

DEVELOPMENT OF GUIDED DISCOVERY-BASED LEARNING TOOLS USING HYPERCONTENT TO IMPROVE STUDENTS' MATHEMATICAL CRITICAL THINKING ABILITY

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Abstract

Online learning (in the network) is learning online through specified media. This study aims to: 1) describe how the level of validity, practicality and effectiveness of guided discovery-based learning tools using Hypercontent to improve critical mathematical thinking skills at SMAN 1 Tambangan; 2) describe the improvement of students' mathematical critical thinking skills using guided discovery-based learning tools using Hypercontent at SMAN 1 Tambangan. The method used in this research is development research. The subjects in this study were students of class XI SMAN 1 Tambangan in the academic year 2021/2022. The results showed that 1) Guided discovery-based learning tools using hypercontent to improve students' mathematical critical thinking skills that were developed already met the criteria of being valid, practical and effective; 2) The improvement of mathematical critical thinking skills using guided discovery-based learning tools using hypercontent that has been developed seen from the N-gain value in the first trial of 0.33 increased to 0.4 in the second trial, meaning that it is in the "medium" category.

Keywords: Online Learning, Guided Discovery, Hypercontent, Critical Thinking Skills

Abstrak

Pembelajaran Daring (dalam jaringan) merupakan belajar secara online melalui media-media yang ditentukan. Penelitian ini bertujuan Untuk : 1) mendeskripsikan bagaimana tingkat Validitas , kepraktisan dan efektifitas perangkat pembelajaran berbasis penemuan terbimbing menggunakan *Hypercontent* untuk meningkatkan kemampuan berpikir matematis kritis di SMAN 1 Tambangan; 2) mendeskripsikan Peningkatan kemampuan berpikir kritis matematis siswa dengan menggunakan perangkat pembelajaran berbasis penemuan terbimbing menggunakan *Hypercontent* di SMAN 1 Tambangan. Metode yang digunakan dalam penelitian ini adalah penelitian pengembangan (*development research*). Subjek dalam penelitian ini adalah siswa kelas XI SMAN 1 Tambangan tahun Ajaran 2021/2022. Hasil penelitian menunjukkan bahwa 1) Perangkat pembelajaran berbasis penemuan terbimbing menggunakan *hypercontent* untuk meningkatkan kemampuan berpikir kritis matematis siswa yang dikembangkan sudah memenuhi kriteria valid, praktis dan efektif; 2) Peningkatan kemampuan berpikir kritis matematis menggunakan perangkat pembelajaran berbasis penemuan terbimbing menggunakan hypercontent yang telah dikembangkan dilihat dari nilai *N-gain* pada uji coba I sebesar 0,33 meningkat menjadi 0,4 pada uji coba II, artinya berada dalam kategori "sedang".

Kata kunci: Pembelajaran Daring, Penemuan Terbimbing, Hypercontent, Kemampuan Berpikir Kritis

INTRODUCTION

At this time, Indonesia is faced with big challenges as a result of the COVID-19 pandemic that is happening in Indonesia. Many victims have been harmed by the COVID-19 pandemic, one of which is educational institutions, where to handle and prevent the spread of the Covid-19 virus which is increasingly spreading, one of the efforts to prevent the spread of

COVID-19 is carried out by the Ministry of Education and Culture towards educational institutions, namely: with the policy of learning from home, through online learning.

The implementation of social distancing policies, physical distancing, is the basis for educational policies by learning from home using and utilizing the internet simultaneously. The government's policies, such as isolation, social and physical distancing, and large-scale social restrictions (PSBB) require all residents to stay at home, work, worship and study at home. Such conditions require educational institutions to innovate in the learning process. One form of innovation is to do online learning or online (in a network). Online learning does provide varied learning media such as learning video media connected to YouTube, video conference media, scientific journal media or digitally systemized topics. However, advances in learning technology must be supported by adequate facilities and infrastructure, such as the distribution of the internet network to schools in rural areas.

In responding to the circular from the government, the school must provide media and online distance learning learning resources. For this reason, the school urges all students to use smartphones (gadgets) or laptops in the implementation of learning from home. The use of information technology (IT) in learning is considered an alternative in responding to special conditions and bringing changes in learning traditions or culture as well as becoming an independent learning system. The learning model that is related to IT and has now become the attention of the education world is a computer-based learning model and learning through electronic media based on web-based learning (Wena, 2009).

In computer-based learning, students will interact and deal directly with computers individually (Wena, 2009). Learning, which is usually teachers and students who are always in one place, then with the use of learning technology can be done using well-designed media which is distance learning.

The development of increasingly advanced technology, of course, affects various sectors of human life. This development also plays a role in the development of a learning device. Learning media is becoming more interesting and more concise, one of the developments in learning tools that are currently widely used is learning media that integrates technology into the world of education, such as interactive learning modules using computers/laptops, computer networks, 2D, 3D animation, Quick Response Code (QR-Code) and others. The

module is a medium that can deliver messages to students (Siang, Ibrahim, & Rusmono, 2017). Therefore, this study aims to overcome the various problems described above by developing learning tools using hypercontent.

The meaning of hypercontent (Prawiradilaga & Chaeruman (2018:2)), namely "hypercontent" is adopted from a nonlinear digital reading pattern. Another meaning of hypercontent is linked (linked) and virtual world (virtual world). In simple terms, hypercontent can be understood as a concept that interweaves one material and another material simultaneously in a certain digital technology program (Prawiradilaga, dkk 2017).

The learning process with the 2013 Curriculum requires student involvement in the learning process and is student-centered. However, based on observations made by researchers, class XI SMAN 1 Tambangan students are still passive in the learning process and depend on the information provided by the teacher, in this new normal era, it is expected that hypercontent as a tool in this research can make students more critical in thinking even though learning is done. from home and online but does not limit students to be more passive but more active and independent to find out for themselves the material to be studied through the learning videos contained in the QR Code provided in accordance with the learning competencies to be studied.

Errors and factors that cause students to make mistakes in solving arithmetic series and series material problems are students forgetting and not being able to write information into mathematical symbols, not knowing the formula that should be used in the problem, in a hurry because time is running out, less thorough, incorrectly wrote the operation sign, did not know the steps to be taken, forgot to write the conclusion, and assumed the final answer was only limited to getting the value sought (Hardianty, 2017:26).

Furthermore, the results of the author's interview with the mathematics teacher at SMAN 1 Tambangan, namely Juliani Hasibuan, S.Pd. On January 11, 2021, it was revealed that there were several problems encountered in learning mathematics, including: students were passive in receiving lessons seen from online learning reports.

Understanding passive, passive students are students who have sufficient ability, but they are shy to express what is on their mind, passive students are not confident, especially when their opinions are refuted and become the object of ridicule by their classmates or peers. students with low communication skills and relatively passive just wait for their

friends to finish doing the assignments given by the teacher, are shy to ask questions, do their own assignments, and do not have an important role in group work. Students who are passive or often silent and only listen to everything the teacher has to say during teaching and learning activities should be given more attention (Hardianty, 2017:26).

Based on the analysis that the researchers conducted on the devices used at SMAN 1 Tambangan, there were several weaknesses in the learning devices. Starting from the lesson plans compiled by teachers which are used as lesson plans, they have never been validated by experts, so it appears that teachers pay less attention to being able to improve the quality of learning that students have.

According to Bruner, discovery learning is an active search for knowledge by individuals and by itself gives better results. Meanwhile, Lefrancosis states that discovery learning is a learning in which students are not treated to material in its final form but it is preferable that students organize themselves (Lefrancois.1999).

From several previous perspectives, the chosen approach should be adjusted to the relevant methods, media and other learning resources in conveying information and guiding students to be optimally involved, so that students can gain learning experiences in order to develop their cognitive, affective and psychomotor abilities. One learning model that focuses on student learning is guided discovery.

In the guided discovery approach, the teacher must provide opportunities for students to become a problem solver, a scientist, and a mathematician. Then it can build students' self-confidence, interest and interest in mathematics, so that by applying a guided discovery approach in learning it is hoped that students will like mathematics more.

METHODS

This research includes development research. This study uses a 4-D development model. This model consists of 4 stages of development, namely Define, Design, Develop and Disseminate.

This research was conducted at SMAN 1 Tambangan which is one of the senior high schools in Tambangan sub-district, Mandailing Natal Regency in the odd semester of the 2021/2022 academic year.

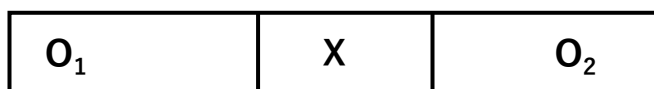
The subjects in this study were class XI students of SMAN 1 Tambangan in the academic year 2021/2022, while the object of this research was a learning device developed based on a guided discovery model on sequences and series material.

The research and development method is a research method used to produce certain products and test the effectiveness of these products (Sugiyono, 2012: 407). The research design used in this research is the research design of the 4-D model development (Four D Models) according to Thiagarajani. This includes 4 stages, namely the stage of defining, designing, developing and disseminating. However, the deployment stage was not carried out, so this fourth stage was not explained in depth.

The learning tools that have been validated are tested in the first trial class. After completing the first trial, they are given a mathematical critical thinking ability test. The results of the first trial were used as a reference for the revision of the learning device so that draft III was produced for the second trial. After finishing the second trial, they were given a critical thinking ability test to see the improvement. Furthermore, the data from the field trials were analyzed and then revised so that in the end, the final learning tool was obtained.

The trial design of this research used the One Group Pretest-Posttest Design. The first step is to take measurements as an initial test (pretest). Furthermore, they are subjected to treatment within a certain period of time, then a final test (post-test) is carried out. The research design can be described as follows (Lestari dan Yudhanegara:123)]:

Pre-test and Post-test Group research design, with the following pattern:



with:

O_1 = Pre-test was conducted to determine learning outcomes before being given treatment

X = Treatment through guided discovery-based learning using hypercontent that has been developed. During the treatment the instruments used were: The instrument for testing students' mathematical critical thinking skills.

O2= The final test (post-test) was conducted to determine the learning outcomes of students' products, processes and performance tests after being given treatment.

After the post-test was carried out, a student response questionnaire was given to the learning.

RESULTS AND DISCUSSION

A. Description of Learning Device Development Stage

1) Description of the Defining Stage (Define)

Based on the results of observations and analysis of learning tools at SMAN 1 Tambangan, it shows that so far teachers do not have learning tools that can improve mathematical critical thinking skills. The existing Learning Implementation Plan (RPP) is not a description of the learning process carried out. The existing LKPD is used not in accordance with the RPP, so the desired learning objectives in the RPP are not contained in the LKPD and the handbook used is inadequate for use during this covid 19 pandemic. In addition, in the learning process students are not involved in the process of finding their knowledge but are directly given by the teacher. This is suspected to be the cause of students' mathematical critical thinking skills are still not good.

2) Description of the Design Stage (Design)

a) Test Compilation Results

The basis of the preparation of the test is task analysis and concept analysis described in the specification of learning objectives. The test in question is a test of mathematical critical thinking skills on the material of Lines and Series.

b) Media Selection Results

The learning media prepared include: Learning Implementation Plans (RPP), Student Worksheets, Modules, and Students' Mathematical Critical Thinking Ability Tests.

c) Format Selection Results

The results of the selection of the format in this study were adjusted to the 2013 curriculum.

d) Preliminary Design Results

At the initial design stage, a learning implementation plan was produced for two meetings in field trials, student worksheets, modules, learning outcomes tests in the form of mathematical critical thinking ability tests along with alternative solutions, student scoring guidelines. All results at this design stage are called Preliminary Drafts.

3) Description of Development Stage (Develop)

a) Test results I

The mathematical critical thinking ability test is carried out once at the beginning before the learning activity begins which is called the Pre-Test and once at the end of the lesson after carrying out three meetings of teaching and learning activities called the Post-Test. Giving Pre-Test and Post-Test aims to determine the increase in mathematical critical thinking skills obtained by students after being given the treatment of guided discovery-based learning on the material of sequences and series. The data from the first trial can be seen in Table 1. below:

Table 1. Results of Mathematical Critical Thinking Ability Test on Trial I

Category	Pretest	Presentation of classical completeness	Posttest	Presentation of classical completeness
	Number of students		Number of students	
Complete	4	15,4 %	12	46,1%
Not Complete	22	84,6%	14	53,9%
Amount	26	100 %	26	100 %
Class Average	57,14		70,88	

Based on Table 1. it can be seen that the average mathematical critical thinking ability class of students in the pre-test trial I was 57.14 while the average mathematical critical thinking ability class in the post-test trial I was 70.88.

The results of the mathematical critical thinking ability test for each aspect are shown in Table 2. below:

Table 2. Mathematical Critical Thinking Ability Test Results for Each Aspect in Trial I

Aspects of Mathematical Thinking	Average	
	Pretest	Posttest
Interpretation	13,04	16,42
Analysis	11,38	11,62
Evaluation	13,46	18,58

Inference	2,11	3
All aspects	39,99	49,62

Based on Table 2. the average mathematical critical thinking ability shows that there is an increase in every aspect of mathematical critical thinking ability. Students experienced an increase in mathematical critical thinking skills in the Interpretation aspect with an average of the pre-test (13.04) while the post-test (16.42), then in the Analysis aspect with an average of pre-test (11.38) while post-test (11.62), then on the Evaluation aspect with an average pre-test (13.46) while the post-test (18.58), and then on the Inference aspect with an average pre-test (2, 11) while the post-test (3), it can be seen that the average mathematical critical thinking ability shows that there is an increase in every aspect of mathematical critical thinking.

Based on Table 2. it can be seen that the average value in each aspect has increased, the highest increase is 5.12, namely the Evaluation aspect. While the lowest increase is the analysis aspect, which is 0.24.

b) Test results II

The mathematical critical thinking ability test is carried out once at the beginning before the learning activity begins which is called the Pre-Test and once at the end of the lesson after carrying out three meetings of teaching and learning activities called the Post-Test. Giving Pre-Test and Post-Test aims to determine the increase in mathematical critical thinking skills obtained by students after being given the treatment of guided discovery-based learning on the material of sequences and series. The data from the second trial can be seen in Table 3. below:

Table 3. Results of Mathematical Critical Thinking Ability Test on Trial II

Category	Pretest Number of students	Presentation of classical completeness	Posttest Number of students	Presentation of classical completeness
Complete	12	46,1 %	23	88,4 %
Not Complete	14	53,9%	3	11,6%
Amount	26	100 %	26	100 %
Class Average	68		79,2	

Based on Table 3. it can be seen that the average mathematical critical thinking ability class of students in the pre-test trial II is 68 while the average class average mathematical critical thinking ability in the post-test trial II is 79.2.

The results of the mathematical critical thinking ability test for each aspect are shown in Table 4. as follows :

Table 4. Mathematical Critical Thinking Ability Test Results for Each Aspect in Trial II

Aspects Mathematical Thinking	of Critical	Average	
		Pretest	Posttest
Interpretation		15,27	17,31
Analysis		11,65	13,65
Evaluation		17,42	19,46
Inference		3,27	5
All aspects		47,61	55,42

From Table 4. the average mathematical critical thinking ability shows that there is an increase in every aspect of Mathematical Critical Thinking. Students experienced an increase in mathematical critical thinking skills in the Interpretation aspect with an average of the pre-test (15.27) while the post-test (17.31), then in the Analysis aspect with an average of pre-test (11.65) while post-test (13.65), then on the Evaluation aspect with a pre-test average (17.42) while the post-test (19.46), and then on the Inference aspect with a pre-test average (3, 27), while the post-test (5) shows that the average mathematical critical thinking ability shows that there is an increase in every aspect.

From Table 4. it can be seen that the average value in each aspect has increased, the highest increase is 2.04, namely the Interpretation and Evaluation aspect. While the lowest increase is Inference, which is 1.73.

c) Hypothesis testing

The analysis used is a t-test with the help of SPSS 22. The t-test of mathematical critical thinking skills aims to determine whether the average value of increasing students' mathematical critical thinking skills who are given learning using guided discovery-based learning tools using hypercontent in trial 2 is more higher than the average value of increasing students' mathematical critical thinking skills who were given learning using guided discovery-based learning tools using hypercontent on trial 1 at SMAN 1 Tambangan.

The summary of the t-test is the average value of increasing students' mathematical

critical thinking skills who are given learning using guided discovery-based learning tools using hypercontent in trial 1 with an average value of increasing students' mathematical critical thinking skills who are given learning using discovery-based learning tools. guided using hypercontent in trial 2 is shown in Table 5. below:

Table 5. Summary of t-test results for Mathematical Critical Thinking Ability

	Average	t_{hitung}	t_{tabel}	P
Trial 1	70,46	4,436	2,060	0.000
Trial 2	78,73			

Based on Table 5. it was found that the average value of increasing mathematical critical thinking skills of students who were given learning using guided discovery-based learning tools using hypercontent in trial 1 was 70.46 and the average value of increasing mathematical critical thinking skills of students who were given learning by using guided discovery-based learning tools using hypercontent in trial 2 of 78.73 so that there is a difference of 8.27. It was also found that $t_{hitung} > t_{tabel}$ at a significance level of 5% ($4,436 > 2,060$) and had a p value < 0.05 which means H_0 was rejected so it can be concluded that the average value of increasing students' mathematical critical thinking skills who were given learning using learning tools based on guided discovery using hypercontent in trial 2 was higher than trial 1 at SMAN 1 Tambangan so that the difference was declared significant.

4) Description of the Dissemination Stage

The next step is to carry out a limited distribution in the form of distributing the final equipment to the MGMP forum at SMAN 1 Tambangan which is marked by the submission of learning tools to the MGMP forum in the hope that the mathematics teachers who are members of the forum can apply the learning tools to the next lesson.

B. Discussion

1) Development of learning tools

The components of learning tools developed using guided discovery based using hypercontent are in the "valid" category with the average value of each component, namely 3.61; 3.63; 3.67; 3.85 and 43.81. However, although the components of the learning tools

developed have met the criteria for validity, there are several things that must be corrected according to the notes provided by the expert team, including the use of language, writing or typing and displaying images that must be in accordance with clarified conditions. So based on the results of the notes from the expert team that this learning device has met the criteria for validity in the "valid" category with a slight revision note.

The fulfillment of the validity aspect is in line with the opinion of Akker (1999) which states that validity refers to the extent to which the design of the device is based on the latest state of technology, art or science ('content validity') and the various components of the device are consistently related to each other ('content validity'). construct validity').

In addition to validity, practicality is also needed as a condition for good learning tools. In this study, 2 practical indicators were determined, namely the response of a team of experts or validators which stated that learning tools could be used with minor revisions and the implementation of guided discovery-based learning tools using hypercontent was at the IO criteria = 4.44 high.

In addition to practicality, effectiveness is also needed as a condition for good learning tools. In this study, 3 indicators of effectiveness were determined, namely the achievement of student learning mastery, the teacher's ability to manage learning obtained an average of 4.08 or in the "good" category and student responses to learning obtained an average of 90.38%

From the results of the expert team's response and the teacher's ability to manage learning, it can be concluded that guided discovery-based learning tools use "practical" hypercontent for use in learning.

2) Mathematical Critical Thinking Ability

From the results of trial I and trial II, the results of the N-Gain test of students' mathematical critical thinking abilities are shown in Table 6. below:

Table 6. N-Gain Results of Mathematical Critical Thinking Ability Test I and Test II

No	Indicator	N-Gain	
		Trial I	Trial II
1	Interpretation	0,5	0,4
2	Analysis	0,03	0,2

3	Evaluation	0,8	0,8
4	Inference	0,1	0,3

From Table 4.31 above, it can be seen that the N-Gain value of the mathematical critical thinking indicator in Trial I is 0.5; 0.03 and 0.8 and 0.1. While in the Second Trial each was 0.4; 0.2; 0.8 and 0.3. So that the indicator with the highest increase is the third indicator in Trials I and II with an N-gain value of 0.8, namely: Evaluation.

CONCLUSION

Guided discovery-based learning tools using hypercontent to improve students' mathematical critical thinking skills that have been developed already meet the valid, practical and effective criteria, namely:

- a. The average validity of the lesson plans is 3.61, the average student worksheet validity is 3.63, and the module validity average is 3.67.
- b. Practicality in terms of 1) The response of the expert team or validator stating that the learning tools can be used with minor revisions 2) The implementation of the learning tools on the IO criteria = high 4.44.
- c. The effectiveness in terms of 1) Classical completeness reached 88.4%, which had met the criteria for completeness, namely 85% of students reached the KKM. 2) The ability of teachers to manage learning obtained an average of 4.08 or in the "good" category. 3) Student responses to learning obtained an average of 90.38%.

The improvement of mathematical critical thinking skills using guided discovery-based learning tools using hypercontent that has been developed is seen from the N-gain value in the first trial of 0.33 increasing to 0.4 in the second trial, meaning that it is in the "medium" category.

Teachers should be able to use guided discovery-based mathematics learning tools using hypercontent and instruments as an alternative to learning in the classroom because these tools have been effective and can improve students' mathematical critical thinking skills with the highest aspect, namely generality.

Research and development in the form of learning tools using the Thiagarajan, Semmel and Semmel models can be used as an alternative for developing learning tools for mathematics and other subjects because the Thiagarajan model is very easy to implement and the steps for implementing development are very clear and structured.

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