



## Efforts to improve numeracy skills through the STAD model assisted by concrete object media

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### ABSTRACT

The purpose of this study was to determine the mathematical abilities of first-grade students at SD Negeri 2 Wonokerso, Tembarak District, Temanggung Regency, using the Student Teams Achievement Division (STAD) model with the aid of concrete objects. This study is a Classroom Action Research (CAR) conducted in two cycles. Each cycle consisted of three meetings. Each cycle consisted of four stages: planning, implementation, observation, and reflection. The subjects of this study were 30 first-grade students at SD Negeri 2 Wonokerso, Tembarak District. Data collection techniques used in this study were multiple-choice tests and observation sheets. Data analysis used both qualitative and quantitative methods. The results of Classroom Action Research and the discussion that has been presented show that the average numeracy ability of class I students at SD Negeri 2 Wonokerso in Mathematics learning using the STAD Model Assisted with Concrete Object Media in Pre Cycle I, the average completion rate was 31%, with 5 students exceeding the Learning Goal Achievement Criteria (LGAC) in cycle II, the average completion rate for Post Cycle II was 81%, 13 students exceeding the LGAC. In this case it can be proven that there is an increase in the percentage from cycle I and cycle II, namely 50%. So it can be concluded that the use of the Student Teams Achievement Division (STAD) learning model assisted by concrete object media can improve the numeracy skills of class I students at SD Negeri 2 Wonokerso.



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## INTRODUCTION

One of the important parts of education is learning activities. Learning activities involve teachers and students where teachers help students to gain knowledge in solving problems (Komalasari et al., 2019). The learning process in the classroom is directed to the child's ability to memorize information. Children's brains are forced to remember and hoard various information without being required to understand the information they remember to relate to daily life. Mathematics is one of the subjects that has an important role in education.

Mathematics is one of the fields of study that supports the development of science and technology (Prihaswati et al., 2023). However, until now there are still many students who find mathematics to be a difficult, unpleasant subject, even something very scary. This is because there are still many students who experience difficulties in understanding the operation of adding and subtracting integers in learning. Latifah (2021) stated that, although mathematics is considered to have a high level of difficulty, everyone must learn it because it is a means to solve problems in daily life. Mathematics is a symbolic language that has a practical function to express quantitative and spatial relationships. Meanwhile, its theoretical function is to make it easier to think. In other words, mathematics is a provision for students to think logically, analytically, systematically, critically and creatively. Apart from being a symbolic language, mathematics is also a science whose study of objects is abstract.

One of the abilities that students must possess is the ability to calculate. These skills can be trained through basic learning about addition and subtraction, which is important initial knowledge for the child's learning process at school. Children are often involved in activities in this material such as counting various items and are often able to do simple summation (Harefa & Kaat, 2022). In addition, basic arithmetic skills are also closely related to the cognitive development of elementary school-age children which is the foundation for logical thinking skills at the next level (Susanto et al., 2024).

However, the relationship between knowledge before or outside school and learning inside school is still often under-noticed. This also makes the problem of students less motivated to learn mathematics because they think there is no connection between what they learn and real life (Pratama & Sari, 2022). In mathematics learning, especially addition and subtraction materials for low grades, structured stages are needed that are the basis for understanding the next mathematical concept (Rohmawati, 2021).

This research is focused on the ability of basic calculation operations, namely addition and subtraction. Although this material is still a simple basic material, if the material is faced with grade II elementary school students, it is possible that there will be difficulties experienced by students in learning it. According to the author's analysis, based on the problems that have been raised by previous studies on integer summation material, many students in the lower class have not mastered the addition material. One of them is a study conducted by Wibowo and Saputro (2023) which states that the cause of students' difficulties in solving addition and subtraction problems is the lack of students' understanding of the concept of the material. Students have not fully mastered the procedure of adding numbers by saving and subtracting numbers by borrowing, students still have difficulty in turning story problems into summation or number reduction operations (turning everyday sentences into mathematical sentences), and students are in a hurry to work on problems that cause lack of research and lead to errors in the answers given.

The findings are in line with the results of an interview conducted by the researcher with one of the teachers at SD Negeri 2 Wonokerso. Based on the information revealed by the teacher during the interview, the researcher found a problem in learning this material, namely the difficulty of students learning in solving the summation material problems. The results of the interview are also supported by the results of the Mid-Semester Exam, mathematics learning is still low or has not reached the LGAC that have been determined by the school, the low student learning outcomes, namely with a total of 25 students, the number of students who have completed is 10 students (36%), while students who have not completed are 15 students (64%).

With these conditions, teachers have made efforts to overcome these problems, namely through teaching and learning activities with group activities and group formation that are carried out randomly so that students can blend in with all friends. Group learning activities are carried out to train students' communication so that they dare to speak and express their ideas. But in fact, this has not given maximum results so that students' critical thinking skills have not been facilitated optimally so that the ability to ask questions possessed by is still low. Therefore, there is a need for new innovations in teaching and learning activities so that these problems can be minimized.

New innovations that can be made by teachers to get solutions to these problems are to use the right learning models and media so that they are able to realize learning materials. The appropriate learning model applied in this condition is the STAD model. According to (Rusman, 2017) the advantage of the STAD learning model is that it can spur students to encourage each other and help each other to master the skills taught by the teacher. In addition, in STAD, students are divided into heterogeneous groups so that students can cooperate well between group members. This opinion is in line with Sudarsana (2021) who stated that the application of the STAD model of students is required to be independent in solving problems because they cannot help between group members. So, they must be able to solve problems independently without relying on their group members.

However, this learning model will get maximum results if it is supported using interesting learning media. According to Khairani and Izzatika (2025), the use of learning media is very important, especially in teaching elementary school students who are on average 7-12 years old. Media is a tool used to convey messages from the sender to the recipient of the message. In the world of education, media is not a new thing used in the process of teaching and learning activities. The use of media will help teachers and students in the teaching and learning process. In accordance with the existing conditions of the problem, the media that is considered appropriate to support the use of the STAD model in mathematics learning is the media of concrete objects.

Learning using concrete object media is more able to provide real experience to students because students can see, feel and feel the props used. A more concrete learning experience will be more appropriate for elementary school-age children. This is in line with Dale's opinion about the cone of experience as quoted by Hamalik (2017) who explains that experience takes place from an ascending level to a more abstract level.

The use of media aims to attract students' attention so that it is easier to learn the operation of counting addition and subtraction so that learning goals can be achieved optimally (Jelita, 2025). In addition, the STAD learning model assisted by concrete object media can be done by playing guessing so that students feel happy. This media can help students work together and interact in groups, in addition to teaching students to think critically and quickly. Usually, if the teacher explains without using the media, students will easily get bored and bored. Based on this background, the researcher is interested in conducting research on improving computational ability by using the STAD model assisted by concrete object media.

## **RESEARCH METHODS**

### **Research Design**

This type of research uses the CAR design with a spiral model developed by Kemmis and McTaggart, which emphasizes repeated cycles until learning improvements are achieved according to the research objectives. Each cycle consists of four stages, namely planning, acting, observation, and reflection. This model was chosen because it is in accordance with the character of research which aims to improve the learning process and outcomes in the classroom continuously. This research was carried out collaboratively by involving peer teachers as collaborators who played a role in assisting researchers in planning, implementing, observing, and reflecting on actions. Through this repetitive cycle, researchers can make continuous improvements to the learning process based on the results of reflection from the previous cycle. The design of this research was chosen because it is in accordance with the character of the research which aims to improve the learning process and results continuously in the classroom environment.

### **Research Sample**

Research is carried out collaboratively by involving peer teachers as collaborators who play an active role in each stage of research, starting from planning, implementation of actions, observation, to reflection. The research subjects are all grade I students of SD Negeri Wonokerso, Tembarak District, for the 2024/2025 school year totaling 30 students. The selection of subjects is carried out as a whole or in a whole class without using sampling techniques because all students are considered important to be involved in the application of the developed learning model. In this study, there are three main variables, namely input variables in the form of the application of the STAD model assisted by concrete object media, process variables in the form of the implementation of mathematics learning activities using the STAD model assisted by concrete object media to improve numeracy skills, and output variables in the form of increasing students' numeracy skills after being given action.

### **Research Procedure and Instrument**

The research was carried out in two cycles, and each cycle consisted of three meetings. The research procedure starts from the planning stage which includes the preparation of learning tools, observation sheets, and test instruments to be used. Furthermore, at the stage of implementing actions, teachers apply the STAD model with the help of concrete object media in the classroom. Students are divided into small, heterogeneous groups with members of four to five people. Teachers act as facilitators who provide guidance, motivation, and direction during the learning process. Observation activities are carried out by researchers and collaborators to record the activities of teachers and students during the learning process using the observation sheets that have been prepared. After the implementation of the action is completed, a reflection stage is carried out to analyze the results of activities in the cycle and determine the necessary improvement steps in the next cycle. The research instruments used include multiple-choice tests and observation sheets. The test is used to measure students' numeracy ability by referring to indicators that have been compiled in the question grid, while observation sheets are used to observe the activities of teachers and students during learning. Before use, the research instrument is first tested to ensure its validity and reliability so that the data obtained is truly accurate and reliable.

### **Data Analysis**

The data obtained in this study was analyzed using qualitative descriptive analysis techniques combined with the calculation of the percentage of learning outcome achievement. Quantitative data

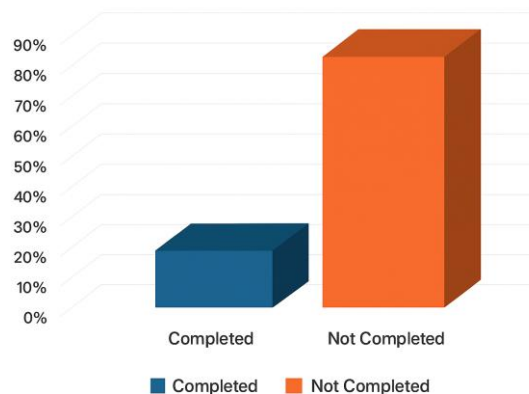
was obtained from the results of the numeracy test which was then calculated as the average score and the percentage of student learning completeness. Meanwhile, qualitative data was obtained from the results of observation of teacher and student activities, field notes, and reflections on each cycle. All of these data are processed systematically to provide a comprehensive picture of students' learning conditions and numeracy development.

## RESULTS

This research was carried out in two cycles, each consisting of three meetings with 30 research subjects of grade I students of SD Negeri 2 Wonokerso, Tembarak District, Temanggung Regency. The focus of the research is to improve the ability to calculate the addition and subtraction operations of integers by using the STAD learning model assisted by concrete object media. Data was collected through learning outcome tests and observation sheets of student and teacher activities.

### Pre-Action Results

At the pre-cycle stage, learning is still carried out conventionally. The teacher explains the concept of adding and subtracting integers on the board, then gives practice problems to students to work on individually. The learning process runs one-way; students tend to only listen to the teacher's explanation without being involved in much of the activity. Some students seemed confused, some just copied answers from friends, and even some students seemed to lose focus. The test results showed that out of 30 students, only 5 students (31%) had achieved completeness, while 25 students (69%) had not completed it. The average grade of the class is also still low. This shows that abstract learning has not been able to help students understand the concept of simple arithmetic. Figure 1 presents the results of the preliminary action.



**Figure 1. Achievement of Numeracy Skills in Precycle**

This is also supported by the results of initial observations that show that student participation in participating in classroom learning is still lacking. When the teacher is explaining the material, most of the students are not paying attention. Some students were just silent, scrambling through notebooks, and some even looked sleepy. As a result, students become less concentrated during the learning process and cannot understand the material that has been explained by the teacher. This condition is in line with the findings of Sanjaya (2020) who stated that low student involvement in learning activities is often caused by monotonous and teacher-centered learning methods.

During the learning process, teachers several times tried to create a more active atmosphere by giving students the opportunity to ask questions and express their opinions, but few students responded. This shows that learning is still one-way, and students have not been actively involved in the learning process. According to Hamalik (2017), student involvement in learning will increase if teachers are able to create two-way interactions and provide space for students to actively participate.

This condition occurs because students have not fully understood the material delivered by the teacher. At the end of the lesson, when the teacher asked the students to answer the summing operation question orally, only a few students were able to answer correctly. This illustrates that students' counting operation skills are still not optimal. Suyanto and Jihad (2019) explained that difficulties in counting

operations are often caused by learning approaches that are too abstract and not in accordance with the stage of cognitive development of elementary school students.

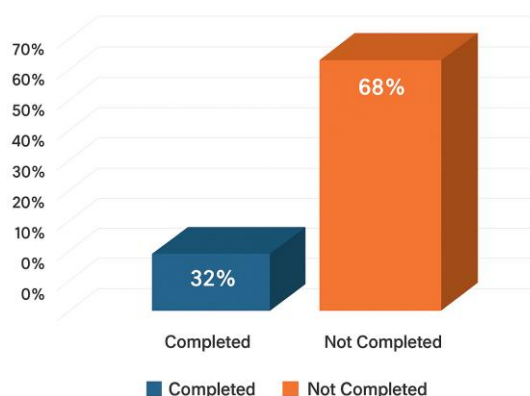
The ability of calculation operations that has not been developed optimally can be caused by two main factors, namely the teacher factor and the student factor. Teachers have an important role in creating an active learning atmosphere and choosing the right learning model so that learning goals can be achieved (Asta et al., 2015). Trianto (2021) emphasized that the selection of a learning model that suits students' characteristics can significantly increase learning motivation and learning outcomes. In this context, the use of passive lecture methods has proven to be less effective because students tend to rely on friends who understand better, so the learning process does not take place evenly.

The problem of low student activity and motivation in learning encourages researchers and teachers of grade I to collaborate in improving the learning process. One of the solutions chosen is to apply the STAD learning model assisted by concrete object media. This learning model has been proven to be able to increase student involvement in groups, encourage cooperation, and help them understand mathematical concepts more clearly through concrete objects that are appropriate to the child's stage of cognitive development (Slavin, 2019).

### Results of Cycle I Actions

Entering the first cycle, teachers began to apply the STAD model assisted by concrete object media. Students are divided into small, heterogeneous groups, each group consisting of 4–5 people with diverse academic abilities. The teacher begins the learning by conveying goals and motivations, explaining that they will learn to count in a more fun way using real objects. Furthermore, the teacher distributed media in the form of marbles, ice cream sticks, and wooden blocks. Students are asked to solve simple story problems with the help of concrete objects, for example counting the number of marbles a child has or reducing the number of borrowed blocks. At this stage, students begin to look more enthusiastic because they can directly hold and manipulate the objects provided.

Each group then discusses to solve the problems on the worksheet. The teacher goes around accompanying each group, helping students who are still struggling, and giving directions so that the discussion runs smoothly. After the discussion, each group appointed one representative to present their answers in front of the class. Some groups were able to convey answers with confidence, but there were also groups that were still hesitant. At the end of the lesson, the teacher gives an individual quiz to assess the student's understanding. The test results showed an increase compared to the pre-cycle, the number of students who achieved completeness increased, although not completely. Observations also show that some students are still passive in discussions, tend to rely on smarter friends, and do not dare to express their opinions. Figure 2 presents the results of the achievement of cycle I.



**Figure 2. Achievement of Numeracy Skills in Cycle I**

Based on the results of the achievement of the first cycle, it clearly shows that the ability of students' counting operations in learning activities is still lacking. This can be seen from 16 students, only 5 students or 31% were able to achieve the LGAC and the remaining 11 students or 69% were not able to achieve the LGAC. The indicators used are being able to solve problems orally and in writing, being able to explain how to solve problems using tools, having precision and concentration, and having

high creativity and imagination. Reflections from cycle I show the need for improvements in the division of roles in groups so that each student has responsibility. In addition, teachers also need to add a variety of concrete media that are closer to daily life so that students can more easily understand concepts.

In cycle II, the teacher applies improvements from the reflection of cycle I. The group remains heterogeneous, but each member is given a clear role, for example, the group leader oversees leading the discussion, the recorder writes the results of the answers, the presenter delivers it in front of the class, while other members help with the calculations. Thus, no student just sits idly by without contributing. The concrete media used are also more varied, such as pencils, erasers, and rulers that are commonly used by students every day.

### Results of Cycle II Actions

The learning process in cycle II takes place more actively. Students seem more excited because they can learn with real objects that are close to their lives. For example, in the question "Ani has 7 pencils and lends 2 pencils to her friend, how much is Ani's pencil left?", students can immediately calculate with the pencil they are holding. Discussion activities took place livelier, students helped each other, and even students who were originally passive began to dare to convey ideas. Teachers continue to play an active role in monitoring the course of discussions and providing positive encouragement. The group presentations also went better, students were more confident when delivering answers in front of the class, and other groups responded enthusiastically.

At the end of the lesson, individual quizzes are again given. The test results showed a significant increase compared to cycle I. As many as 81% of students or 13 people managed to achieve completeness. The grade point average increased noticeably. Observations show that almost all students are actively involved, both in group discussions and in the use of concrete media. The classroom atmosphere is more pleasant, students seem to enjoy learning mathematics, and the interaction between students becomes more positive. Figure 3 presents the results of the achievement of cycle II.

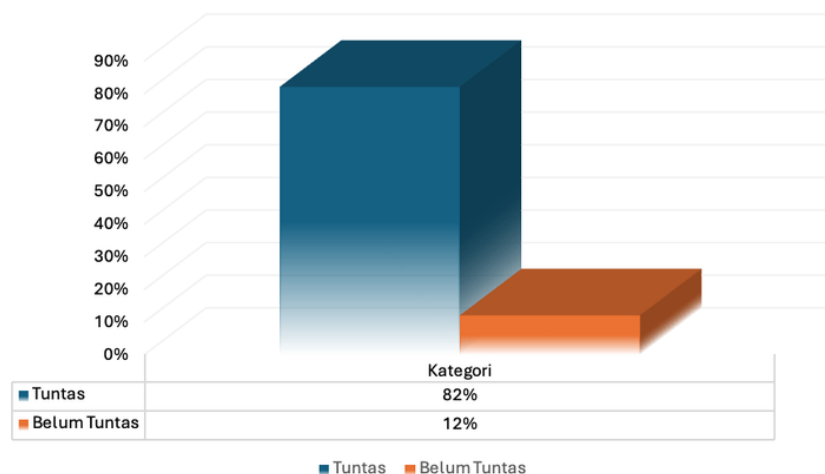


Figure 3. Achievement of Numeracy Skills in Cycle II

Figure 3 clearly shows that the ability of students' counting operations in learning activities has still increased when compared to the pre-system. This is seen from 16 students, 13 students or 81% were able to achieve the LGAC and the remaining 3 students or 19% were not able to achieve the LGAC. The indicators used are being able to solve problems orally and in writing, being able to explain how to solve problems using tools, having precision and concentration, and having high creativity and imagination.

Overall, from pre-cycle to cycle II, there was an increase in learning completeness by 50%. This proves that the application of the STAD model assisted by concrete object media is not only effective in improving numeracy skills, but also able to foster motivation, increase activeness, and build student confidence. Concrete learning experiences through real objects provide a deeper understanding for students than abstract learning, so that the research goal of improving students' numeracy skills can be achieved well.

## DISCUSSION

The problem found at SD Negeri 2 Wonokerso where this research is conducted is the low ability of students to solve calculation operation problems, both addition and subtraction in class I. Initial test results show that most students have not reached the Minimum Completeness Criteria (MCC). The most prominent difficulties arise when students have to understand the concepts of more abstract computational operations, such as subtraction by borrowing or repeated multiplication. This is due to previous learning that emphasizes lecture methods and written exercises without the support of concrete media that are appropriate to the cognitive development stage of elementary school students. As a result, students quickly feel bored, lack focus, and do not dare to try to solve problems independently. This condition shows the need for an innovative learning model that emphasizes student activities, group involvement, and the use of concrete media so that the concept of counting can be understood more deeply (Suryani & Wibowo, 2022).

The research design used was the Kemmis and McTaggart model Class Action Research (PTK) which was carried out in cycles. This design was chosen because it provides an opportunity for teachers to improve learning practices continuously through cycles of planning, action, observation, and reflection. According to Gaddafi et al. (2025), PTK is research oriented towards improving the quality of learning in the classroom by involving teachers as researchers. In the context of this study, PTK was used to test the effectiveness of the application of a STAD-type cooperative learning model assisted by concrete object media in the learning of students' mathematical calculation operations. The use of concrete object media was chosen because it is in accordance with the characteristics of elementary school students who are in the concrete operational stage according to Piaget (Sanjaya et al., 2024), namely that children are easier to understand concepts through direct experience with real objects than just symbols or abstractions. Thus, the application of the STAD model assisted by concrete media is expected to be able to improve the numeracy skills as well as the learning motivation of elementary school students (Nurhayati, 2021).

The STAD-type cooperative learning model was developed by Slavin and colleagues in 1978 at Johns Hopkins University. This model is one of the simplest but most effective forms of cooperative learning to improve students' numeracy operations as well as social skills. According to Slavin (2019), STAD has five main steps, namely the delivery of goals and motivation, the presentation of materials, group activities, individual quizzes, and group awards. The advantage of this model is the combination of individual responsibility and group cooperation. Each student is required to learn independently while contributing to the success of the group. This concept is supported by Vygotsky's constructivist theory of learning which emphasizes the importance of social interaction in building knowledge through the zone of proximal development. In addition, Bandura's social learning theory also states that individuals learn through observation, imitation, and interaction with their environment. Thus, STAD provides opportunities for students to learn from teachers and peers.

The first syntax of STAD is the delivery of learning objectives and motivation. At this stage, the teacher explained the goal to be achieved, which is for students to be able to perform addition and subtraction operations appropriately using the medium of concrete objects. Motivation is provided by associating the material with the students' daily experiences, for example counting the number of pencils on the table or reducing the number of marbles in the container. According to Slavin (2019), clear goals and the right motivation can increase student engagement from the beginning of learning. Observations in cycle I showed that when the teacher conveyed the goals in simple language and connected them with concrete objects, students focused more on paying attention. In cycle II, students are even able to repeat the learning objectives in their own words. This is in line with the opinion of Nurishlah et al. (2023) who stated that intrinsic motivation can grow if students feel that learning has relevance to their lives.

The second syntax is the presentation of the material. At this stage, the teacher delivers the material with the help of concrete object media such as ice cream sticks, marbles, or grains to illustrate the concept of counting operations. Students are invited to observe, touch, and manipulate concrete objects to understand the meaning of number symbols. According to Piaget's theory of cognitive development, children aged 7–11 years are at a concrete operational stage so that the use of real objects becomes a bridge to understand abstract mathematical concepts. Fatimah's research (2013) shows that the use of concrete media in mathematics learning can improve students' understanding of concepts

compared to learning that only uses verbal explanations. Observations in the classroom showed that when teachers demonstrated reductions using ice cream sticks, students seemed to understand more easily than when they were only given written questions. In cycle II, students are even able to make their own examples with the concrete objects available.

The third syntax is group work. Students are divided into heterogeneous small groups consisting of students with high, medium, and low abilities. The teacher gives a group worksheet containing calculation operation problems that can be solved with the help of concrete objects. In group discussions, students work together, help each other, and discuss to solve problems. According to Vygotsky, social interaction between students in groups allows learning to occur through the zone of proximal development, which is when students who are more able to help underprivileged students (Salsabila & Muqowim, 2024). Wahyuni's research (2024) also shows that group work in STAD improves students' mathematical communication skills. Observations show that in the first cycle some groups are still dominated by high-ability students, but after reflection, in the second cycle there is an increase in the participation of all group members because the teacher affirms the rule that each member must contribute.

The fourth syntax is the individual quiz. After the group activity is over, each student is asked to work on the quiz individually without the help of a group. This is done to ensure that each student really understands the material, not just relying on friends. Slavin (2019) emphasized that individual quizzes are an important component of STAD because they encourage personal responsibility in learning. In this study, individual quizzes are equipped with pictures and concrete objects so that students can still associate the questions with real experiences. The results of observations show that the individual scores of students increased from cycle I to cycle II. Students who initially did not reach KKM, after cycle II, have mostly succeeded in surpassing KKM. Previous research by Sari (2020) also found that the existence of individual quizzes in STAD can increase the perseverance and learning responsibility of elementary school students.

The fifth syntax is group awarding. After the individual quiz scores are calculated, the teacher sums each student's increased score to determine the group's average score. The group that achieved the highest score was awarded in the form of a commendation, star sticker, or recognition as the best group. According to Skinner's theory of reinforcement, giving rewards or positive reinforcement will increase motivation and expected behaviors. Dewi's research (2021) also found that group awards in STAD can increase student enthusiasm and cooperation because they are motivated to contribute to the success of the group. The results showed that students felt proud when their group was rewarded, and even some students who were usually passive became more motivated to actively participate so that their group could win at the next meeting.

Overall, the application of the STAD model assisted by concrete object media has been proven to improve students' mathematical calculation operation skills. In the first cycle, student activities began to increase even though there were still some obstacles such as the dominance of certain students and limited discussion time. However, after reflection, in cycle II there was a significant improvement: all students were actively involved, individual quiz results increased, and classical completeness exceeded the set targets. This shows that the combination of STAD cooperative learning and concrete object media is effective in helping students understand the concept of counting operations while improving their motivation and social skills.

Based on the results that have been achieved, the researcher and collaborators concluded that this classroom action research has reached the set target, which is 80% of the number of students who have increased their numeracy skills by obtaining a score of  $\geq 75$ . This means that the numeracy skills of grade I students of SD Negeri 2 Wonokerso can be improved through the STAD model assisted by concrete object media which can be used as a guideline for teachers in providing varied learning models. It is evidenced by the results of cycle II, namely the student success rate of 81%.

The findings of this study are consistent with previous research. Huda (2018) stated that STAD is effective in improving student learning outcomes in various subjects in elementary school. Dewi (2021) found that group awards in STAD are able to increase students' motivation to learn. Wahyuni (2019) emphasized that group discussions in STAD improve students' mathematical communication. Fatimah (2013) shows that the media of concrete objects plays an important role in bridging the understanding of abstract concepts. Sari (2020) also proves that the existence of individual quizzes in STAD increases students' learning responsibilities. Thus, the results of this study strengthen the

evidence that the application of STAD assisted by concrete object media is an effective and appropriate learning strategy for elementary school students.

However, this research also has limitations. First, the study was only conducted in one class with a limited number of students, so the results could not be generalized to a wider population. Second, the research only covers basic computational operations material, so the effectiveness of this model for other materials such as fractions, geometry, or measurements still needs to be tested. Third, the application of this model relies heavily on teachers' skills in managing groups and providing appropriate concrete media. Therefore, further research is recommended by involving more schools, material variations, and the use of more diverse concrete media so that the effectiveness of the STAD model can be tested more widely.

## CONCLUSION

The average numeracy ability of grade I students of SD Negeri 2 Wonokerso in Mathematics learning using the Model Student Teams Achievement Division (STAD) Assisted by Concrete Object Media in Pre Cycle I, the average completeness obtained was 31%, as many as 5 students exceeded the KKTP in cycle II, the average post-cycle demand was 81%, as many as 13 students exceeded the KKTP. In this case, it can be proven that there is an increase in the percentage from cycle I and cycle II, which is 50%. Thus, it can be concluded that the use of the Student Teams Achievement Division (STAD) Model learning model assisted by Concrete Object Media can improve the numeracy skills of grade I students of SD Negeri 2 Wonokerso.

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