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Improving Students' Critical Thinking Skills in Mathematics with The CTL Approach

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ABSTRACT

The low results of students' critical thinking skills in mathematics subjects with the CTL approach at MI Uswatun Hasanah Jagapura Kulon on Fraction material. This study aims to determine how to apply the CTL approach in improving students' critical thinking skills in mathematics subjects at MI Uswatun Hasanah Jagapura Kulon and improve students' critical thinking abilities in the field of mathematics subjects with the CTL approach at MI Uswatun Hasanah Jagapura Kulon. This research is a class action research conducted in 2 cycles, and the research subjects are students of class III-A MI Uswatun Hasanah Jagapura Kulon, which amounted to 21 students. Test results and observations obtained data on critical thinking skills in math lessons with the CTL approach. CTL contextual learning steps include constructivism, inquiry, questioning, learning community, modeling, reflection, and authentic assessment. The results showed a significant increase from pre-cycle to Cycle II, with the percentage of completeness increasing from 19.04% to 85.71%, showing an increase in the criteria for critical thinking skills from "not critical" to "very critical."

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1. INTRODUCTION

Mathematics is a subject taught at every level of education, from elementary school to college, and learning it is a prerequisite for continuing to the next level. The term "mathematics" has its roots in the Latin word "mathematica," which itself is derived from the Greek "mathematike," meaning "the study" or "that which is learned" [1]. This etymology emphasizes the intrinsic connection between mathematics and the process of acquiring knowledge, highlighting its role as a foundational discipline in education. In contrast, the Dutch term for mathematics, "wiskunde," translates to "exact science," reflecting a cultural perspective that emphasizes precision and logical reasoning in mathematical practice [2]. This distinction underscores the dual nature of mathematics as

both a field of study and a rigorous science, where reasoning plays a crucial role in problem-solving and understanding complex concepts. The relationship between these terms illustrates how different cultures perceive mathematics not only as a technical skill but also as a vital component of intellectual development and critical thinking [1], [2].

According to Permendikbud No. 21 of 2016, in Mathematics lessons at the primary level, the aim is to develop positive attitudes towards mathematics, such as accuracy, thoroughness, honesty, responsibility, perseverance in solving problems, as well as curiosity, enthusiasm for continuous learning, confidence, and interest in mathematics through learning experiences [3].

Susanto argues that mathematics learning is how teachers teach and learn to improve students' thinking and creativity, enhance their ability to understand new knowledge, and attain a high understanding of mathematics [4]. Mathematics is a science that studies abstract concepts arranged using symbols and is an exact language, careful and free from emotions, so creativity in thinking is needed [5]. Mathematics fundamentally explores abstract concepts through symbols, forming a precise language that facilitates clear communication of complex ideas and relationships, thereby fostering logical reasoning and problem-solving skills [1]. The ability to manipulate symbols and engage with mathematical narratives is crucial for students, as it aids in their understanding of the underlying principles of various phenomena [1]. However, the study of mathematics is not solely about rote memorization or algorithmic processes; it requires creativity in thinking, which combines logical and divergent thought processes [2]. Creative thinking in mathematics is characterized by the ability to generate novel solutions and approaches to problems, reflecting a deeper engagement with the material [6]. This interplay between structured reasoning and creative exploration is essential for developing a comprehensive understanding of mathematical concepts, ultimately enhancing students' mathematical fluency and problem-solving capabilities [7], [8].

Effective learning in the classroom is when the teacher facilitates and creates a pleasant learning atmosphere because this directly impacts student learning outcomes [9]. The ideal approach to learning focuses on students and relates it to mathematical situations in everyday life, aiming that students are interested in learning mathematics, which is considered essential and valuable. According to Wragg, Effective education also includes the ability for students to acquire relevant knowledge, such as facts, skills, values, concepts, and ways of living in harmony with others or a required educational outcome [10].

Critical thinking skills are essential in learning mathematics because they allow a person to infer information, use that information in solving problems, and find relevant sources of information [11]. Critical thinking is the ability of a person to obtain information and solutions to a problem by asking himself to investigate the information at his disposal [12]. Critical thinking involves analyzing, solving problems, and evaluating opinions in a disciplined, logical, and in-depth manner. Every student must develop critical thinking skills to help them overcome real-world problems.

This is because, in the learning process, students will naturally challenge the information received and use their thinking skills to analyze and evaluate problems with

logic. Critical thinking involves a purposeful and straightforward reflective process to solve problems, make decisions, and assess assumptions to determine appropriate action.

Jumaisyaroh et al. argue that math critical thinking is a practical thinking skill that can help a person to make, evaluate, and decide what he believes or does not believe[13]. There are several stages in critical thinking, namely: 1) Focus, 2) Reason, 3) Inference, 4) Situation, 5) Clarity, and 6) Overview [14].

Based on interviews with several students, they consider math difficult because it requires understanding detailed formulas and numbers and high accuracy and concentration. The results of interviews with class teachers show that students' critical thinking skills are still lacking, as seen from the Mathematics written test scores on Fractions, which show that only 28.6% of students reached the minimum completion criteria of 70%. The class average score was 61.5%, with a percentage of students who completed 28.6% (6 students) and a percentage of students who did not complete 71.4% (15 students). Most students struggle to apply and understand the problem and cannot relate the material to real life.

Methods to improve students' critical thinking skills can be applied to the Contextual Learning Approach (CTL) method. CTL helps teachers relate subject matter to students' real lives so that students can more easily understand the material. This approach Encourages students to connect the knowledge they have acquired with their daily lives so that student's knowledge and skills develop through their construction during the learning process.

The components of the Contextual Learning Approach, according to Hosnan, have five strategies to achieve maximum student competence: relating, experiencing, applying, cooperating, and transferring. According to Trianto, context learning has seven main components: constructivism, questioning, inquiry, community learning, modeling, reflection, and authentic assessment [15].

Previous research conducted by Sulastri, with the title "Application of contextual approach (CTL) in mathematics learning," aims to evaluate the application of contextual approach (CTL) in mathematics learning to improve the understanding of mathematical concepts among elementary school students. This study involved fourth-grade students with a research subject of 34 students. The results showed that students' understanding of mathematical concepts improved significantly after applying the contextual approach, with an increase of 23% from Cycle I to Cycle II. This was characterized by increased student activity and enthusiasm during the learning process.

From the description above, there is a gap between the learning objectives of mathematics, including critical thinking skills, and the reality of the field. In order to develop students' critical thinking skills, it is essential to involve them actively in the learning process.

Based on the background of the problem above, researchers are interested in examining the use of CTL to improve critical thinking skills. Through research entitled "Improving Students' Critical Thinking Skills in Mathematics with the CTL Approach." This research focuses on fraction material.

2. METHODS

According to Priyono, a research method is to do something by applying the mind in a way that's focused on achieving its objective [16]. This study used classroom action research to improve student's critical thinking skills in class III-A Mathematics at MI Uswatun Hasanah Jagapura Kulon with the CTL Learning Approach. The research consists of several cycles with four stages, planning, action, observation, and reflection, to improve in the next cycle. This study uses the five stages of contextual learning mentioned by Hamdayama, namely building meaningful relationships (Relating), doing something meaningful (Experiencing), collaboration (Collaborating), critical and creative thinking (Applying), and developing individual potential (Transferring) [17].

Jalil states that educators proficient in PTK usually have an excellent professional attitude. By conducting PTK regularly, teachers can understand students better. In this research, the teacher designs provides treatment, observes, evaluates, and analyzes the results to determine the success of the action provided in improving classroom conditions. The information helps the teacher determine the next steps [18].

Classroom action research (PTK) is an observation and intervention in the learning process in the classroom. Arikunto explains that in PTK, teachers deliberately pay attention and take actions designed together in the classroom [19]. This research method uses a design consisting of two cycles: the Kemmis & McTaggart model and the Kurt Lewin model. According to the Kemmis and Mc Taggart model in Arikunto, four main activities are involved in the research flow: planning, implementation, observation, and reflection. These stages begin with planning, where the researcher details what, why, when, where, by whom, and how the action will be carried out [20]. Implementation is the implementation step of planning, which includes learning strategies and scenarios. Observation is the process of monitoring the implementation of actions as they take place. Meanwhile, reflection is a comprehensive evaluation of the actions taken to improve the following steps based on the data collected.

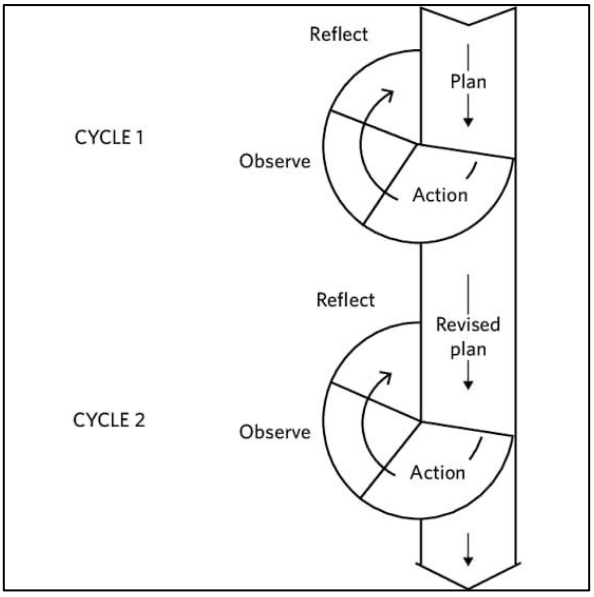

Figure 1. Action Research Cycle [21]

According to Arikunto, population refers to all research subjects [22]. Sugiyono reveals that the population includes a generalization area of objects or subjects with specific characteristics and features specified by the researchers for study and conclusions [23]. This shows that the population comprises humans and things or beings in the natural world. Populations include not only the number of individuals in an object or subject of research but also all the characteristics of the object or subject. Therefore, the population is the totality of subjects or objects that are the research focus, considering the characteristics relevant to the research objectives. In this context, the research population is all male and female students who attended MI Uswatun Hasanah Jagapura Kulon in the 2020/2021 school year, totaling 269 students.

Sugiyono explains that the sample is part of the number and characteristics of the population under study. Thus, the sample represents the existing population, so the research and samples taken have something in common with the population. The research was conducted in class III-A MI Uswatun Hasanah Jagapura Kulon, where there are 21 students to be studied, consisting of 9 girls and 12 boys. All students in the class became research subjects. This research was conducted in the even semester of the 2020/2021 academic year. The research was conducted from November 01 to 13, 2021, at MI Uswatun Hasanah Jagapura Kulon, located on Jl. Raya Jagapura Kulon, Gegesik District, Cirebon Regency.

In this study, data collection techniques consisted of tests and non-tests. Tests are used to measure or know something with predetermined rules, whereas researchers use essay questions in Mathematics subjects for class III-A. Tests were conducted at the end of each cycle to evaluate students' critical thinking skills related to fraction material. Observation is a way to collect data by observing ongoing events and recording them using observation tools to investigate things [24]. Observation is used to observe learning activities in the classroom, including teacher activities in delivering material and student activities during learning. Observations were made to evaluate the application of the CTL approach in improving students' critical thinking skills in Mathematics. Documentation was conducted during the learning process by taking photos and evaluation questions, which would then be used to strengthen the analysis of the research results.

This study's data collection instruments included test questions, observation sheets, and interviews. The test questions contained questions related to the competency standards of fraction material in the form of essay questions. The goal was to assess the improvement of students' critical thinking skills after the action was taken. The test questions were tested twice, in cycles I and II, to measure the progress of critical thinking per the specified indicators. The observation sheet provided an overview of students' critical thinking skills during learning. The focus was to assess the effectiveness of applying the CTL approach in improving students' critical thinking skills in Mathematics, especially fraction material. Using an unstructured interview approach, interviews were conducted with students and homeroom teachers. The purpose was to gain insight into students' activities, responses, and attitudes toward learning Mathematics with the CTL approach. Interview guidelines were prepared to guide researchers in conducting interviews with students and homeroom teachers of class III-A at MI Uswatun Hasanah Jagapura Kulon.

Sugiyono explains that data analysis is a systematic process of compiling and organizing data from interviews, field notes, and documentation. This process involves organizing data into categories, dividing it into units, synthesizing, arranging patterns, selecting important information, and making conclusions so researchers and others can easily understand them. This research uses descriptive analysis, focusing on the reflection of each action cycle for learning improvement in the next cycle. The data obtained included observation sheets, interview results, and learning outcomes for each cycle [25].

Data analysis was conducted qualitatively, starting at the time of data collection and continuing after data collection was completed in each period. Data processing and analysis were carried out throughout the research, from the beginning to the end of implementation. Observations were made by paying attention to teachers and students during learning. This observation is limited to using an observation sheet that records the observed activities and shows the level of these activities with the percentage in formula (1)

$$P = \frac{F}{N} \times 100\% \quad (1)$$

Description:
P = Percentage number
F = Frequency of activity that appears
N = Total number of activities

Creating a percentage range for the categories of teacher and student observation assessment criteria consisting of various criteria.

Table 1. Categories of Assessment Criteria for Teacher and Student Activity Observation Results

Value	Criteria
0% - 39%	Not Critical
40% - 55%	Less Critical
56% - 65%	Critical Enough
66% - 79%	Critical
80% - 100%	Very Critical

Documentation in this study involves taking photographs of student activities during learning and other relevant documents, which aim to serve as evidence of the research implementation.

Quantitative analysis was conducted on student test results, where the average test score was calculated at the end of each cycle, and the results were described. Students' critical thinking skills must reach the Minimum Completeness Criteria (KKM), which is at least ≥70 at MI Uswatun Hasanah for Fraction material in grade III. Test score data is used to analyze students' critical thinking skills.

To evaluate the level of learning completeness, the data were analyzed using descriptive percentage analysis techniques and specific formulas.

$$P = \frac{F}{N} \times 100\% \quad (2)$$

Description:
P = percentage
F = Frequency of student answers
N = Total number of students

3. RESULTS AND DISCUSSION

3.1 Application of Contextual Teaching and Learning (CTL) Approach

This Classroom Action Research (PTK) was conducted in class III of MI Uswatun Hasanah Jagapura Kulon, Gegesik District, Cirebon Regency. According to Aqib, classroom action research is a form of inquiry carried out by teachers within their classrooms, focusing on self-reflection to enhance their efficacy and ultimately elevate student learning outcomes [26]. This classroom action research aims to enhance students' critical thinking abilities in mathematics, specifically focusing on the fraction topic through implementing the Contextual Learning Approach. This research action was carried out in 2 cycles. Each cycle consists of two meetings; each meeting consists of 2 lesson hours or 2x35 minutes.

The pre-cycle was carried out on November 01-03, 2021, attended by 21 students, 12 male and nine female students. The pre-cycle stage was carried out to obtain initial data regarding the results of students' critical thinking skills with the CTL approach in the mathematics subject of fraction material before taking action. The data obtained at this pre-cycle stage can be through observation and test results.

The first cycle meeting I was held on Thursday, November 04, 2021. All third-grade students of MI Uswatun Hasanah Jagapura Kulon attended the learning activities. The material used in implementing learning is fraction material, and the media used at the first meeting is a banana. Implementation of actions using the CTL approach to improve students' critical thinking skills.

The second meeting of cycle I was held on Friday, November 05, 2021. The learning activities were continuing the material about fractions using the CTL approach.

The teacher divides the students into groups. Each group solves the fraction drawing problems and then discusses the answers with the teacher. The teacher explains the material further, and students ask questions. Some students actively ask questions; the rest are silent. The teacher explains and summarizes the material again. Observations showed that it was according to plan, but there were shortcomings, such as students who were reluctant to ask questions. In the second meeting, the learning implementation was as planned, showing progress.

In Cycle I, the focus was on applying the CTL Approach to improve students' critical thinking skills by using concrete objects around the classroom. According to Taniredja, Contextual Teaching and Learning is an educational approach that supports

educators in relating the curriculum to students' real-life experiences, fostering connections between their knowledge and its practical application in everyday situations [27].

Before starting the research, planning is essential to ensure the smoothness and applicability of the activities. Cycle I planning included the preparation of lesson plans, preparation of test questions and groups, preparation of fraction materials, procurement of teaching materials and learning media, and preparation of observation sheets to strengthen test data. The action plan in Cycle II still follows the same pattern as Cycle I, but pays more attention to the results of Cycle I reflection to overcome obstacles that may arise.

Observation is used to determine the application of the CTL approach. The observation stage was carried out together with the implementation of the action. Peers and class teachers made observations. The first meeting of cycle II was held on Monday, November 08, 2021. All third-grade students of MI Uswatun Hasanah Jagapura Kulon attended the learning activities. The material used in the implementation of learning is fraction material, and the media used is Omelet. The second meeting of Cycle II was held on Tuesday, November 09, 2021. The learning activities were continuing the material about fractions using the CTL approach. In the core activities, the teacher applies the CTL approach. Students are divided into new groups. The teacher asked questions and answers about fraction material and examples of concrete objects around the school. This improved students' critical thinking skills.

Second, the teacher serves as a facilitator. From the students' questions, the teacher explained a little about fraction material and examples of fractions through concrete objects around the school. Third, the teacher asks students to understand the core material and practice fraction values with concrete objects. Encourage passive students to actively ask questions and provide direction. Giving group assignments, paying attention to work, and giving directions to passive students to improve cooperation. Fourth, each group presented the results of their cooperation with the example of fractions. Students were more active in asking questions compared to Cycle I. The teacher discusses the questions together to improve the answers. Confirming students' learning experience and motivating the group. Students ask questions before working on individual problems. In the final activity, the teacher and the students make conclusions about the material they have learned, ask questions to stabilize it, and convey the plan for the next meeting. Then, close it by reading Hamdalah together, praying, and saying greetings.

Table 2 shows increased teacher skills in applying the CTL approach in each cycle. Teacher skills improved from cycle I to cycle II. The percentage of teacher skills that were successful increased in each cycle. In each cycle I, the percentage of teacher success of 92.5% increased in cycle II to 97.5%.

Table 2. Results of Recapitulation of the Application of the CTL Approach Cycle I and Cycle II

No.	Indicator	Score	Value
		Cycle I	Cycle II
1	Introduction Activity	12	12
2	Core Activities	18	19
3	Closing Activities	7	8
4	Total	37	39
5	Percentage	92,5%	97,5%
6	Criteria	Very good	Very good

The minimum completeness criteria (KKM) for MI Uswatun Hasanah Jagapura Kulon mathematics lessons is 70. The results of students' critical thinking skills in the Pre-Cycle with the CTL approach were completed or reached the KKM of 70, with as many as four students at 19% and 17 students at 81%. The test results show that the class average score is 59.04%, with the highest score of 70 and the lowest score of 30.

3.2. Improvement of Students' Critical Thinking Skills with the CTL Approach

According to Handayani, critical thinking is a thought process in making decisions according to beliefs that can be proven correct through various strategies [28]. Meanwhile, according to Dewey (in Yaumi), the capacity for critical thinking involves actively comparing one's thought processes by gathering information from diverse sources [29]. Therefore, question-and-answer activities and discussions are essential strategies teachers employ to enhance students' critical thinking abilities.

Based on the research results, in the pre-cycle using the CTL approach, 21 students completed or reached the KKM, namely 70, 4 students with a percentage of 19%, and 17 students who did not complete, with a percentage of 81%. The total score obtained was 1,240, with an average student score of 59.04%, with the highest score of 70 and the lowest score of 30.

Table 3. Results of Recapitulation of Students' Critical Thinking Ability in Mathematics Subjects with Pre-Cycle CTL Approach

No.	Description	Pre Cycle Results
1	Number of students	21
2	Number of students who completed	4
3	Number of students who did not complete	17
4	Total score obtained	1240
5	Average student score	59,04%
6	Percentage of completeness	19%
7	Percentage of non-completion	81%

In cycle I, with the CTL approach, 21 students completed or reached the KKM, namely 70, as many as 16 students with 76%, and students who did not complete as many as five with a percentage of 24%. The total score obtained was 1,520, with an average student score of 72.38%, with the highest score of 90 and the lowest score of 50.

Table 4. Results of Recapitulation of Students' Critical Thinking Skills in Mathematics Subjects with the CTL Approach Cycle I

No.	Description	Cycle I Results
1	Number of students	21
2	Number of students who completed	16
3	Number of students who did not complete	5
4	Total score obtained	1520
5	Average student score	72,38%
6	Percentage of completeness	76%
7	Percentage of non-completion	24%

In cycle II, the results of students' critical thinking skills in mathematics lessons with the CTL approach changed. The results of the critical thinking skills of students who completed their learning or reached KKM 70 were 18 students with 86% and students who had not completed as many as three students with a percentage of 14%. The total score obtained was 1,700, with an average student score of 80.95%, with the highest score of 100 and the lowest score of 60.

Table 5. Results of Recapitulation of Students' Critical Thinking Skills in Mathematics Subjects with the CTL Approach Cycle II

No.	Description	Cycle II Results
1	Number of students	21
2	Number of students who completed	18
3	Number of students who did not complete	3
4	Number of scores obtained	1700
5	Average student score	80,95%
6	Percentage of completeness	86%
7	Percentage of non-completion	14%

The results of students' critical thinking skills in mathematics subjects with the CTL approach at MI Uswatun Hasanah Jagapura Kulon increased in Cycle I to 76% or as many as 16 students who managed to get scores above KKM, and 24% or as many as five students who could not reach KKM.

The success indicator for students' critical thinking skills is 80%, and the results for students' critical thinking skills in cycle I were 76%. It can be stated that the application of the CTL approach has almost achieved the set success indicators, but there are still discrepancies with the initial plan, especially in inviting students to participate more actively, ask questions, and make conclusions. Therefore, it is necessary to continue to Cycle II.

Table 6. Comparison of the Results of the Recapitulation of Students' Critical Thinking Skills in Mathematics Subjects with the CTL Approach.

Assessment	Pre-cycle	Cycle I	Cycle II
Max	70	90	100
Min	30	50	60
Average	59,04%	72,38%	80,95%
Completeness	19%	76%	86%
Non-completion	81%	24%	14%

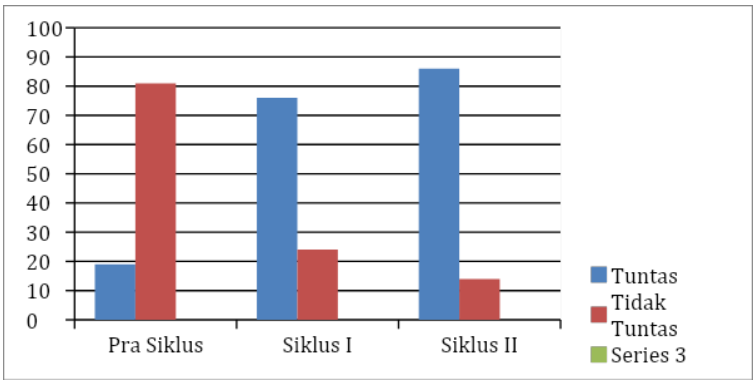

Figure 2. Graph of Critical Thinking Ability Results Cycle I and Cycle II

From Figure 2, it can be seen what percentage of students are complete and what percentage of students are not complete. During Cycle I, the completeness rate reached 76%, with 24% incompleteness, while in Cycle II, the completeness rate increased to 86%, with 14% incompleteness. This suggests that implementing the CTL approach effectively enhances the critical thinking abilities of students in class III-A at MI Uswatun Hasanah Jagapura Kulon.

The results of students' critical thinking skills in cycle I were seen from 16 students who were complete with a percentage of 76% and five students who were not complete or 24%. In cycle II, 18 students were complete, with a percentage of 86%, and three students, or 14%, were not complete. From the description above, it has increased in each cycle and meets the predetermined success indicator of 80%.

Based on the results of observations and research on the student's critical thinking skills in mathematics subjects with the CTL approach, it can be seen that there was an increase from the initial condition of students to the end of cycle II. The results of students' critical thinking skills in Cycle I with the CTL approach were completed or reached the KKM, namely 70, as many as 16 students with a percentage of 76% and five students with a percentage of 24% who were not complete. The average class score was 72.38%, with the highest score of 90 and the lowest score of 50.

This research is based on previous research, namely, Sulastri. The study results show that understanding of mathematical concepts has increased in each cycle. In cycle I, understanding of mathematical concepts reached 71%. Meanwhile, in Cycle II, reached 94% [30]. The practical implications after implementing this class action research are that teachers can use creative, innovative, and fun learning approaches to improve the quality of lessons. In addition, teachers' knowledge and skills are also growing with the use of

creative and innovative learning models. Teachers can also implement learning improvement actions to improve work professionalism. The professional development of teachers is significantly enhanced through the adoption of creative and innovative learning models, which not only enrich their pedagogical skills but also foster a culture of continuous improvement in their teaching practices. Research indicates that implementing models such as Problem-Based Learning (PBL) can substantially improve student learning outcomes, as it encourages teachers to engage actively with their students and adapt their teaching strategies accordingly [31].

Moreover, as teachers embrace these innovative approaches, they cultivate a deeper understanding of their subject matter and develop essential skills critical for effective teaching [32], [33]. This professional growth process enables educators to implement targeted learning improvement actions, enhancing their professionalism and benefitting their students [34]. By fostering an environment where creativity and critical thinking are prioritized, teachers can better navigate the complexities of modern education, ensuring that they remain influential leaders in their classrooms [35].

4. CONCLUSION

From the findings and deliberations, it can be inferred that implementing the Contextual Teaching and Learning (CTL) method in mathematics education, mainly focusing on fractions, at MI Uswatun Hasanah Jagapura Kulon, proves effective in enhancing students' critical thinking abilities. The analysis showed that the CTL approach significantly improved students' critical thinking skills in mathematics. In Cycle I, the percentage of students who reached the minimum completion criteria (KKM) was 76% (critical category), while in Cycle II, it increased to 86% (very critical category). The average score also increased from 72.38% in Cycle I to 80.95% in Cycle II, which exceeded the success indicator of 80%.

To improve the quality of learning, the researcher has appreciated the valuable input from subject teachers and students as a basis for providing recommendations for future similar research. Students are also expected to improve their critical thinking skills in mathematics by applying the CTL approach, which will enrich their learning experience. In addition, teachers are expected to continuously improve the quality of the learning process by avoiding complacency and overcoming boredom, thus creating a more exciting and compelling learning atmosphere for students. Schools are advised to routinely carry out coaching programs and classroom supervision of the learning process carried out by teachers. The program results can be used as a guideline to improve the quality of learning programs in the future, thus forming a more productive and efficient learning environment.

In addition, it can be concluded from the given data that the interest and learning outcomes of grade IV UPTD SDN Singajaya students have increased after applying the Learning Cycle 5E learning model in science subjects. This conclusion is supported by the N-Gain results, which fall in the medium category.

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