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THE ROLE OF STUDENT TEAM HEROIC LEADERSHIP STRATEGY: MATHEMATICAL COMMUNICATION OF MIDDLE-SCHOOL STUDENTS

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Abstract. The Role of Student Team Heroic Leadership Strategy: Mathematical Communication of Middle-School Students. Objectives: In this article, we focus on how to improve students' mathematical communication in building effective group discussions using the student team's heroic leadership strategy. Methods: This type of research is Classroom Action Research, which was held in 2 cycles. The research subjects were 16 seventh-grade students (six boys and ten girls) using purposive sampling. Findings: The findings indicated that by implementing the Student Team Heroic Leadership learning strategy, students' mathematical communication improved significantly. This finding is confirmed by the increase in the average score on students' communication tests from 76% in cycle I to 96% in cycle II. The completeness criteria of the students' mathematical communication exam results also progressed from the first to the second cycle. Other data indicate that students concealed information they did not comprehend during the learning process, making it harder for the teacher to assess their comprehension of the mathematical concepts provided. Conclusion: The study's findings indicate that after using the Student Team Heroic Leadership learning strategy, students' mathematics communication skills improved significantly. As suggested, additional research should be able to examine ways to boost students' self-confidence, particularly while displaying confusion when doing mathematical tasks provided by the teacher.

Keywords: **group discussion, mathematical communication, student team heroic leadership strategy.**

A. Introduction

By embracing a constructivist perspective, mathematics educators are now calling for students to engage in more active learning and for teachers to play a more facilitative role. A critical component of the majority of modern instructional programs is the expectation that students will discuss mathematics with their peers and teachers (Meyer & Schnell, 2020). This increased emphasis on mathematical communication presents a new challenge for teachers and students worldwide. The fundamental research in mathematics education, mathematical interaction, or the communication process serves as a vehicle for teachers' professional development by providing insight into the learning process and mathematical understanding, as well as social processes involved in teaching and interacting (Godino et al., 2021; Planas et al., 2018). Thus, researchers underline the need of effective mathematical communication skills for teachers and students in order to foster future mathematics learning.

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Mathematics is frequently associated with numerical counts and formulas, leading to the misconception that communication skills cannot be developed through mathematics education. In fact, communication skills are critical for mathematics learning. Mathematical communication is one of the standard processes in learning Mathematics proposed by the National Council of Mathematics Teachers (NCTM, 2000). Mathematical Communication Skills (MCS) refer to students' ability to: (1) structure and relate mathematical thinking through communication; (2) communicate logical and clear mathematical thinking to friends, teachers, and others; (3) analyze and assess mathematical thinking and strategies used by others; and (4) use mathematical language to express mathematical ideas correctly (NCTM, 2000). One of the critical components that can affect students' success in mathematics is the accuracy of students' calculations and language (Pourdavood & Wachira, 2015). Language and communication are a vital part of mathematics education since they serve as a means of exchanging and clarifying ideas (Erath et al., 2018; Robertson & Graven, 2020). Classroom mathematics instruction should assist pupils in communicating their ideas. Mathematical communication skills must be developed by teachers and students because communication in mathematics education enables teachers and students to conduct more in-depth mathematical analysis (Khairunnisa et al., 2020; Paruntu et al., 2018).

Interviews conducted with mathematics teachers from one of the public junior high schools in Makassar revealed several issues with mathematics instruction in the classrooms. These include the following: (1) teachers used the lecture method; (2) student-centered learning was not implemented in the classroom; and (3) students were less capable of writing mathematical symbols correctly when solving math problems, including failing to record what was known and what was asked of the question given. The students could not write mathematical notation or explain mathematical symbols using everyday language. For example, when a mathematical problem "the distance traveled by a motorbike at 40 km/hour is 4 hours" was given, the students looked confused as to why the mathematical notation was 40 x 4. Then, the question was changed to "the distance traveled by a motorcycle with a speed of 4,000 cm/hour is 240 minutes, how many kilometers is the distance covered by the motorcycle?" For this question, the students answered 240 x 4000 = 96000. Due to their failure to record what was known and what was requested in the question, the students were unaware that the units of time and speed needed to be translated to hours and kilometers. Even after the teacher wrote, d= distance, t = time, v=speed, the students seemed perplexed with what was known and what was asked of the question. Because of that, the question was changed into: if t = 4 hours, v = 40 km/hours, then s =….? At the end, only 30% of students obtained the Minimum Completeness Criteria (KKM) with the highest score of 81 on this question.

Delivering material using the lecture method results in students' poor mathematical communication (Darkasyi et al., 2014). Many teachers adhere to the transfer of knowledge paradigm, which is defined as learning in which the teacher views him/herself as the center and is responsible for everything, including searching for, collecting, completing, and even presenting lessons, while students merely listen and observe (Johar et al., 2018). This type of learning system does not support students' active classroom involvement and results in a lack of conceptual grasp of mathematical concepts, as it is not student-centered (Meyer & Schnell, 2020). In a class that is not student-centered, students are not trained to interpret problems or ideas in mathematics both orally and in writing (Meyer & Schnell, 2020). Students' poor mathematical communication was observed at Public Junior High School No. 6, Tommo (Sari et al. 2017), where the students only achieved 41.1% out of 100% communication skills measured. Indonesian students had low levels of mathematical communication ability (Darkasyi et al., 2014).

Mathematical communication is a critical skill for students to possess in mathematics education. Mathematical communication is a necessary component of completing, exploring, and investigating mathematics, as well as a way of social interaction in exchanging thoughts and opinions, and can help sharpen ideas when convincing others (Rifdah & Priatna, 2020). Students can arrange and organize mathematical thinking processes through mathematical communication, both orally and in writing (Wood, 2012). Therefore, mathematical communication as one of the abilities that secondary students must learn and develop (Nurhusain & Hasby, 2021; Wood, 2012). Students can use mathematical communication to connect real-world objects and imagery to mathematical concepts and to communicate everyday occurrences and activities using mathematical symbols (Manouchehri & John, 2006).

We are interested in enhancing students' communication skills using the student team heroic leadership strategy. The student team heroic leadership strategy is a mode of learning in which the instructor serves as a mediator rather than as the source of information (Nurhusain & Hasby, 2021; Simidi, 2015). Additionally, the student team heroic leadership strategy is a cooperative learning strategy in which students are separated into different groups of four to five students each (Li et al., 2022; Slavin, 2015). Students no longer only listen and "see" learning; they actively participate by collaborating with their group members to solve the teacher-assigned tasks (Hallinger & Heck, 2011). This technique not only engages students but also cultivates a sense of leadership in them (Klar et al., 2016). Students' leadership spirit can be seen in their ability to continuously develop the potential that exists within them, recognize their weaknesses and strengths and use them as a measuring stick for growing as a person, and always take advantage of opportunities from what has been learnt, always be cheerful, encouraging, and selflessly assisting one another (Hallinger & Heck, 2011).

The importance of group discussion in mathematics education has garnered considerable attention from scholars in mathematics education (Björklund et al., 2020; Slavin, 2015). Research has yielded several different ways to conceptualize interactions (Prusak et al., 2012; Radford, 2011) and there are numerous research findings highlighting the benefits of group discussion-based learning, including those in learning civic empowerment, agency, power, and political challenges (Radford, 2011; Straehler-pohl, 2017). Others investigate the relationship between learning material and group discussion following the application of group discussion in learning (Nilsson & Ryve, 2010; Weber et al., 2008). Furthermore, some studies have demonstrated the beneficial effect of group work on mathematics learning (Byrne & Prendeville, 2020; Smith et al., 2014; Sofroniou & Poutos, 2016), while the others found that students had substantial difficulty establishing productive group discussions (Attard, 2013; Ryve et al., 2013). In this article, we focus on how to improve students' mathematical communication in building effective group discussions using the student team heroic leadership strategy

B. Method

Research Design

This study was done as Classroom Action Research (Creswell, 2017) which employed the student team heroic leadership strategy. It was conducted in two cycles which were suitable for the needs to elevate students' achievement standard of learning (Creswell, 2017). Each of the cycles consisted of the following activities: 1) Planning, 2) Implementation, 3) Observation, 4) Reflection.

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Sample and Data Collection

The research subjects were 16 seven-grade students (six boys and ten girls) from Middle-School 6th Tommo, Makassar. The study was carried out in the odd semester of the 2021/2022 academic year. Two cycles of research were planned. Cycle I lasted four sessions, three of which were used to implement actions and one of which was used to conduct the cycle's final test. The second cycle had three meetings and concluded with a test. Cycle II consisted of activities aimed at resolving the issues raised during cycle I. In the classroom, students' mathematical communication was improved using the student team heroic leadership strategy.

According to the lesson plan above, this classroom action research consisted of four stages: planning, implementation, observation, and reflection. The following instruments were used in this study: (1) a test to assess students' mathematical communication skills; (2) student response questionnaires to elicit student feedback on the implementation of the student team heroic leadership learning strategy; and (3) interviews with several students to elicit information about aspects of the student team heroic leadership learning strategy that are difficult to observe or cannot be observed directly by the researcher during observations. The mathematical communication exam adaptation was developed in accordance with the indicators of mathematical communication skills in problem-solving by (Brenner, 1998; Fitrianti et al., 2018; Nasrullah, 2022; Puspa et al., 2019). The test indicators are presented in Table 1.

Table 1. Test Scoring Guidelines

No	Score	Qualitative Category	Quantitative Category	Representation
1.	4 (Four)	The answer is complete and correct, student fluently provides a variety of different correct answers.	The explanation makes sense and is mathematically correct, although there are some linguistic flaws.	Everyday language
			Student can paint diagrams, pictures, or tables completely and correctly.	Drawing
			Student can form algebraic equations or mathematical models, then answer correctly	Mathematical model or algebraic equation
2.	3 (Three)	The answer is almost complete and correct, student fluently provides a variety of different answers.	The explanation makes sense and is mathematically correct, with a few errors detected	Vocabulary
			Student can draw diagrams, pictures, or tables completely, with a few errors detected	Drawing
			Student can use algebraic equations or mathematical models	Mathematical model or algebraic equation

No	Score	Qualitative Category	Quantitative Category	Representation
			completely, with a few errors detected	
3.	2 (Two)	The answer is partially complete and correct.	The explanation makes sense mathematically but is only partially complete and correct	Vocabulary
			Student can draw diagrams, pictures, or tables which are partially complete	Drawing
			Student can use algebraic equations or mathematical models that are partially complete	Mathematical model or algebraic equation
4.	1 (One)	The answer is vague and procedural.	Student shows limited understanding both in terms of the content of writings, diagrams, pictures, or tables as well as the use of mathematical models and calculations	Vocabulary drawing equation
5.	0 (Zero)	The answer is incorrect and does not contain adequate details.	The answer shows that the student does not comprehend the idea and so is unable to provide sufficient explanation	Vocabulary drawing equation

Analyzing of Data

The data obtained were analyzed qualitatively and quantitatively. Quantitative data were derived from the results of students' mathematical communication tests administered at the end of each cycle and analyzed using descriptive statistics. Meanwhile, the data from the questionnaire responses were evaluated using descriptive statistics. The criteria for research success were determined based on the research objective, namely whether the average test results of students' mathematical communication skills met the minimum completeness criteria score of ≥ 75, and whether the students, classically, can complete at least 85% of the mathematical communication skills' indicators

C. Result and Discussion

Students' Mathematical Communication Skills

Descriptive statistics were used to assess the data collected following the implementation of the student team heroic leadership learning strategy. Table 2 presents the findings of a descriptive statistical analysis of students' mathematical communication skills from cycles I and II.

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Table 2. Descriptive Analysis of Students' Mathematical Communication Skills

Statistics	Cycle I	Cycle II
Number of students	16	16
Ideal Score	100	100
Maximum	96	98
Minimum	66	74
Score Range	36	24
Mean	75	87
Median	76	88
Variance	51.333	34.133
Standard Deviation	9.93	5.842
Mode	76	90

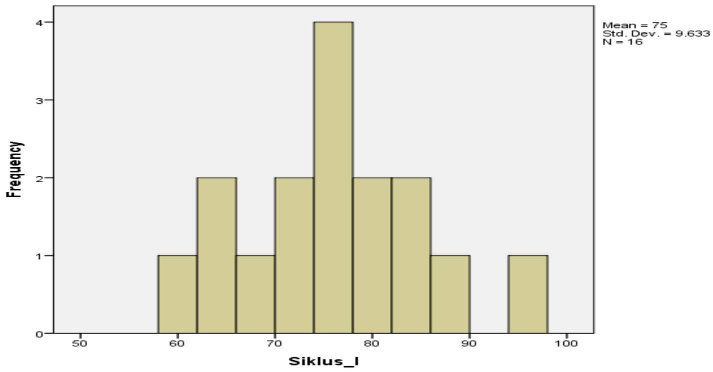

Figure 1. Students' Mathematical Communication Skills on Cycle I

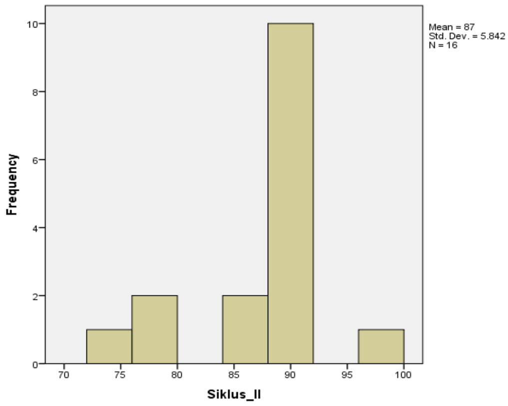

Figure 2. Students' Mathematical Communication Skills on Cycle II

Based on the tables and graphs above, it appears that there is an increase in students' mathematical communication skills following the implementation of the Student Team Heroic Leadership (STHL) learning strategy. Figure 1 and Figure 2 show that the average score of students' mathematical communication skills rose from cycle I to cycle II. Students' individual skills also developed significantly, to the point where all students reached the Minimum Completeness Criteria (KKM) of 75. As a result, it can be concluded that learning through the application of the Student Team Heroic Leadership strategy, which is part of cooperative learning, is highly effective. This finding corroborated that cooperative learning can improve students learning achievement significantly (Arifin, 2022; Carlos Torrego-Seijo

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et al., 2021; Sarah et al., 2021). Additionally, other research demonstrates that learning in a team or group setting has an effect and benefits students' learning outcomes (Roschelle et al., 2010; Slavin, 2015; Toumasis, 2004). To summarize, implementing the Student Team Heroic Leadership strategy has the potential to significantly increase the quality of mathematics instruction, particularly students' mathematical communication skills.

Teacher and Student Activity

The teacher and student activity data contained in the observation sheet demonstrates that there are some indicators of the success of the learning process that have not been reached by the students. One of them is some inaccuracies in portraying a mathematical problem in the form of verbal interpretation, writing, images, tables, graphs, concrete objects, or mathematical symbols. Students are presented with a mathematical problem during classroom instruction, they will attempt to comprehend the problem and solve it using methods they are familiar with (Meyer & Schnell, 2020). It is also claimed that these methods are inextricably linked to students' prior knowledge, which is relevant to the problem at hand. One of the efforts that students can do to solve the problem is to create a model or a representation of it (Chronaki & Planas, 2018). The model or representation may vary according on an individual's ability to interpret the problem at hand. Thus, learning mathematics should provide students with ample opportunities to practice and develop mathematical representation abilities as an integral part of the problem-solving process. The problem must be adjusted to the substance and depth of the topic at each level, considering students' existing or prerequisite knowledge.

The following are examples of two mathematical problems related to mathematical representations that the participants had to solve in this study:

1. Rafli owns a box of "indomie" (eg. instant noodles), Asiyah brings three plastic bags containing "indomie" (eg. instant noodles), and Devi has five "indomie" (eg. instant noodles) packets. Determine the constants, variables, and coefficients for "indomie" (eg. instant noodles) owned by Rafli, Asiyah, and Devi.
2. If Rafli puts his "indomie" (eg. instant noodles) into six plastic bags, each bag will contain five "indomie" (eg. instant noodles) packs. Then Rafli handed Yudi his two plastic "indomie" (eg. instant noodles) bags. Now, write the algebraic form of "indomie" (eg. instant noodles) for Rafli, Asiyah, and Devi.

One member of a student's group could solve problem no. 1, although the rest of them answered the coefficients and constants in reverse. However, with question number 2, only 3 groups were able to complete it and the other 2 groups had difficulty solving the problem. The two groups answer was: Rafli's "indomie" (eg. instant noodles) 1 box = X, 6 plastic bags = 6Y, and 5 packs = 5. Therefore, the algebraic equation for Rafli's "indomie" (eg. instant noodles) was 6Y – 2Y x 5. Because the students were having problems representing their answers, the teacher quickly assisted them by clarifying that Rafli's "indomie" (eg. instant noodles) is now available in four plastic bags or in other words, twenty packets. Even still, the two groups were perplexed as to how to obtain the solution. Finally, the researcher discussed the solution on the whiteboard to the two groups: (1) Rafli puts his "indomie" (eg. instant noodles) into 6 plastic bags, eliminating the need to count the "indomie" (eg. instant noodles) box. He then gave Yudi two plastic bags of "indomie" (eg. instant noodles), bringing the total to six – two = four plastic bags. As a result, the answer is four plastic bags plus three plastic bags plus five packets (4y+3y+5 = 7y+5); (2) Rafli puts his "indomie" (eg. instant noodles) into six plastic bags, each bag will contain five "indomie" (eg. instant noodles) packs, then 6 x 5 = 30 packs of "indomie" (eg. instant noodles), but since Rafli gave Yudi two plastic bags of "indomie" (eg. instant noodles) (10 packs of "indomie") (eg. instant noodles), then now Rafli only has 30 – 10 = 20 packs of "indomie" (eg. instant noodles). The correct equation for

Rafli's "indomie" (eg. instant noodles) is 3y+5+20 = 3y +25. The simple algebraic form of Rafli's "indomie" (eg. instant noodles) is 1 box = 6 plastic bags, (1 plastic bags = 5 packs) = 6 x 5 = 30 packs of "indomie" (eg. instant noodles). According to the description above, a teacher can provide a more simple and understandable explanation to encourage pupils to think further, for example, by re-questioning their answers to a problem or resolving the problem using alternative ways.

The development of students' conceptions and representational abilities is influenced by the nature of their teacher's conceptions of representation (Stylianou, 2010). Not only do students struggle with mathematical processes such as representations, but teachers also deal with representing their own talents when teaching mathematics (Dreher & Kuntze, 2015; Rattan et al., 2012), as well as with mathematical proving and reasoning.

The first stage in the Student Team Heroic Leadership strategy aims to instill self-awareness that students both in groups and individually can become leaders who have heroic traits. This is consistent with the concept of heroic leadership. Heroic leadership is the peak of leadership, as it is predicated on the heroism concept. A hero is described as an individual who (a) conducts an activity that is deemed to be excellent on their own volition or is motivated by a noble principle or a greater good; (b) makes considerable sacrifices; and (c) takes major risks. A leader's role is to compel all members of the group to participate, not merely to bear personal responsibility for the group's accomplishments (Allison & Goethals, 2016).

The second stage of the Student Team Heroic Leadership strategy is group discussion (student team). This stage also serves as the core stage of the strategy. As revealed in this study, meaningful discussions occurred in the classroom where all students participated actively in the topic as well as in presenting and defending group responses. Students paid close attention to one another's arguments and dispute those they believe were incorrect. Some students, particularly those with limited ability, assumed that the discussion's aim was to enable professors to assess students' mathematics comprehension (Henning et al., 2012). Students frequently believe their duty in the discussion is to convey the mathematics they understand and conceal the mathematics they do not (Henning et al., 2012; Weber et al., 2008).

The teacher's role in group discussions is critical. For instance, the teacher may urge pupils to verbally explain and justify their opinions at the conclusion of the lesson. Following that, the teacher reminds students to pay attention to one another when speaking. Occasionally, students become very passionate during the discussion, and at one point, many students yell their ideas simultaneously. If this is the case, the teacher may attempt to preserve order by inviting specific students to speak and limiting each student's participation to one at a time.

Through the Student Team Heroic Leadership strategy, teachers can instill a sense of leadership in students through group discussions. This is in line with what Istiyani (2013) mentions that the Student Team Heroic Leadership strategy encourages pupils to think, respond, and assist one another, which can build a heroic leadership attitude. Independence in mathematics is one of the fundamental talents that students must possess, along with the ability to finish assignments, take responsibility for problem-solving, and believe in one's own abilities. Similarly, autonomous learning can help an individual develop a more productive attitude toward collaborative learning activities (Jackson & Shenton, 2015). Our primary objective is to improve students' reasoning skills when addressing trigonometric problems. We will explain the three steps involved in completing a trigonometry problem, with excerpts from interviews with the three research subjects.

D. Conclusion

Kesimpulan adalah pernyataan singkat dan tepat yang merupakan jawaban dari rumusan masalah. Saran berisi pertimbangan yang ditujukan kepada pihak lain yang terkait dengan hasil penelitian.

The study's findings indicate that after using the Student Team Heroic Leadership learning strategy, students' mathematics communication skills improved dramatically. This is seen by the increase in the average score of students' mathematical communication test from 76 % in cycle I to 87 % in cycle II. Additionally, the cycle I variance (51.33) reduced to 34.27 in cycle II. The percentage of students' achievement in the mathematical communication test also increased from cycle I to cycle II. Additionally, there were favorable changes in student activities between cycles I and II. In short, students' mathematical communication skills improve after the implementation of the Student Team Heroic Leadership strategy, which is student-centered.

The results of this study also revealed that students tended to conceal what they did not comprehend during the learning process, making it harder for the teacher to assess the students' comprehension of previously taught mathematical topics. Further research needs to investigate how to increase students' self-confidence, allowing them to articulate the difficulties they encounter during mathematical problem-solving.

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