Effectiveness of Hybrid Learning Models on Critical Thinking Ability in Mathematics Grade V

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Abstract: This study aims to examine the effectiveness of the hybrid learning model on critical thinking skills in class V mathematics learning. The research employs an experimental approach, utilizing the Nonequivalent Control Group Design. The experimental and control groups were not randomly selected but underwent pre-testing. The experimental group was exposed to the Hybrid Learning model, while the control group received the expository model. The study was conducted at two schools, SDN Dengkek 01 (control class) and SDN Sidoharjo (experimental class), with 27 students in each group. The research used the Independent T-test and the N-Gain test for hypothesis testing. The research findings indicate that the hybrid learning approach significantly impacts the critical thinking abilities of elementary school students in mathematics. Notably, the indicator related to problem conclusion achieved the highest average of 90%, indicating that students were proficient in drawing appropriate and accurate conclusions based on the given problems.

Keywords: Hybrid learning, critical thinking ability

1. Introduction

During the Covid-19 Pandemic, distance learning activities were carried out; learning could no longer be carried out expository or face-to-face because there was concern that it could become a cluster of transmission of the Covid 19 virus. Distance learning strives to adhere to educational standards by leveraging technology, such as gadgets, to facilitate connections between teachers and students. This approach ensures that the learning process can continue effectively even when physical classroom interactions are not possible.

Several schools in the Rorosuli Cluster experienced many obstacles in implementing these distance learning activities. Among them are many students who do not have gadgets, some who cannot use devices in education. Additionally, parents expressed concerns as they had to incur additional expenses to purchase credits for online learning. Consequently, a significant number of schools in the Rorosuli Cluster resorted to using only WhatsApp as their primary platform for the learning process.

Some of these obstacles had a significant impact on students particularly in terms of their critical thinking abilities, especially in mathematics (Irwanto et al., 2022). This can be seen when children get math assignments; they always ask, "What are you being told to do, ma'am?" or "How do I solve this, ma'am?". This, of course, affects children's learning outcomes.

Here an educator is required to be able to innovate and be able to choose a learning model that is suitable for children and the pandemic conditions that occur. Amid a pandemic, various learning models, including the hybrid learning approach, can be implemented to continue education effectively.

Hybrid learning, according to Suwanto et al. (2022), is an educational approach that combines the advantages of online learning systems, incorporating innovation and technological advancements, with the active engagement and involvement found in traditional learning models. Hybrid learning is a social process that will occur when face-to-face

learning is disrupted so that distance learning can be used, namely online-based learning (Annisa et al., 2021; Sujanem, 2018).

The hybrid learning model holds the potential to enhance cognitive abilities, particularly critical thinking skills. In an academic setting, mathematics education at schools and colleges plays a vital role in cultivating these skills (Istikomah et al., 2022). Mathematics learning delves into systems, structures, concepts, principles, and the intricate connections between different elements (Syaiful et al., 2022; Adeyemi 2019). However, despite the significance of mathematics in fostering critical thinking, there is still a noticeable deficiency in this area, especially among students. The limited development of critical and creative thinking skills is evident from the weak reasoning abilities of learners (Rigusti et al., 2020). This inadequacy becomes apparent when students encounter descriptive questions and word problems in math tests, and a considerable number of them struggle to comprehend and solve these types of questions.

1.1 Conceptual Framework

Effective learning involves the acquisition of specific skills, knowledge, and attitudes, empowering students to grasp valuable information, master essential skills, and achieve desired learning outcomes. This type of learning equips students with practical facts and abilities that they can apply in real-life situations. Effective learning can shape students' morality, and the habit formed is an act done repeatedly (Prabowo et al., 2021; Cai et al., 2015).

Ideally, the expected learning is effective learning. The word practical comes from English, a verb from the adjective effective. Astuti & Abadi, (2015) stated that "*effectiveness provides an answer to the question, "Have students met the learning goals established for each unit of the course?"*". Effectiveness is a response to the question, "To what extent do students achieve the learning objectives specified for each lesson unit?" This shows that the effectiveness of learning is the level of achievement of predetermined teaching goals (Astuti & Abadi, 2015).

There are several critical aspects of effective learning (Astuti & Abadi, 2015), i.e., clarity, variety, task orientation (Task Orientation), Student involvement in Learning (Engagement in Learning), and High Achievement of Student Success.

In addition to effectiveness, learning also requires an appropriate learning model. One such model is the Hybrid Learning approach, which integrates various learning methods, including Traditional Classes (TC) for expository teaching in a classroom, Real Workshops (RW) utilizing computers for hands-on learning, and Virtual Workshops (VW) conducted through internet-based platforms. *Hybrid Learning* aims to deliver the most effective and efficient learning experience by blending traditional face-to-face class meetings with the integrated management of the e-Learning environment, referred to as the *Traditional Classes-Real Workshop-Virtual Workshop* (TC-RW-VW) approach (Tukur et al., 2023).

Hybrid learning is an educational method that blends traditional face-to-face (F2F) instruction with computer-mediated instruction. This approach encompasses not only in-classroom learning but extends to learning activities conducted outside the physical classroom, often known as online learning. By adopting the hybrid learning model, students engage in a broader range of activities, fostering active and student-centered learning (Zein et al., 2019). *Hybrid learning makes learning in the classroom and online networks based on quality; hybrid learning can also recognize each student's learning style* (Prabowo et al., 2019).

The stages in *hybrid learning* in this research are as follows: 1) presentation of material by the teacher; this stage will be carried out by making several video practice questions which will be given via *WhatsApp*; 2) giving practice questions at this stage after studying the tutoring submitted by students, they are required to answer practice questions; 3) the use of internet services to help with practice questions; 4) discussion of practice questions, at this stage, an answer will be given when students have tried to answer the exercise questions provided via the internet service, namely *WhatsApp* (Adharini & Herman, 2020).

The implementation of the hybrid learning model is expected to enhance critical thinking skills in the context of learning mathematics. According to Nurkholifah et al. (2018), critical thinking skills involve students' capacity to analyze and assess information to determine its credibility, enabling them to derive valid conclusions from the information presented.

The indications of mathematical critical thinking abilities considered in this research include: 1) the ability to identify; 2) the ability to generalize; 3) the ability to analyze algorithms; and 4) the ability to solve problems. Students require essential mathematical critical thinking skills to enable them to make rational decisions and optimal choices for themselves. Moreover, inculcating the practice of critical mathematical thinking in students is crucial as it empowers them to analyze and address diverse challenges encountered in their daily lives (Samura et al., 2022).

The possession of critical thinking skills is paramount for students as it involves the process of reaching informed beliefs and making decisions about actions to take (Sumarmo et al., 2012). Despite this importance, students often encounter challenges in their mathematical critical thinking endeavors, particularly in analyzing questions, answers, relevant arguments, and re-evaluating statements or processes. This may lead to difficulties in arriving at accurate conclusions, as they may struggle to provide the correct or incorrect results (Sayekti, 2022; Adharini & Herman, 2020).

According to Susanto (2013), critical mathematical thinking involves the mental activity of contemplating ideas or concepts related to a given problem or concept. On the other hand, Ennis (2011) defines critical mathematical thinking as a process through which one can make rational decisions about the validity of beliefs and perform them accurately.

Drawing from these perspectives provided by various experts, it can be inferred that the capacity for critical mathematical thinking is a practical cognitive skill that enables an individual to assess, evaluate, and decide on what to believe or how to act (Bamiro, et.al., 2020; Yolanda, 2019).

1.2   Research Objectives

Our research objective is to assess the effectiveness of a hybrid learning model on the development of critical thinking skills in fifth-grade mathematics learning.

2.   Methodology

The methodology employed in this study is experimental research. Both the experimental and control groups were not randomly chosen but underwent a pre-test assessment. Each group was subjected to distinct treatments, with the experimental group exposed to the Hybrid Learning model, while the control group received instruction through the expository model. The study culminated with a final test conducted for each group.

2.1   Respondents of the study

Research subjects are individuals, objects, or organisms used as a source of information for collecting research data. In quantitative research, the determination of research subjects is carried out when the researcher begins to make a research design.

This research was conducted in class V, Public Elementary School Gugus Roro Suli, consisting of Public Elementary School No. 01 Dengkek, with 27 students, Public Elementary School Sidoharjo, with 27 students, and Public Elementary School Geritan, with 31 students. The research subjects were Public Elementary School 01 Dengkek, as the control class, Public Elementary School No. 01 Sidoharjo, as the experimental class 1, and Public Elementary School Geritan, as the experimental class 2. The selection of research subjects was based on consideration of the homogeneity of the average grade V learning outcomes.

Data collection techniques refer to what methods need to be carried out in research in order to obtain data. These techniques can involve direct or indirect approaches to obtain information. Data collection techniques carried out by researchers are as follows, Observation, Questionnaire, and Test.

In this research, the form of the test questions used is a description test, and the selection of questions in the form of this description aims to find out how far students can understand the material. In general, this essay test requires students to be able to describe, explain, discuss, compare, and give reasons using their own words and language. This test instrument was used during *the pretest* and *posttest,* with the characteristics of the questions in each test being identical. This study uses inferential statistical data analysis to test the parametric hypothesis, namely the independent T-Test, and N-Gain.

3.   Results and Discussion

3.1   Results

The research results are aligned with the research goal, which is to assess the impact of the hybrid learning model on enhancing critical thinking skills in elementary school mathematics education. The experimental group engaged in learning activities using the hybrid learning approach, while the control group followed the conventional learning model. The findings revealed that the hybrid learning model significantly improved critical thinking skills among fifth-grade students in elementary school mathematics.

Completeness test in fifth-grade elementary school mathematics learning (experimental class) Elementary School No. 01 Sidoharjo, was conducted to determine individual and classical completeness and critical thinking skills. Table 1 displays the students' classical and individual completion of the cognitive learning outcomes from the pretest data.

Table 1 - Critical thinking ability pretest

Intervals	Frequency	Percentage	Category
86-100	1	4%	Very good
71-85	6	22%	Good
56-70	12	44%	Enough
41-55	8	30%	Not enough
< 40	0	0%	Very less
Amount	27	100%	
Average value		66,25	
The highest score		87	
Lowest Value		45	
Classical Mastery		52%	

It is evident from Table 1 that after the implementation of *the pretest* in the results of critical thinking skill. Excellent results were achieved by 1 student, representing 4% of the participants, while 6 students (22%) demonstrated good results. The moderate results category included 12 students, comprising 44% of the participants. Students with lacking results accounted for 8 individuals, making up 30% of the total, and there were no students with inferior results. The completeness of new students reached 52%, and students who had not completed reached 48% with an average grade of 66.25. The research findings suggest that the students' critical thinking skills are relatively deficient. Fig. 1 provides more information about the outcomes of students' critical thinking abilities.
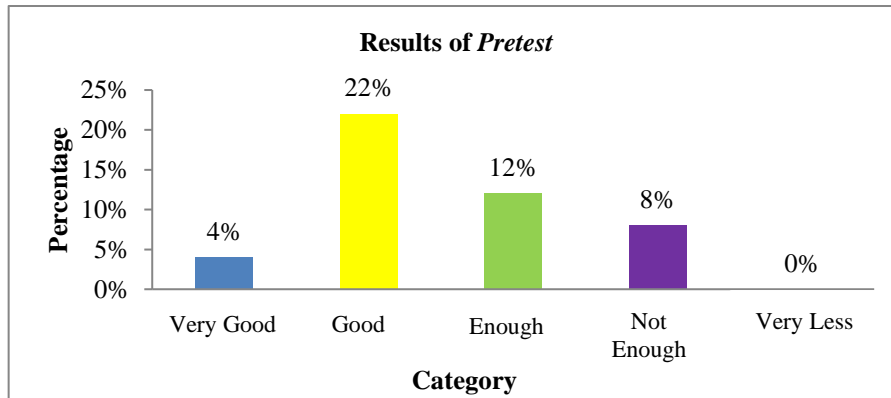

Fig. 1. Critical thinking ability result diagram pretest

Furthermore, students who complete and students who do not complete can be seen in Fig. 2.
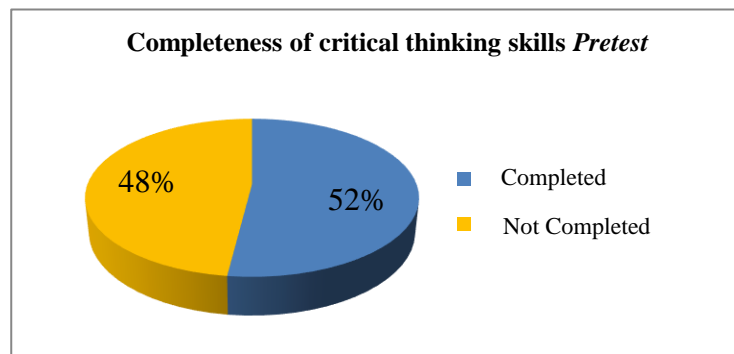

Fig. 2. Diagram of completeness of critical thinking ability cognitive pretest

The mean score for pretest critical thinking skills is 66.25. However, only 52% of the students who completed classical training achieved this level, while those who did not complete it reached 48%.

The data obtained from the pretest results in the experimental class 1 showed individual and classical mastery in learning Mathematics in class V Public Elementary School No. 01 Sidoharjo, which was still low. Then action is taken with the *hybrid learning model*.

Table 4 presents the posttest results of critical thinking skills in elementary mathematics learning activities for Class V at Public Elementary School No. 01 Sidoharjo, conducted using the hybrid learning model.

Table 2 - Results of critical thinking ability posttest

Intervals	Frequency	Percentage	Category
86-100	10	37%	Very good
71-85	11	41%	Good
56-70	5	18%	Enough
41-55	1	4%	Not enough
< 40	0	0%	Very less
Amount	27	100%	
Average value		81.70	
The highest score		100	
Lowest Value		55	
Classical Mastery		93%	

Based on Table 2, it is evident that following the administration of the posttest in the outcomes of critical thinking abilities, the results show that 10 students, accounting for 37% of the participants, achieved excellent results, while 11 students (41%) demonstrated good results. The moderate results category included 5 students, making up 18% of the participants. There was only 1 student (4%) in the lacking results category, and no students obtained inferior results. The student completion rate has reached 93%, leaving 7% of students who are yet to finish, and they have an average grade of 81.70. These findings suggest that students' cognitive learning outcomes are relatively low. For more details, Figure 3 displays students' cognitive learning outcomes.
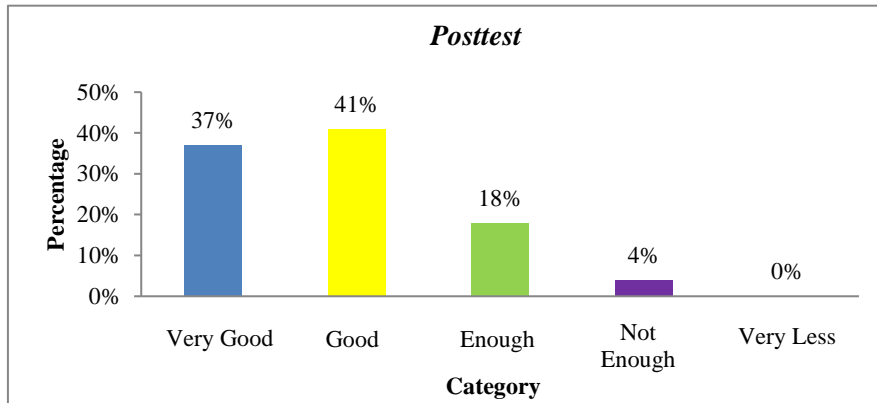

Fig. 3. Posttest cognitive learning outcomes diagram

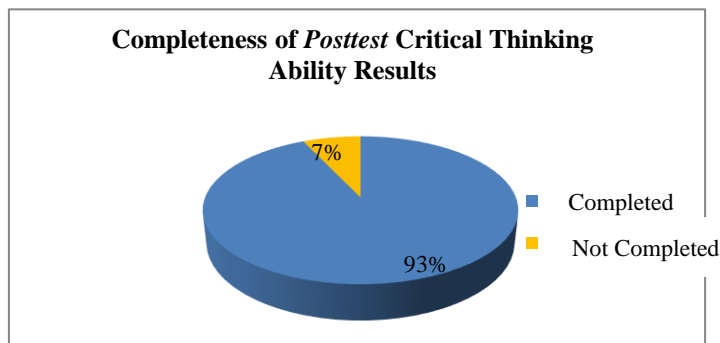Furthermore, students who complete and those who do not can be seen in Fig. 4.

Fig. 4. Posttest cognitive learning outcome completeness diagram

The *posttest* cognitive learning outcomes have an average value of 81.70, with a classical completeness rate of 93% for students who have completed. In contrast, students who have not completed have a completion rate of 7%.

Based on the results of classical mastery and individual *pretest,* the action was taken with *hybrid learning*. The findings of the critical thinking abilities posttest indicated an improvement. Table 3 provides a comparison of the growth in the outcomes of cognitive learning and the development of critical thinking skills.

Table 3 - Comparison of pretest to posttest data results

Variable	Research data	*Pretest*	*Posttest*	**Ascension**
Critical Thinking	Average value	67,10	81.51	14,41
Ability Results	Classical Mastery	48%	93%	45%

Based on Table 3, the cognitive learning outcomes of *pretest students* show an average value of 67.10 with 48% classical completeness. After implementing the hybrid learning model, the posttest results demonstrated a significant improvement in students' critical thinking abilities, with an average score of 81.51 and a classical completeness rate of 93%. This indicates a clear increase in critical thinking skills from the pretest to the posttest.

From the data that has been described, it can be concluded that hybrid learning is successful in raising students' critical thinking skills. This conclusion is drawn from the observed increase in average class scores and individual completeness or classical completeness.

Table 4 shows the differences in levels between the experimental class and the control class, illustrating the variation in rise based on the results of the pretest and posttest.

Table 4 - Differences in pretest to posttest classical completeness experiment class and control class

Variable	Research data	Pretest		Posttest	
		Experiment Class	Control	Experiment Class	Control
Critical Thinking Ability Results	Classical Mastery	48%	30%	93%	50%

According to the data presented in Table 4, the pretest results for critical thinking skills in the experimental class students were 48%, while in the control class, it was 30%, resulting in a difference of 18%. After the posttest, the critical thinking skills of the experimental class students improved to 93%, whereas the control class reached 50%, with a difference of 43%. These findings demonstrate that utilizing the Hybrid Learning model significantly enhances students' critical thinking abilities compared to conventional teaching methods.

An independent sample t-test was employed to assess disparities in the effectiveness of the hybrid learning model on students' critical thinking skills in elementary mathematics learning. The variation in effectiveness was measured based on the average scores from the post-test results. This test compared the average difference between the experimental class 2 and the control class. Detailed results of the independent sample t-test for students' critical thinking skills can be found in Table 5.

Table 5 - *Posttest* t test critical thinking ability

Sig. 2 tailed	α	Means		Information
		Experiment	Control	
0.00 _	0.05	80. 82	64,15	There is an average difference in students' critical thinking skills.

Based on the post-test t-test table provided, the significance value indicates the number $0.00 < 0.05$. This indicates a significant difference in the average values of students' critical thinking skills between the experimental and control classes after the learning process. Analyzing the mean values, it is evident that the experimental class achieved an average score of 80.82, while the control class obtained a mean score of 64.15. These results clearly demonstrate that the average critical thinking ability of students in the experimental class is higher than that of students in the control class.

3.2   Discussion

The study took place at Public Elementary School No. 01 Sidoharjo, and involved an experimental class utilizing the hybrid learning model, while Public Elementary School No. 01 Dengkek, was designated as the control class. The research focused on students from class V, with a total of 54 participants evenly distributed between the experimental and control classes, each containing 27 students.

The initial condition of students before conducting the research was obtained from the *pretest scores* of students from both classes; the average score was almost the same. This is due to the absence of the use of learning models.

The test questions were carried out in class V at Public Elementary School No. 01 Sugiharjo. Test questions were given to class V, consisting of 57 students, with details of 29 students from class VA and 28 from class 5 B. The results of the test questions were then tested for validity, reliability, difficulty level, and discriminating power before being used as a research instrument.

The purpose of this study is to evaluate the impact of employing a hybrid learning model on developing critical thinking abilities in mathematics learning at Public Elementary School Sidoharjo as well. Learning was carried out on geometric materials, namely the value of cubes and blocks, using *Experimental Design*.

Following the pretest, numerous students raised questions regarding the answers to the presented questions. However, once they underwent the hybrid learning model treatment, there was a noticeable change. During the posttest, the students seemed to have become more focused and serious, working diligently on the problems without asking for answers.

Based on the analysis of students' responses on each critical thinking skills indicator, it can be confidently stated that hybrid learning has a positive influence on enhancing students' critical thinking abilities. This positive impact can be attributed to the nature of hybrid learning, which involves presenting students with problems to solve. By engaging with these problems, students are encouraged to analyze situations before taking action, consider various solutions, and explore alternatives, all of which contribute to the development and emergence of their critical thinking skills. The current findings align with previous research conducted by Mulyanto et al. (2018), which revealed that the hybrid learning model positively and significantly impacted the critical thinking skills of fifth-grade elementary school students in the context of Mathematics. Additionally, Nikmah et al. (2020); Astuti & Abadi (2015), conducted a study where she observed

differences in the critical thinking skills of students who were taught using the hybrid learning model compared to those who received instruction through experimental learning 2. Moreover, the research highlighted that the interaction between hybrid learning and students' intelligence levels also played a role in influencing the extent of their critical thinking skills.

Hermawan et al. (2021) research states that the test results clearly demonstrate that the hybrid learning model has a significant positive impact on empowering students' critical thinking skills in comparison to the conventional model. In the research of Sulistyanto (2021), the results achieved in their research showed that the critical thinking skills of students participating in hybrid learning were relatively high.

5. Conclusion and Recommendation

Based on data collected and data analysis about the effectiveness of the hybrid learning model on students' critical thinking abilities, it can be said that the model is successful in developing students' mathematical critical thinking abilities during the study of elementary mathematics.

The study comparing elementary mathematics learning using hybrid and conventional learning models revealed a disparity in the average critical thinking abilities and cognitive learning outcomes of the students. Notably, the indicator related to drawing conclusions exhibited the highest average score, reaching 90%, indicating that students successfully draw accurate conclusions for the given problems.

Based on the findings and subsequent discussions, the researcher offers two recommendations to enhance the study. Firstly, there should be an addition of an influence analysis, which will help determine the extent to which various variables impact the critical thinking abilities and learning outcomes of the students. Secondly, a correlation analysis is suggested to assess the relationships between different variables, shedding light on how they are interconnected within the context of elementary mathematics learning.

Acknowledgment

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