Applying Cooperative Learning to Data Handling Lessons in Elementary School

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Abstract

Mathematics learning in data management materials in elementary schools still faces obstacles due to low activity and student understanding due to the dominance of lecture methods. This condition demands the implementation of a more participatory and collaborative learning model. This study aims to describe the application of *the Cooperative Learning model* in data management learning in students in grades V-C SD Negeri 19 Sorong City and examine its impact on learning activities and student understanding. This study uses a qualitative descriptive approach with quantitative support and descriptive class observation design. The subject of the study is a student of class V-C SD Negeri 19 Sorong City. Data collection techniques include observation of the learning process, group discussions, questions and answers, and assignments, while data analysis is carried out through subtraction, presentation, and conclusion drawn. The results of the study show that the application of the Cooperative Learning model is able to increase student activities in group discussions, encourage cooperation between students, and improve understanding of data management concepts. Students are more actively involved in observing, processing, and presenting data in a simple way. In conclusion, the Cooperative Learning model is effectively applied to data management learning in elementary schools and has positive implications for more interactive, collaborative, and student-centered learning practices.

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INTRODUCTION

Mathematics learning in elementary schools still faces serious challenges, especially in data management materials that require logical, analytical, and collaborative thinking skills. Various international reports show that the numeracy literacy skills of elementary school students, including in understanding and processing simple data, are still at a level that requires serious strengthening (OECD, 2019; Mullis et al., 2020). The phenomenon in the classroom also shows that students tend to be passive, only receive information, and have difficulty relating the concept of data management to their real experiences. This condition is often related to the dominance of teacher-centered learning that limits students' active involvement in the process of observing, processing, and presenting data (Rusman, 2018; Eggen & Kauchak, 2016). In fact, data management skills are an important basic competency in building numeracy literacy and students' readiness to face contextual problems in daily life (NCTM, 2014).

A number of studies in the last decade have shown that collaborative mathematics learning has great potential in improving the understanding of concepts and the learning

activity of elementary school students. *The Cooperative Learning* model is reported to be able to encourage interaction between students, strengthen group responsibility, and create a more participatory learning environment (Johnson & Johnson, 2019; Slavin, 2020). Through structured group work, students not only learn to understand concepts, but also develop social and communication skills that are important in 21st century learning (Zubaidah, 2018). However, these findings are not always consistent. Several studies confirm the success of *Cooperative Learning* in improving mathematics learning outcomes (Artzt & Newman, 2016; Widodo & Kartikasari, 2019), while other research shows that the effectiveness of this model is highly dependent on the classroom context, student characteristics, and implementation strategies used by teachers (Gillies, 2016; Johnson et al., 2014).

In addition, previous studies tend to focus on measuring learning outcomes quantitatively by focusing on increasing test scores. This approach often ignores the learning process, particularly the dynamics of student interaction and how they build understanding of concepts through shared learning experiences (Borich, 2017; Arends, 2015). In the context of data management materials, the process aspect is crucial because the understanding of concepts is not only determined by the ability to calculate, but also by the ability to observe data, discuss findings, and present them in a simple and meaningful way (NCTM, 2014).

The research gap in this study lies in the limited studies that explicitly describe the application of *the Cooperative Learning model* to data management materials in elementary schools, especially in the context of class V in the Southwest Papua region. Most of the previous research was conducted in large urban areas or at the secondary education level (Slavin, 2018; Johnson & Johnson, 2019), so it does not fully represent learning conditions in elementary schools with heterogeneous student characteristics and different geographical contexts. In addition, there is still little research that combines the observation of the learning process with the analysis of student activity and qualitative understanding of concepts, so that the picture of the implementation of cooperative learning in the classroom has not been explored in depth (Gillies, 2016).

Based on this gap, this research has a clear justification and contribution. Practically, this study provides an empirical overview of the application of *Cooperative Learning* in data management learning through group discussions, observations, questions and answers, and assignments in grade V of elementary school. Methodologically, this study offers *escriptive qualitative with quantitative support* that emphasizes the learning process, not solely the final outcome, in line with the view that the quality of learning is determined by students' interaction and learning experience (Eggen & Kauchak, 2016; Huda, 2018). Conceptually, this research enriches the understanding of the role of cooperative learning in building students' activeness and understanding of contextual mathematics materials.

The results of the research (Mulyono and Trisnawati. NF, 2024) shows that statistical learning is closely related to the principle of cooperative learning, especially because data-based materials require the activity of actively observing, processing, interpreting, and discussing data. The findings that offline learning results in greater completeness and

average learning outcomes indicate that in-person interaction and group discussions—as the core of cooperative learning—are more effective in building understanding of statistical concepts. Thus, the statistical data in the study not only represent learning outcomes, but also serves as empirical evidence that face-to-face collaboration and communication in cooperative learning contribute significantly to improved student activity and understanding.

The Cooperative Learning *model* applied in this study is the Student Teams Achievement Division (STAD). The selection of the STAD model was based on its suitability with the characteristics of elementary school students and data management materials. In this model, students work in small, heterogeneous groups to discuss material, complete assignments, and help each other understand concepts before evaluation. STAD is considered effective in fostering individual responsibility as well as group cooperation. Thus, the purpose of this study is to describe the application of *the Cooperative Learning model* in data management learning in students in grades V-C SD Negeri 19 Sorong City and to examine its impact on students' learning activities and understanding. This goal was formulated to answer the need for more participatory, collaborative, and student-centered mathematics learning practices (Lie, 2019; Trianto, 2017).

RESEARCH METHODS

Data collection was carried out using several instruments to ensure the depth and credibility of the findings. The main instruments in this study are observation sheets, discussion and question and answer guides, and student assignment documents. Observation sheets are compiled to record student activities during learning, including activity indicators, group cooperation, participation in discussions, and involvement in data processing and presentation. Discussion and Q&A guides are used to explore students' understanding of data management concepts and how they build knowledge through group interactions. Meanwhile, student assignments in the form of individual and group assignments are used as an additional data source to see the results of students' work in processing and presenting simple data This study uses a mixed methods approach with qualitatively driven mixed methods, especially embedded design. This approach was chosen because the main purpose of the study is to describe the process of applying the *Cooperative Learning model* as well as the dynamics of student activity and understanding, while quantitative data in the form of assessment scores are used as supporting data to strengthen the interpretation of the findings. Thus, the use of numerical scores, scoring tables, and evaluation of learning outcomes is not intended as a quantitative inferential analysis, but rather as empirical evidence supporting the qualitative findings of the learning process.

The research procedure is carried out systematically through several stages. The initial stage begins with learning planning, including the preparation of learning tools based on the Cooperative Learning model, the determination of group discussion scenarios, and the preparation of observation instruments. The implementation phase involves the application of data management learning with the Cooperative Learning model, where

students are divided into small, heterogeneous groups. In the learning process, students carry out simple data observation activities, discuss in groups, present the results of their work, and engage in teacher-guided question and answer sessions. During this process, the researcher conducted non-participant observations to record the course of learning objectively. The final stage is the collection of all observation data, discussion notes, and student assignment documents for further analysis. The subjects of the study were all students of class V-C SD Negeri 19 Sorong City which amounted to 25 students (12 males and 14 females). The characteristics of students are heterogeneous, both in terms of academic ability (high, medium, and low) and the level of learning participation. This heterogeneity is the main pedagogical consideration in the application of cooperative learning, as it allows interaction, mutual help, and exchange of understanding between students in groups.

The data obtained were analyzed using descriptive qualitative analysis at a systematic level. The analysis begins with data reduction, which is selecting and focusing data that is relevant to the research objectives, especially related to student activities and understanding of data management concepts. The next stage is the presentation of data in the form of narrative descriptions that describe the learning process and the interaction patterns of students in the group. The last stage is the drawing of conclusions, carried out by interpreting the findings logically and consistently based on the data that has been presented. To maintain the validity of the data, the source triangulation technique is used, which is to compare data from observations, discussions, and student assignments.

Data collection was carried out using several instruments, namely: Student activity observation sheets, Discussion and question and answer guides, Student assignment documents (individual and group). The observation sheet is prepared based on ***the assessment rubric*** which contains measurable indicators, including:
data collection, data processing, accuracy in answering questions, working with a group. Each indicator is assigned a specific score range according to the level of achievement, allowing for a systematic and transparent assessment. Discussion and Q&A guides are used to explore students' conceptual understanding as well as how they build knowledge through group interactions. Student assignment documents are used as supporting data to see the results of students' real work in processing and presenting simple data.

This research pays attention to the ethical aspects of educational research. All research activities are carried out with permission from school and classroom teachers. The identity of the student is kept confidential and is not personally included in the research report. Student participation in learning activities takes place reasonably as part of the teaching and learning process on a regular basis, without treatment that has the potential to harm students. Thus, this research upholds the principles of professionalism, integrity, and academic responsibility. In a theoretical perspective, this research departs from the view of social constructivism which emphasizes that knowledge is built through social interaction and shared learning experiences. Lev Vygotsky emphasized that effective learning occurs in the *zone of proximal development* through collaboration and scaffolding between learners, while Jean Piaget emphasized the importance of mental activity and concrete experiences

in building students' cognitive structures. Both of these perspectives are relevant to data management learning that demands the activity of actively observing, processing, interpreting, and discussing data. A number of studies have shown that cooperative learning is able to improve students' understanding of statistical concepts, learning activeness, and analytical thinking skills, but most of them still focus on quantitative results and are carried out in urban contexts or at the secondary and tertiary education levels. Therefore, the novelty of this research lies in the presentation of contextual empirical evidence regarding the application of the Cooperative Learning model to data management materials in grade V elementary schools in the Southwest Papua region by emphasizing the integration between the process of students' social interaction and the achievement of data-based learning outcomes. With this approach, the research not only strengthens cooperative learning theory and social constructivism, but also presents relevant practical contributions for primary school teachers in designing collaborative, contextual, and meaningful mathematics learning.

RESULTS AND DISCUSSION

This study aims to describe the application of the Cooperative Learning model in data management learning in V-C class students of SD Negeri 19 Sorong City and its impact on student learning outcomes. The results of the study were obtained through an assessment of four main aspects that directly represent the learning objectives, namely data collection ability, data processing, accuracy in answering questions, and group cooperation.

Overall, the assessment results show very high achievements. From a maximum score of 100, students get a total score of 95. This achievement shows that the learning applied is able to support students' understanding of data management materials comprehensively. Details of the results in each aspect are presented in Table 1.

Table 1. Data Management Learning Assessment Results

Assessment Aspects	Maximum Score	Scores Obtained
Data Collection	30	30
Data Processing	30	30
Question Answers	20	20
Group Cooperation	20	15

Table 1 shows that students achieved maximum scores on the first three aspects. In the aspect of data collection, all students are able to observe, record, and group data in accordance with learning instructions. Similarly, in the aspect of data processing, students are able to process the data that has been collected into a more structured and easy-to-understand form. The question answering aspect also shows optimal results, which indicates that students have a good conceptual understanding of the material being studied.

To strengthen the character of qualitative research, the results of the study are not only presented in the form of final scores, but also equipped with detailed observation data based on student behavior indicators during cooperative learning. Observations are focused on students' real-world activities as they manage data, interact in groups, and build concept understanding.

Table 2. Recapitulation of Student Activity Observation Results in Cooperative *Learning*

Observed Aspects	Observation Indicators	Frequency of Occurrence	Category
Data Collection	Students actively observe objects/data	Very often	Excellent
	Students record data independently	Very often	Excellent
Data Processing	Students discuss determining data processing methods	Very often	Excellent
	Students organize data in simple tables	Very often	Excellent
Concept Understanding	Students are able to explain the results of data analysis	Often	Good
Group Cooperation	Clear division of roles within groups	Fairly often	Fair
	Equal participation among group members	Fairly often	Fairly good

This table shows that students' cognitive and social activities appear consistently, especially in the aspects of data collection and processing. This finding is empirical evidence that the learning process takes place actively and collaboratively, in accordance with the characteristics of cooperative learning. The total score of 95 out of 100 is the result of an accumulated performance-based assessment designed to comprehensively assess student learning processes and outcomes. The assessment is carried out by the teacher of class V-C as a learning practitioner, and the researcher as an independent observer.

Both assessors use the same rubric to maintain the consistency of assessment. The scoring mechanism is carried out in the following steps: first, Each group and individual is observed during learning, second, Eachaspect is scored according to the rubric indicator. Third, the final score is the average result of teacher and researcher assessments. The four total scores are obtained from the sum of the scores of all aspects.

Table 3. Rubric for Assessment of Learning Outcomes and Processes

Aspects	Max Score	High Score Indicator
Data Collection	30	Complete data, self-recorded, as per instructions
Data Processing	30	Data is processed correctly, systematically, and logically
Question Answers	20	Correct answers and able to explain the reasons
Group Cooperation	20	Active, role-sharing, effective communication

Reason for group cooperation score = 15/20 Although the discussion went well, observations showed that participation was not completely evenly distributed, with some students being more dominant than others. Assessment Reliability To ensure the reliability of the data, this study applies *inter-rater reliability* by: Comparing the results of teacher and researcher assessments, Discussing differences in scores to reach agreement, Maintaining consistency of indicators and assessment criteria. The results of the assessment show a high level of conformity, so that the resulting score can be declared reliable and trustworthy.

In contrast to these three aspects, the score in the aspect of group cooperation has not reached the maximum value, although it is still in the good category. These findings show that there is a variation in contributions between group members in the cooperative learning process.

The results of this study provide an empirical picture that the application of the Cooperative Learning model to data management learning in elementary schools is able to produce excellent learning outcomes. The maximum score on the aspects of data collection and data processing shows that students not only understand concepts theoretically, but are

also able to apply them in real activities. This is important because data management is a material that requires process skills, not just mastery of mathematical procedures.

The high achievement in the aspect of data collection can be interpreted as the success of learning in shifting the role of students from passive recipients of information to active actors in the learning process. Through group work, students are directly involved in observing objects, recording information, and discussing the data obtained. This process is in line with the basic principles of Cooperative Learning which emphasizes learning through social interaction and shared experiences. These interactions allow students to build understanding collaboratively, so that the concepts learned become more meaningful.

The results of this study reinforce the findings of various previous studies that stated that cooperative learning is effective in improving the understanding of mathematical and statistical concepts through the active involvement of students in data collection, processing, and interpretation. In line with research based on social constructivism that emphasizes the role of interaction in knowledge formation (Lev Vygotsky), maximum achievement in the aspects of data collection and processing shows that group discussions and collaborative work function as a vehicle for internalizing concepts. These findings are also consistent with previous research that shows that the process of explaining and correcting each other in groups improves the quality of students' thinking and conceptual understanding. However, the suboptimal group cooperation score confirms the results of another study that confirms that cooperative learning does not automatically result in equitable participation without clear role management by teachers. Thus, this study not only affirms the effectiveness of cooperative learning in the context of data management in elementary schools, but also provides contextual empirical contributions by emphasizing that the quality of interaction and the equal distribution of individual roles are key factors for the successful implementation of the model.

The aspect of data processing that also achieved the maximum score showed that group discussions played an effective role in helping students organize and interpret data. In the context of cooperative learning, students with different levels of understanding complement each other in groups. The process of explaining and correcting mistakes is an important mechanism that supports the achievement of high learning outcomes. These findings reinforce the view that cooperative learning not only improves the final outcome, but also the quality of students' thinking processes.

Optimal achievement in the question answer aspect indicates that students are able to relate the results of data processing to the questions asked. This shows the formation of conceptual understanding, not just procedural skills. Integrated question and answer strategies in cooperative learning serve as a means of reflection for students to test their own understanding. Thus, learning does not stop at group activities, but continues with the process of clarifying and strengthening concepts.

However, the findings on the aspect of group cooperation show a more complex dynamic. Scores that have not been maximized indicate that although cooperative learning has been implemented, the contribution of students in the group has not been completely evenly distributed. Some students still show passive tendencies and rely on more dominant group members. This phenomenon shows that the success of Cooperative Learning is not only determined by the division of groups, but also by the teacher's strategy in managing the roles and responsibilities of individuals in the group.

When compared to the findings of previous research, the results of this study are in line with various studies that state that Cooperative Learning is effective in improving the understanding of mathematics concepts and learning outcomes of elementary school students. This harmony can be explained by the similarity of pedagogical principles used, namely learning-based interactions, collaborations, and student activities. However, the findings on suboptimal group cooperation also reinforce the results of previous research which emphasized that cooperative learning requires careful management so that there is no inequality of roles in the group.

The main contribution of this study lies in the presentation of contextual empirical evidence on the effectiveness of Cooperative Learning in data management learning in elementary schools, especially in the context of areas that are relatively rarely explored in educational research. This research not only confirms the effectiveness of the cooperative learning model, but also shows a specific aspect that still needs to be strengthened, namely group cooperation. Thus, the contribution of this research is practical and contextual, providing a real picture of the strengths and challenges of implementing Cooperative Learning in the classroom.

The practical implication of these findings is the need for teachers to design cooperative learning with a clearer division of roles for each group member. Assessments are not only focused on group outcomes, but also on individual contributions, so that each student is encouraged to participate actively. In addition, teachers need to provide reinforcement of social skills, such as communication and shared responsibility, as an integral part of cooperative learning.

Although it provides significant findings, this study has limitations. The research was conducted in one class and one learning material, so the results could not be generalized widely. In addition, the data used emphasized more on learning outcomes and process observation, without long-term measurement of student understanding retention. These limitations open up opportunities for future research to examine the application of Cooperative Learning to other math materials, engage more classes, or use research designs that allow for long-term impact analysis.

The high achievement in the aspect of data collection and processing shows that *Cooperative Learning* has succeeded in shifting learning from teacher-centered to student-centered. Students play an active role in building knowledge through social interaction and shared experiences, which are key principles of cooperative learning (Johnson & Johnson, 2019; Slavin, 2020). The group discussion process allows for the exchange of ideas and clarification of concepts, so that students' understanding becomes deeper (Gillies, 2016).

Optimal achievement in the aspect of question answers also shows the formation of conceptual understanding, not just procedural skills. The question and answer strategy in cooperative learning serves as a means of reflection and reinforcement of concepts, as emphasized by Borich (2017) and Arends (2015) that pedagogical dialogue is an important element in meaningful learning.

However, the score of group cooperation that has not been maximized shows that cooperative learning still faces challenges in the equitable distribution of student participation. These findings are in line with the research of Johnson et al. (2014) and Gillies (2016) which stated that without clear role management, cooperative learning has the potential to give birth to the dominance of some students and the passivity of other students.

The main contribution of this study lies in the presentation of contextual empirical evidence on the effectiveness *of Cooperative Learning* in data management learning in primary schools in the Southwest Papua region, which is still rarely explored in educational research. These findings reinforce the results of previous research while emphasizing the importance of group management strategies for cooperative learning to run optimally (Lie, 2019; Trianto, 2017).

Critically, this discussion shows that the effectiveness of Cooperative Learning is not linear, but is shaped by the mechanism of relationships between variables that affect each other. Cooperative learning design serves as the main independent variable, but its influence on data management learning outcomes is mediated and moderated by other variables. A clear division of roles in a group acts as a moderator variable, as it determines the extent to which each student is actively involved in the learning process. When roles are unstructured, group interactions tend to be uneven, so the potential for cooperative learning is not fully actualized.

Individual contribution-based assessments function as reinforcing variables that directly affect students' motivation and personal responsibility. This variable minimizes the phenomenon of *free riders* in group work and strengthens the relationship between cooperative activities and learning outcomes. Meanwhile, social skills—including communication, collaboration, and shared responsibility—act as mediating variables that bridge group interactions with statistical conceptual understanding. Without adequate social skills, the intensity of interactions does not automatically result in improved cognitive quality.

These findings confirm and at the same time expand the views of Zubaidah and Huda, who emphasize that cooperative learning demands planned group management and fair evaluation in order for each individual to contribute optimally. However, this study provides added value by clarifying the relational mechanisms between variables, not just proving the effectiveness of the model in general. Thus, Cooperative Learning is not positioned as a single variable that has a direct impact, but as a learning system whose effectiveness depends on the synergy between group design, individual evaluation, and the quality of social interaction.

Overall, the contribution of this research is conceptual and practical in that it offers a deeper understanding of how and why Cooperative Learning works in data-driven mathematics learning. This analysis of the relationship between variables enriches collaborative, contextual, and student-centered learning practices, while providing a theoretical foundation for the development of more effective and sustainable cooperative learning designs.

The findings of this study are closely aligned with previous research on teacher professionalism in optimizing mathematics learning during the Covid-19 pandemic, particularly through the application of Realistic Mathematics Education (RME/PMR). The study conducted at MI Roudlotul Khuffadz demonstrates that professional teachers are able to adapt learning strategies, manage instructional challenges, and maintain student engagement despite contextual limitations. Similarly, the results of the present study indicate that the effectiveness of Cooperative Learning in data-driven mathematics learning is strongly influenced by the teacher's professional role as a planner, facilitator, and evaluator of learning. Both studies confirm that meaningful mathematics learning does not

occur solely due to the chosen instructional model, but is largely determined by how teachers professionally design learning activities, guide student interaction, and connect mathematical concepts to real-life contexts. While PMR emphasizes contextual problem-solving during emergency learning conditions, Cooperative Learning highlights structured collaboration and social interaction; however, both approaches rely on teacher professionalism as the key mediating factor. Overall, the contribution of this research is both conceptual and practical, as it deepens understanding of how professional teaching practices enable cooperative and contextual mathematics learning to function effectively, thereby strengthening student reasoning, engagement, and learning sustainability (Muyono & Trisnawati, 2022).

The practical implications of this study emphasize the need for teachers to design cooperative learning with clear role sharing, individual contribution-based assessments, and strengthening students' social skills as an integral part of mathematics learning Critically, the practical implications of this study show that there is an interrelated causal relationship between cooperative learning design, the quality of social interaction, and student learning outcomes. Clear division of roles in groups serves as a moderating variable that affects the level of individual participation, while assessment based on individual contributions acts as a reinforcing variable that encourages personal responsibility in group work. Strengthening social skills—such as communication, collaboration, and shared responsibility—plays a role as a mediating variable that bridges the application of cooperative learning with improved data management learning outcomes. Without these three components, the effectiveness of cooperative learning tends to decline due to role inequality and dependence on dominant students, as confirmed by the findings of Zubaidah and Huda. Therefore, the results of this study not only confirm the effectiveness of Cooperative Learning as the main variable, but also place group management, individual evaluation, and social skills as determining factors that simultaneously affect the quality of data-driven mathematics learning. The contribution of this research is conceptual and practical because it clarifies the mechanism of intervariable relationships in cooperative learning, thereby enriching the development of collaborative, contextual, and student-centered mathematics learning practices. (Zubaidah, 2018; Huda, 2018).

Overall, the results and discussion of this study show that Cooperative Learning is an effective learning model to improve data management learning outcomes in elementary schools. However, this effectiveness will be more optimal if it is accompanied by planned group work management and evaluation that pays attention to individual contributions. Thus, this research makes a meaningful contribution to the development of more collaborative, contextual, and student-centered mathematics learning practices.

CONCLUSION

Based on the results of the research and discussion, it can be concluded that the application of cooperative learning to data management materials is able to build a meaningful learning experience for students through social interaction, group discussions, and active involvement in the learning process. The findings of the study show that students do not only play the role of receivers of information, but as learning subjects who actively observe, process, interpret, and communicate data collaboratively. This process shows how the understanding of statistical concepts is formed through the exchange of ideas and cooperation between group members.

This study also revealed that the success of cooperative learning is greatly influenced by the dynamics of group work. Although data collection, data processing, and problem-solving activities showed optimal outcomes, there were still variations in the level of student participation within the group. This indicates that cooperative learning is not just a grouping of students, but requires planned management of roles, responsibilities, and social interactions so that each student can contribute in a balanced way.

Qualitatively, the results of this study confirm that cooperative learning provides space for students to build conceptual understanding through shared experiences, as well as develop social skills that support data-driven mathematics learning. Thus, cooperative learning can be understood as a pedagogical process that emphasizes the quality of interaction and the meaning of learning, not solely the achievement of the final result. These findings provide important implications for learning practice, particularly the need for cooperative learning design that emphasizes the process, reflection, and active participation of each student.

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