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Enhancing Mathematical Critical Thinking Skills using Lectora Inspire Interactive Learning Media in the Discovery Learning

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Abstract

Critical thinking skills are one of the abilities that everyone must have to face the challenges of the 21st century. The use of interactive learning media lectora inspire in discovery learning can facilitate to develop students' mathematical critical thinking skills. Therefore, a study was conducted that aims to see the improvement of critical thinking skills using lectora inspire interactive learning media in the discovery learning model. This research is included in the pre-experimental design with the research design used is a single group one-group pretest-posttest design. The samples used in this study were 26 eighth-grade students in Pekanbaru, Riau. Data analysis techniques using Normality - Gain (N-Gain) test and t-test. The N-gain value obtained was 0.59 with moderate criteria. Based on the T-test results, there is a significant difference in the average pretest score and posttest score. The level of effectiveness occurs in the posttest after using lectora inspire interactive learning media, so the use of lectora inspire interactive learning media in the discovery learning model can improve students' mathematical critical thinking skills. This research makes a significant contribution to the innovation of mathematics learning in Indonesia, by offering a more effective and fun approach. The findings are expected to be a reference for educators, researchers, and educational policy makers in an effort to enhance the quality of mathematics learning.

Keywords: *Critical Thinking Skills, Lectora Inspire, Interactive Learning Media, Discovery Learning Model.*

INTRODUCTION

In the era of globalization and rapid technological advancement, critical thinking skills are considered important for individuals, especially in the field of education (Chimbunde et al., 2023a; López et al., 2023a; Munawaroh, 2024). Mathematics learning plays an important role in developing students' critical thinking skills (Sachdeva & Eggen, 2021). However, conventional teaching methods commonly used in schools often fail to develop these skills, leading to a passive learning environment where students are merely recipients of information without being challenged to use critical thinking skills (Indrawatiningsih et al., 2020). To address this challenge, innovative approaches in mathematics education have been explored to enhance students' reflective thinking abilities (Pepin et al., 2021). For example, research has investigated the impact of mathematical reasoning and critical thinking skills on students' mathematical literacy, emphasizing the importance of integrating these competencies into educational practices (Mulyanto & Indriayu, 2018). In addition, various studies have highlighted the importance of developing teachers' critical thinking skills in solving mathematical problems, underscoring the role of educators in fostering a culture of critical inquiry in the classroom (Susanti, 2024). In addition, the literature underscores the need for a paradigm shift towards more interactive and engaging pedagogical strategies to promote critical thinking in mathematics education. The application of models such as problem-based learning and guided discovery learning have been shown to be effective in improving students' critical thinking and problem-solving skills (Wong et al., 2022).

According to Anugerahwati (2019) and Indriani (2017), everyone should have at least 6 skills to face the challenges of the 21st century, namely critical thinking, collaboration, communication, creativity, citizenship/culture, and character education/connectivity. HOTs will fulfill the needs required in learning such as critical thinking, problem solving, collaboration and creativity and innovation. Among the fulfillment of the needs of these abilities, students will be able to learn in a critical and creative way in making a determination

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and solving an obstacle by investigating, considering and making the final result (Anderson & Krathwohl, 2001, As'ari et al., 2017; Firdaus et al., 2015).

Retrieved from Chukwuyenum (2013), critical thinking skills are useful in improving students' understanding of mathematical concepts, because these techniques can help them interpret, analyze, evaluate, understand and present data in a logical and orderly manner. Critical thinking is an instructive and highly transparent process that involves mental processes such as problem solving, decision making, reasoning and hypothesis analysis used to complete scientific research (Johnson, 2002). Activities such as comparing, contrasting, encouraging, generalizing, sorting, classifying, testing, connecting, analyzing, evaluating, and modeling can help students learn to think critically in mathematics lessons (Appelbaum, 2004). Critical and creative thinking skills are not only owned by students, but teachers must create conditions and activities for students to develop critical thinking. (Sellars et al., 2018). For this reason, activities that involve cognitive activities in learning are needed, which include mathematics learning tools that intend to develop critical and creative thinking, which can be applied in the classroom if the teacher uses the right learning model (Edi & Rosnawati, 2021).

Traditional teaching methods that emphasize direct teaching and mechanical question practice have proven ineffective in developing critical thinking skills among students (Chimbunde et al., 2023b; López et al., 2023b). Research shows that a teacher-centered approach, reliance on textbooks as the main source, poor questioning techniques, and traditional assessment methods hinder the development of critical thinking skills (Malmarugan, 2022). In contrast, research shows that interactive, dynamic, and student-centered teaching strategies can improve critical thinking skills (López et al., 2023b). Implementing methods that encourage active participation and student engagement in the learning process, such as problem-based learning and teaching critical reading strategies, has been shown to significantly improve students' critical thinking skills (Chakarvarti, 2023). Therefore, shifting from traditional teaching methods to more interactive and student-focused approaches is essential to effectively foster critical thinking skills. In this context, it is important to re-evaluate teaching methods and look for more effective approaches.

The increasing demand for innovation in learning mathematics education has encouraged educators and researchers to find more effective solutions, one of which is the use of interactive learning media (Alammary, 2019). Interactive media has the potential to enhance the learning experience by making it more interesting and challenging, thus encouraging students to actively participate in the learning process. Utilizing Information and Communication Technology (ICT) offers significant opportunities to develop innovative and efficient learning tools that meet diverse learning styles and needs (Akın, 2022). Using the right learning media through the discovery learning model, teachers will be able to develop students' mathematical critical thinking skills as stated by Hasnunidah (2012), Among the factors that determine the success of developing students' critical thinking skills is the teacher's ability to choose appropriate learning media. This is in line with Mayer (2002) that the right choice of media used in learning can determine the success of developing students' critical thinking skills.

Interactive learning media can be useful for both teachers and students, so its use in educational activities is very effective (Karimah et al., 2017). Interactive learning media involves the use of a variety of media equipped with controllers that can be operated by learners, allowing them to select the learning they want (Karimah et al., 2017). The use of interactive learning media in an educational program is fun because it is designed to be engaging (Syawaluddin et al., 2020). Since the subject matter is already available in the media, students have plenty of time to focus and understand the content of the subject first, and have the opportunity to review and explore the material first. The teacher will have enough time to convey the material being discussed and can relate it to other math materials or other topics by using interactive learning media (Junedi & Sari, 2020).

Lectora inspire is one of the technology-based learning tools that can be used to develop interactive learning content (Murtini et al., 2020). Through the use of this media, students can interact directly with learning materials, explore, and get immediate feedback (Candra et al., 2024). By using various tools contained in lectora inspire, learning materials are packaged in a practical and interesting way, because they contain material, sample questions and their discussions, animations, learning videos, and interactive evaluation questions (Rao Naidu et al., 2021). The evaluation contained in Lectora Inspire, can display feedback that shows correct or incorrect answers, and scores that can be known directly. This makes it easier for teachers to conduct assessments because

scores or values automatically appear. For teachers who are not very skilled in operating computers or laptops, it will be easy to use lectora inspire (Shalikhah et al., 2017). Several studies have shown the positive effect of Lectora Inspire on students' learning outcomes and abilities in various math topics. For example, research shows that the use of Lectora Inspire during the math learning process can improve students' number sense, analytical skills, and understanding of mathematical concepts (Musafa, 2018; Putri & Jumadi, 2021; Simorangkir, 2018). In addition, it was found that interactive learning media based on Lectora Inspire significantly influenced the improvement of students' mathematics learning outcomes (Akbarini et al., 2018; Aprilia et al., 2023). Furthermore, the software has been recognized for its potential in improving student learning achievement and higher order thinking skills (HOTS) in learning (Kurniawan et al., 2023; Vai et al., 2020).

The discovery learning model can help improve students' critical thinking. Based on the advantages of the discovery learning model, namely: 1) develop students' critical thinking, 2) helps students to be able to work together with other students by strengthening their concepts and self-confidence, 3) encourages student participation in learning, 4) fun learning situations, 5) students are trained to be able to learn on their own, 6) students can think and use their skills to find the final result actively in learning (Hosnan, 2014). According to Ardhini et al. (2021) said that the discovery learning model makes students able to make initial hypotheses/assumptions. Students then have to conduct research to draw conclusions. The discovery learning model is a student-centered learning model, meaning that students are actively involved in the discovery learning process starting from identifying problems to drawing conclusions (Ariani et al., 2024; Haeruman et al., 2017; Suparman et al., 2024). Students not only understand the material, but also the concept. Using the right learning media through the discovery learning model, teachers will be able to develop students' mathematical critical thinking skills as stated by Hasnunidah (2012), Among the factors that determine the success of developing students' critical thinking skills is the teacher's ability to choose appropriate learning media. This is in line with Mayer (2002) that the right choice of media used in learning can determine the success of developing students' critical thinking skills.

Integrating Lectora Inspire in the discovery learning model can create a rich and dynamic learning environment. Through Lectora Inspire, educators can design activities that encourage students to seek information, test hypotheses, and conclude independently, especially in learning mathematical concepts with interactive simulations, virtual experiments, or educational games. This study aims to explore the effectiveness of Lectora Inspire media in improving students' mathematics critical thinking skills. The novelty of this research lies in the integration of lectora inspire e with the discovery learning model in mathematics learning, which has not been widely implemented in Indonesia. By combining the advantages of lectora inspire as an interactive learning media and discovery learning as a learning model that emphasizes exploration and discovery, this research is expected to make a significant contribution to mathematics learning innovation. In addition, this research will also explore how these approaches can be adapted to the learning context. The scope of this research includes the development of interactive learning media using lectora inspire, the implementation of the media in the context of mathematics learning in the classroom, and the evaluation of its effectiveness in improving students' mathematical critical thinking skills The results of this research are expected to provide new insights for educators, researchers, and educational policy makers in an effort to improve the quality of mathematics learning.

Method

This research is included in the pre-experimental design with the research design used is a single group design one-group pretest-posttest design, which gives a pretest before treatment then after treatment in the form of a posttest. This study aims to determine students' mathematical critical thinking skills before and after being taught using lectora inspire interactive learning media. One Group Pretest-Postest Design which can be described as follows (Sugiono, 2011);

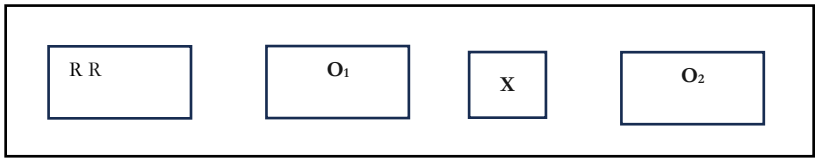

Figure 1. Schematic of Experiment Design

The assessment used in this study is by calculating the number of respondents' answers using the critical thinking skills scoring guidelines in accordance with the indicators used in this study, then the number of correct answer scores for each aspect of observation is divided by the ideal answer score for all aspects of observation multiplied by 100%. (Wahab et al., 2021). The scoring guidelines for critical thinking skills used in this study are as follows:

Table 1. Critical Thinking Ability Scoring Guidelines

Indicators of Mathematical Critical Thinking	Student Response	Score
Identify (I)	No answer, indicating that the student could not mention the main concept of the problem and could not communicate the concept back.	0
	Incorrect in focusing on mentioning the main concept of the problem and re-communicating the idea of the problem.	1
	Can focus on the main idea of the problem and communicate the idea of the problem but inaccurately.	2
	Can focus on the main concept of the problem and rephrase the concept appropriately.	3
Define (D)	Did not provide reasons, indicating that she did not understand the problem.	0
	Incorrect in writing the known information and what is asked, and able to provide information that is not needed.	1
	Can make known information and what is asked and provide information that is not needed, but there are still actions that are less precise.	2
	Can make known information and what is asked and can inform what is not needed appropriately.	3
Enumerate (E)	Could not write down and find a solution strategy.	0
	Incorrectly wrote down and found the solution strategy.	1
	Can write down and find a solution strategy, but there are still steps that are not correct.	2
	Can write down and find a solution strategy with the right steps.	3
Analyze (A)	Not analyzing strategy choices and guessing good answers, indicating that they do not understand the problem.	0
	Incorrect in analyzing strategy choices and guessing good answers.	1
	Can analyze strategy choices and guess good answers, but there are still steps that are not correct.	2
	Can analyze strategy choices and guess good answers with the right steps.	3
List (L)	Did not provide an explanation, indicating that they did not understand the problem.	0
	Provides an explanation but is not in accordance with the information provided	1
	Can explain and relate information, but some are still wrong	2
	Can present an explanation and can relate information appropriately	3
Self - Correct (S)	Did not check back and draw conclusions, indicating that he did not understand the problem	0
	Incorrect in re-examining the solution and drawing conclusions	1
	Can draw conclusions, but there are still steps that are not correct	2
	Can check back thoroughly and draw conclusions with the right steps.	3

Data analysis techniques include prerequisite test analysis and hypothesis testing. The prerequisite test is a test that must be carried out in choosing the right testing technique in proving the research hypothesis. Prerequisite tests include data normality test and variance homogeneity test. The data used for hypothesis testing was obtained by calculating the N-Gain Score using:

$$\text{N- Gain} = \frac{Posttest\ Score - Pretest\ Score}{NMax\ Score - Pretest\ Score}$$ (Hake, 1998)

The category or interpretation of the N Gain Score value can apply the N Gain value directly or in percentage form.

Table 2. Division of Gain Score (N Direct Gain)

N-Gain Value	Category
g > 0,7	High
0,3 ≤ *g* ≤ 0,7	Medium
g < 0,3	Low

(Hake, 1998)

Table 3. Effectiveness Category N Gain (Percentage)

Percentage (%)	Interpretation
> 76	Effective
56 – 75	Moderately Effective
40 – 55	Less Effective
< 40	Not Effective

(Farell et al., 2021)

RESULTS

The mathematical critical thinking ability test was given to students at the beginning of the meeting (pretest) and at the end of the meeting (posttest). The test instrument given is based on indicators of critical thinking skills, namely Identify (I), Define (D), Enumerate (E), Analyze (A), List (L), and Self-Correct (S). Pre test and post test are given to determine the description of statistics learning outcomes using descriptive statistical analysis and to determine the effectiveness or improvement of student learning outcomes using Paired T Test analysis and N-Gain improvement test. Diagram The following shows a comparison of the average pretest and posttest results of the six indicators involved in the class.

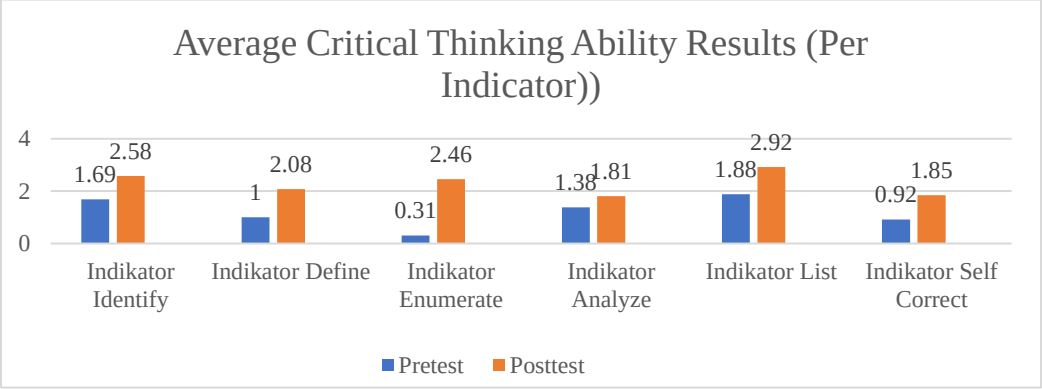

Figure 2. Average Critical Thinking Ability Results (Per Indicator)

When viewed from the diagram in Figure 2, it can be seen that all indicators increased from pretest to posttest. The increase for indicator 1, Identify (I) was 0.89, for indicator 2, Define (D) was 1.08, for indicator 3, Enumerate (E) was 2.15, for indicator 4, Analyze (A) was 0.43, for indicator 5, List (L) was 1.04, and the last indicator 6, Self-Correct (S) was 0.93. From the results of this increase, the Enumerate (E) indicator shows the highest increase. The indicator whose increase is not too high is the Analyze (A) indicator. N-Gain data obtained from pretest and posttest results are presented in the following table.

Table 4. N-Gain Score Calculation Results of Mathematical Critical Thinking Ability

Experiment				
No.	Pretest	Posttest	N Gain	Kriteria
1	44,44	77,78	0,60	Medium
2	38,89	77,78	0,64	Medium
3	38,89	66,67	0,45	Medium
4	5,56	66,67	0,65	Medium
5	33,33	77,78	0,67	Medium
6	33,33	83,33	0,75	High
7	55,56	77,78	0,50	Medium
8	50,00	66,67	0,33	Medium
9	38,89	72,22	0,55	Medium
10	27,78	66,67	0,54	Medium
11	33,33	72,22	0,58	Medium

12	50,00	72,22	0,44	Medium
13	55,56	77,78	0,50	Medium
14	27,78	88,89	0,85	High
15	44,44	83,33	0,70	Medium
16	33,33	55,56	0,33	Medium
17	66,67	88,89	0,67	Medium
18	38,89	66,67	0,45	Medium
19	27,78	83,33	0,77	High
20	50,00	88,89	0,78	High
21	27,78	77,78	0,69	Sedang
22	33,33	83,33	0,75	High
23	44,44	72,22	0,50	Medium
24	38,89	77,78	0,64	Medium
25	44,44	83,33	0,70	Medium
26	55,56	72,22	0,37	Medium
Total			15,4	Medium
Means			0,59	
N-Gain Percentage			59 %	Moderately Effective

The total average N Gain is 0.59 with moderate criteria. When viewed per each category, it is obtained that there are 5 people or 19.23% of students experiencing an increase in the high category. There are 21 people or 80.77% of students experiencing an increase in the medium category. In the experimental class there were no failure criteria. When viewed in terms of the percentage of N-Gain, the results obtained are 59% with fairly effective criteria.

The N-Gain results from the mathematical critical thinking ability test have a sig value. > significant level (0.05) which is 0.538. This indicates that the H0 hypothesis is accepted, which means that the data is taken from a normally distributed population. In other words, the assumption of normality data fulfills the N-Gain mathematical critical thinking ability test results.

After conducting the normality test, the researchers then sought hypothesis testing. The results of the hypothesis test carried out through the paired sample t-test test to determine whether there is a difference between the pretest value and the posttest value. Based on the output results obtained, the Sig. (2-tailed) is below 0.05, which is 0.000, which means H_0 is rejected. In other words, H_1 is accepted, namely that there is a significant difference in the average pretest score and posttest score. Based on the criteria that have been determined, the interactive learning media lectora inspire in discovery learning is effectively used to improve mathematical critical thinking skills.

DISCUSSION

The integration of lectora inspire interactive learning media in the discovery learning model to improve students' mathematical critical thinking skills is done by developing interesting content and encouraging discovery learning (Fuad et al., 2017; Juandi et al., 2022; Suparman et al., 2022; Susiyanti et al., 2022). This is achieved through the incorporation of simulations, animations, interactive quizzes, and exploration activities, which challenge students to think critically. Excerpt (Murtini et al., 2020) highlighted that the development process included collaboration with educational experts and testing on small groups of students to ensure the effectiveness of the media. During the implementation, students were given tasks that required independent exploration and discovery of mathematical concepts. Observations showed that students were more active in asking questions, discussing and working together in completing these tasks. The use of interactive media also helps students understand mathematical concepts better through the visualization and simulation provided. Evaluation of the effectiveness of the learning media was conducted through mathematical critical thinking ability tests before and after implementation.

The results of data analysis showed a significant increase in students' critical thinking skills after using Lectora Inspire interactive learning media. Students showed improvement in the ability to analyze, evaluate, and create

solutions to the mathematical problems given. In addition, students also showed improvement in communication and collaboration skills during the learning process. The research is supported by previous studies that explain the effectiveness of learning media in improving students' critical thinking skills. According to (Hanggara & Suhaeti, 2019) focuses on multimedia-based learning media to improve critical thinking skills. (Matsun et al., 2023; Pamorti et al., 2024) explore the effectiveness of augmented reality-based learning media. In addition, (Irfana et al., 2022) investigated the impact of Android-based media and e-learning on critical thinking skills. These studies collectively show a positive correlation between the use of interactive learning media and the improvement of students' critical thinking skills. Opinion (Hidayati et al., 2024) also emphasized the importance of appropriate learning media in fostering critical thinking skills among students. Then (Fitria et al., 2023; Sastra et al., 2023) explore gamification-based and interactive learning media as an effective tool to improve critical thinking skills. In addition (Rizqiyana et al., 2021; Matsun et al., 2023; Nurchurifiani & Zulianti, 2021), investigated the STEM approach, IoT-based media, and problem-based digital comics in improving students' critical thinking skills. These studies collectively support the idea that innovative learning media can have a positive impact on students' critical thinking skills.

Previous research explains that interactive learning media facilitates two-way communication between teachers and students, encourages increased student activity and has a positive impact on learning outcomes (Murtini et al., 2020). In addition, students show high enthusiasm and engagement in the learning process when interactive multimedia, such as lectora inspire, is used (Sary & Jahro, 2022). Research has shown that the development of interactive learning media, such as "5 Projects for beginners" based on lectora inspire, aims to design an interactive learning tool, assess its feasibility, and evaluate student response (Antara et al., 2018). Educational multimedia, such as interactive operating systems using lectora inspire, helps improve students' understanding and acceptance of the learning process (Wibawa et al., 2017). Analyzing data through descriptive methods and statistical analysis is essential in evaluating the effectiveness of computer-based interactive learning media such as lectora inspire in improving conceptual skills among senior high school students (Fajrina et al., 2018).

Although the research results show many advantages, there are some drawbacks and challenges in implementing this interactive learning media. One of the main challenges is the need for adequate technology infrastructure in schools. In addition, training is needed for teachers to be able to use Lectora Inspire effectively (Heinrich et al., 2020). Some teachers admitted to finding it difficult to integrate this technology in their learning due to lack of experience and technology skills (Bingimlas, 2009). Based on the findings of this study, some recommendations for future implementation include the provision of adequate technology infrastructure in schools, continuous training for teachers to improve their skills in using interactive learning media, further development of interactive content that is in line with the curriculum and students' needs, and the implementation of this approach at various levels of education to test its effectiveness more widely. The study concludes that the integration of technology in learning is important to improve the quality of education in Indonesia. The use of interactive learning media, such as Lectora Inspire in the Discovery Learning model, is proven to improve students' critical thinking skills in mathematics. Appropriate support from policymakers is needed for technology provision in schools and teacher training to achieve better education goals.

CONCLUSION

According to this study, the utilization of lectora inspire interactive learning media in the discovery learning model has a significant positive impact on students' mathematical critical thinking skills. This approach encourages students to actively engage in the learning process and enhances their ability to analyze, evaluate, and solve mathematical problems effectively. By utilizing Lectora Inspire, the presentation of the material becomes more engaging and interactive, which in turn increases students' motivation and promotes deeper comprehension of mathematical concepts. Consequently, it is recommended that the integration of interactive learning media, such as Lectora Inspire, into the discovery learning model should be implemented more extensively as an effective strategy to enhance students' mathematical critical thinking abilities.

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