based E-Module are shown by the Gain-Score obtained by students after using the E-Module. This can be seen from the Gain score obtained by the experimental class ranging from 78.03% which indicates that the media is quite effective in learning. This can be seen from the Asymp value. Sig. (2-Tailed) ranges from 0.000 < 0.05, meaning that there is a significant difference in the analytic abilities of students using guided inquiry learning-based E-Modules. The implication of this research is the development of an Electronic Module based on Guided Inquiry Learning, an E-Module Handbook for students and teachers, the developed E-Module application. These findings indicate that the use of Guided Inquiry-based E-Modules provides a new understanding for teachers to be able to improve analytical thinking skills through the integration of models such as guided inquiry learning into learning modules to meet the needs of students in the 21st century.

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