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LITERATURE STUDY OF STAD TYPE COOPERATIVE LEARNING MODEL TO IMPROVE STUDENTS' MATHEMATICAL COMMUNICATION SKILLS

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ABSTRACT

This research is the result of literature research as a technique used to study several references to books and the results of similar research previously conducted by others according to the problem being studied. This study uses a descriptive research method through a qualitative approach. This study aims to determine the improvement of students' mathematical communication skills by applying the STAD Type Cooperative learning model and analyze the causative factors. The data of this study was obtained from several journals and articles that revealed the improvement of students' mathematical communication skills with the application of the STAD Type Cooperative learning model. The researcher's findings show that from the indicators of mathematical communication and syntax of the STAD Type Cooperative learning model, each journal and article studied with the one written by the researcher has several similarities in indicators that explain that there is a suitability of the learning model to improve students' mathematical communication skills. For the results of each journal and article studied, it was stated that there was an increase in student learning outcomes from the students' mathematical communication skills. The STAD Type Cooperative learning model is also considered effective in improving students' mathematical communication skills. From all the articles and journals that were researched experienced an increase in grades and good learning achievement results, it can be concluded that the application of the STAD Type Cooperative learning model can improve students' mathematical communication skills.

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INTRODUCTION

Mathematics is the queen of knowledge and at the same time its servant. Mathematics as the queen of science means that mathematics is the source of all disciplines and the key to science. According to Rositasari (2017), mathematics also functions to serve science, meaning that in addition to growing and developing for itself as a science, mathematics also serves the needs of science in its development and operation. Therefore, education is very important for one generation to the next (Akrim, 2020; Hidayat, 2024; Simbolon, 2024; Sri 2024). This definition means that mathematics is a basic science, both its applied and reasoning aspects have an important role in efforts to master science and technology. Seeing the importance of mathematics, mathematics learning is included in all levels of education in Indonesia from elementary school to university.

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One of the standards of the learning process is communication. Communication in this case is not just oral or *verbal* communication but also written communication. Oral and written communication is contained in mathematical communication. Wijaya (2016) also stated that mathematical communication is the ability of students to express mathematical ideas both orally and in writing. Mathematical communication skills are very important for every student to have because with mathematical communication students are able to verbally and in writing communicate mathematical ideas/ideas with symbols, tables, graphs/diagrams to clarify the situation or problem which is all summarized in the mathematical communication ability indicators. In addition, mathematical communication indicators are included in the standard learning process that must be mastered by every student in order to improve their learning outcomes.

The problem of low mathematical communication skills of students can be due to the teacher's ability to provide interesting mathematics learning and also because of the factor of students who are difficult to communicate the existing problems and are no longer interested in learning. If this continues to be allowed, eventually students will still consider mathematics as a difficult subject and students' mathematical communication skills will remain low.

To improve communication skills and create a conducive and fun learning atmosphere, it is necessary to package an attractive learning model. With the innovation of the learning model, it is hoped that an active learning atmosphere will be created, making it easier to master the material, students will be more creative in the learning process, critical in facing problems, and achieve more optimal communication results.

One type of cooperative learning model that can encourage active student participation in the classroom is the *Student Teams Achievement Division* (STAD) type cooperative learning model. STAD is a type of cooperative learning designed to influence student interaction patterns and provide opportunities for each student to demonstrate their participation to others. *Student Teams Achievement Division* (STAD) is a cooperative method using small groups with the number of members of each group of 4-5 students heterogeneously. It began by conveying learning objectives, material delivery, group activities, quizzes, and group awards.

The application of the STAD-type cooperative learning model is still not well implemented, because it usually still uses conventional teaching methods, so that the results of student learning are still low because it is monotonous in only one model. This is what makes the author combine the STAD-type cooperative learning type to assess students' mathematical communication skills.

This research was conducted in the form of a literature study. This is done because the author is interested and challenged to conduct a literature study, it is still necessary to add references to existing literature studies regarding this research and due to conditions that do not allow researchers to conduct direct research to students in schools. With this literature study, it is hoped that it can provide good and effective results from the application of the STAD-type cooperative learning model to students' mathematical communication skills.

RESEARCH METHOD

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This research is included in the literature study research. Therefore, the researcher carried out the process of searching for data in the form of documents or books, the researcher collected several journals, scientific papers and references through the internet regarding the STAD-type cooperative learning model and students' mathematical communication skills and collected several supporting books from various places, namely city libraries, North Sumatra regional libraries, and bookstores, while the setting of the data collection technique used by the researcher in this study is a literature study, namely by searching for data related to the discussion.
The data prepared in this study is sourced from literature or using library *research* methods with the aim of collecting information data with the help of various materials contained in the library room.

In conducting the research, the researcher collected 6 journal data related to Mathematical Communication Skills and the STAD Type Cooperative Learning Model. In addition, researchers began to read and understand several books and journals regarding the STAD-type cooperative learning model and students' mathematical communication skills.

RESULTS AND DISCUSSION

From the study of articles on the STAD Type Cooperative learning model to improve students' mathematical communication skills, various mathematical materials were obtained sourced from secondary data that were used as research sources.

The articles used as data sources in this study can be coded to make it easier to read the results. The code can be abbreviated, namely, Mathematical Communication Ability with KKM code and STAD Type Cooperative Learning model with STAD code, so that from the 6 articles that will be used as a research source, the KKM + STAD code will be used which is presented in the following table:

Table 3.1 Article Code Description

It	Article Code	Author / Article Identity	Heading	Type of Research
1	**KKM + STAD 1**	Sahat Saragih / Journal of Education and Culture Volume 2 Number 2 June 2013, Postgraduate Program of Medan State University	Improving Mathematical Communication Skills of High School / MA Students in Simpang Ulim District through the STAD Type Cooperative Learning Model	Experiment
2	**KKM + STAD 2**	Tria Muharom / Journal of Education	The Effect of Learning with the Student	Experiment

		and Teacher Training Volume 1 Number 1 of 2014, Open University Postgraduate Program	Teams Achievement Division (STAD) Type Cooperative Model on Students' Mathematical Reasoning and Communication Skills at SMK Negeri Manonjaya, Tasikmalaya Regency	
3	**KKM + STAD 3**	Fitry Wahyuni / *Journal of Mathematics Education and Science* volume 4 Nomor 2 April 2019, STKIP Pelita Bangsa Binjai	Improving Students' Mathematical Communication Skills Through a STAD-type Cooperative Learning Model with a Reciprocal Teaching Approach	Classroom Action Research
4	**KKM + STAD 4**	Sri Apiyati / Journal of Cakrawala Pendas Volume 1 Number 2 July 2015, PGSD STKIP Sebelas April Sumedang	The Use of the Student Teams Achievement Division *(STAD) Type Cooperative Learning Model* in an Effort to Improve Mathematical Communication Skills on the Subject of Fractions	Classroom Action Research
5	**KKM + STAD 5**	Erma Depriana, Rahmad Bustanul Anwar, Satrio Wicaksono Sudarman, Sutrisni Andayani / Journal of Mathematics Education volume 1 number 2 of 2020, Mathematics Education Study	The Effect of the Student Teams Achievement Division *(STAD)* Type Cooperative Learning Model on Students' Mathematical Communication	Experiment

		Program, University of Muhammadiyah Metro		
6	**KKM + STAD 6**	Maisyarah / Journal of Mathematics Education Volume 5 Number 1 April 2017, MAN 1 Banjarmasin	Improving Students' Mathematical Communication Skills Using the STAD Type Cooperative Learning Model in Class XII Social Sciences	Classroom Action Research

The following are the stages carried out by previous researchers based on the secondary data selected by the researcher:

Table 3.2 Stages of Secondary Data Implementation

Article Code	Implementation Stages
KKM + STAD 1	Indicators of mathematical communication skills: 1. Expressing an idea in a real-world phenomenon into an image 2. Formulating the correct equations or rules in conveying an idea 3. Providing an appropriate explanation in using a rule in the problem-solving process STAD Type Cooperative Learning Steps: 1. Clarify the objectives and establish the set 2. Presenting information 3. Organizing students into study teams 4. Helping with teamwork and learning 5. Testing a variety of materials 6. Giving recognition

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KKM + STAD 2	Indicators of mathematical communication skills: 1. Expressing a real situation, image, or object into a mathematical language, symbol, idea, or model 2. Explain mathematical ideas, situations, and relationships orally or in writing 3. Listening, discussing, and writing about math 4. Reading with the understanding of a written mathematical representation 5. Re-expressing a mathematical description or paragraph in one's own language. STAD Type Cooperative Learning Steps: 1. Preparation 2. Presentation of material 3. Group activities 4. Tes individu (ifs) 5. Calculation of individual development scores, 6. Group awards.
KKM + STAD 3	Indicators of mathematical communication skills: 1. Train students to use symbols/notations, mathematical operations appropriately 2. Expressing the idea/idea of a problem 3. Explain a mathematical image, graph, table or sentence into a contextual and appropriate description 4. Presenting contextual problems in the form of images, graphs, tables or algebra 5. Convey mathematical ideas, situations, or relationships with pictures, graphs, tables, algebra, or sentences clearly STAD Type Cooperative Learning Steps: 1. Discuss in groups with student leaders 2. Making conjectures/predictions about the relationships between concepts, providing rational reasons for a statement/opinion, and stating the idea of a problem 3. Students make questions on the material being studied as well as solve it in sequence with the student leader 4. Students present or present the results of group discussions in

	front of all classmates
KKM + STAD 4	Indicators of mathematical communication skills: 1. Reflecting and explaining students' thoughts on mathematical ideas and relationships 2. Pormulating mathematical definitions and generalizations 3. Expressing mathematical ideas orally and in writing 4. Reading mathematical discourse with an understanding 5. Clarify and expand the questions against the mathematics he learns 6. Appreciate the beauty and power of mathematical notation and its role in idea development STAD Type Cooperative Learning Steps: 1. Stage of presentation of material 2. Stages of group activities 3. Individual test stages 4. Score Calculation Stages 5. Group Award Stage
KKM + STAD 5	Indicators of mathematical communication skills: 1. Expressing a mathematical idea through speech, writing, demonstration, and visually describing it in different types. 2. The ability to understand, interpret, and assess ideas presented in writing, orally, or in visual form. 3. Ability to construct, interpret and relate to various representations of ideas and their relationships STAD Type Cooperative Learning Steps: 1. Convey students' motivations and goals 2. Conveying/presenting information 3. Organizing students in study groups 4. Guiding the work and learning group 5. Evaluation 6. Giving Awards
KKM + STAD 6	Indicators of mathematical communication skills: 1. Listening Activities 2. Writing Activities (Merangkum pembelajaran) 3. Mental Activities (Completing individual and group tasks)

	4. Emotional Activities (Active and responsive in providing opinions and questions) STAD Type Cooperative Learning Steps: 1. The presentation teacher, provides the material to be studied in outline and activity procedures, as well as group work procedures. 2. Teachers form groups based on ability, gender, race, ethnicity, number between 3 – 5. 3. Students work in groups, students learn together, discuss or do assignments given by teachers according to LKS. 4. Scafolding, teachers provide guidance. 5. Validation, teachers validate the results of group work and provide conclusions for group assignments 6. Quizzes, teachers hold quizzes individually, score results are collected, averaged in groups, the difference between individual base scores and quiz results (developmental scores) 7. Group awards, based on the calculation score obtained by the members, are averaged, the results are adjusted to the team predicate 8. Evaluation carried out by teachers.

In the table above, it can be seen that the steps taken by the researcher in the secondary data are in accordance with the syntax criteria in the STAD Type Cooperative learning model based on the opinion of Yuliani (2019), with a slight addition of additional activities as an effort to obtain the success of previous researchers' research.

In KKM + STAD 1 the indicators of students' mathematical communication can be seen in the journal in the introduction section which discusses the study of mathematical communication literature. The first indicator contains about stating an idea. Students write mathematical ideas in the form of drawings, where the indicator is the same as the author's first indicator in the study of mathematical communication literature which states to state an idea. Students express mathematical ideas through speech, writing, demonstration, and visually describing them in different types. The second indicator is to prepare an equation for an appropriate idea. Students write mathematical ideas in the form of mathematical models (*mathematical expressions*) which is also the same as the second writer's indicator which states the ability to interpret an idea. Students understand, interpret, and assess ideas presented in writing, orally, or in visual form. And the third indicator provides an explanation for the problem-solving process. Students explain the completion procedure (*Explanations*) which is also in accordance with the three indicators of the author. Students construct, interpret and relate various representations of ideas and their relationships.

Meanwhile, the steps of the STAD Type Cooperative Learning model in the article are contained in the discussion section in the syntax table *of the Cooperative Learning Model* which contains 6 phases in the form of clarifying objectives, presenting information, organizing students into learning teams, assisting teamwork and learning, testing various materials, and providing recognition. This is also the same for all writers' syntax.

In KKM + STAD 2 indicators of mathematical communication are found in the literature and theory review section. The first indicator states an idea in a mathematical model in accordance with the first author's indicator of the ability to express an idea. Students express a situation, image, or real object into a mathematical language, symbol, idea, or model. The second indicator explains the idea orally or in writing according to the second indicator of the author. Students explain mathematical ideas, situations, and relationships orally or in writing. The third indicator of hearing ideas corresponds to the second indicator of the author. Students listen, discuss, and write about math. The fourth indicator explains about reading the same representative of written mathematics as the second indicator of the author. Students read with an understanding of a written mathematical representation. The fifth indicator reexplains a mathematical description that corresponds to the author's third indicator. Students re-express a mathematical description or paragraph in their own language. And in the syntax of the STAD Type Cooperative Learning model, there is also a literature review section and the theory of the article being researched is the same in accordance with the author's syntax, namely Preparation, Presentation of material, Group activities, Individual tests (quizzes), Calculation of individual development scores, and Group awards.

In KKM + STAD 3 where the mathematical communication indicators are found at the discussion stage which contains five indicators, namely Students are trained to use symbols/notations, mathematical operations appropriately, Students express ideas/ideas from a problem, Students explain mathematical pictures, graphs, tables or sentences into contextual and appropriate descriptions, Students present Contextual problems into the form of pictures, graphs, tables or algebra, Students convey ideas, situations, or mathematical relationships with pictures, graphs, tables, algebra, or sentences clearly. All of them have the same number of indicators that have been made by the author. And in the syntax of the STAD Type Cooperative Learning model which states that the four steps are the same as the syntax stated by the author.

In KKM + STAD 4 indicators of mathematical communication, students are discussed in the discussion section of theoretical studies on mathematical communication which contains six indicators, namely students reflect and explain students' thoughts about mathematical ideas and relationships, students emmulgate mathematical definitions and generalizations, students express mathematical ideas orally and in writing, students read mathematical discourse with understanding, students clarify and expand questions to the mathematics they learn, and Students appreciate the beauty and power of mathematical notation and its role in the development of ideas. As well as the syntax of the STAD Type Cooperative Learning model which states that the five

steps are similar to the syntax stated by the author, namely the material presentation stage, the group activity stage, the individual test stage, the score calculation stage, and the group award giving stage.

In KKM + STAD 5, indicators regarding students' mathematical communication skills are found in the introduction in the journal, but the parts of the communication are not clearly explained. The author draws conclusions from the content of the journal in the introduction into 3 major indicators of students' mathematical communication skills, namely, Students express mathematical ideas through speech, writing, demonstration, and describe them visually in different types, Students' ability to understand, interpret, and assess ideas presented in writing, oral, or in visual form, Students' ability to construct, interpret, and connect assortments representation of ideas and their relationships. And in the syntax of the STAD Type Cooperative Learning model is also the same as the mathematical communication indicators, the author concludes by stating the same six steps as the syntax stated by the author, namely, Conveying students' motivations and goals, Conveying/presenting information, Organizing students in study groups, Guiding work and learning groups, Evaluation, and Giving Awards

In KKM + STAD 6 which contains four indicators contained in the results and discussion section in the table of aspects assessed in the journal that was studied, there are differences with those that have been made by the author, where the mathematical communication indicators contained in the journal are, Listening Activities (Listening and paying attention to the teacher), Writing Activities (Summarizing learning), Mental Activities (Completing individual and group tasks), and Emotional Activities (Active and responsive in providing opinions and questions). And in the syntax of the STAD Type Cooperative Learning model which states eight steps that are quite long to be carried out, including: The teacher presents, provides the material to be studied in outline and activity procedures, as well as group work procedures; Teachers form groups based on ability, gender, race, ethnicity, number between 3 – 5; Students work in groups, students learn together, discuss or do assignments given by teachers according to LKS; Scafolding, teachers provide guidance; Validation, teachers validate the results of group work and provide conclusions of group assignments; Quizzes, teachers hold quizzes individually, the results of the scores are collected, averaged in groups, the difference between the initial score (base score) of the individual and the score of the quiz results (developmental score); Group awards, based on the calculation score obtained by the members, on average, the results are adjusted to the predicate of the team; and Evaluation conducted by teachers; but the syntax can already describe the course of the learning process using the STAD model which is similar to the syntax stated by the author.

In the following table, data on research success categories related to journals and theses will be presented as a reference for this research:

Table 3.3 Description of Research Success Based on Secondary Data

Code	Determining Success

KKM + STAD 1	The determination was made by giving pretest and posttest in two classes, namely the control class and the experimental class.
KKM + STAD 2	The determination was made by giving pretest and posttest in two classes, namely the control class and the experimental class.
KKM + STAD 3	Determination by observing teacher activities during learning which is carried out in 2 cycles and looking at the test results given at the end of each cycle I and cycle II.
KKM + STAD 4	Determination by observing teacher activities during learning which is carried out in 2 cycles and looking at the test results given at the end of each cycle I and cycle II.
KKM + STAD 5	The determination was made by giving pretest and posttest in two classes, namely the control class and the experimental class.
KKM + STAD 6	Determination by observing teacher activities during learning which is carried out in 2 cycles and looking at the test results given at the end of each cycle I and cycle II.

In the type of classroom action research that is used as a source, the determination of the success of the research is based on the improvement of students' mathematical communication skills in each cycle by learning using a STAD-type cooperative learning model and improving students' mathematics learning outcomes before and after the action is taken. As for research with experimental types, the determination of success is in the form of comparing the scores of student learning tests using the STAD type cooperative learning model with conventional models, and there are those that make the results of the students' mathematical communication ability tests after being given treatment in the form of a STAD type cooperative learning model.

In the following table, data on research results from each journal and thesis will be presented as a research reference:

Table 4.4 Description of Article Research Results

Code	Research Results
KKM + STAD 1	Based on the results of the research carried out, the improvement of mathematical communication skills of students who participated in STAD-type cooperative learning was higher than that of students who participated in regular learning from each level of KAM. To determine the significance of the correctness of the above analysis, a statistical test was carried out with ANAVA 2 (two) pathways at the significance level α= 0.05, against the null hypothesis (H0) which was stated as

	follows: The improvement of mathematical communication skills of students taught with the STAD-type cooperative learning model was not higher than that of students taught with regular learning. The test criteria, reject H0, if the significance (sig.) < 0.05 in other cases H0 is accepted. For hypothesis testing, it can be found that on the learning factor F of 100.449 with a significance value of 0.000 < 0.05, then reject H0. In other words, the improvement in mathematical communication skills of students who received the STAD-type cooperative learning model was higher than that of students who received the usual learning model.
KKM + STAD 2	Based on the results of research on mathematical communication skills. After learning, the students' mathematical communication skills in the STAD class achieved better results than the students' mathematical communication skills in the direct class, and both were classified as moderate (6.16 and 4.47 out of 12 or 51.33% and 37.25%). The significance value of the learner's initial ability level factor was 0.000. The significance value is less than α=0.025. Thus H0 is rejected or in other words H1 is accepted. Thus, it can be concluded that the mathematical reasoning and mathematical communication skills of students who participate in Student *Teams Achievement Division* (STAD) type cooperative learning are better than students who participate in direct learning based on the initial ability level.
KKM + STAD 3	Based on the results of observation of the implementation of STAD-type cooperative learning with a reciprocal teaching approach, there was an increase in the percentage of learning implementation from 90.90% in the first cycle to 95.45% in the second cycle with the category of very good learning implementation. Meanwhile, based on the results of student mathematical communication observations, there was an increase in students' mathematical communication skills from the first cycle by 75.00% (good category) to 82.41% (good category) in the second cycle. In addition, the results of the mathematical communication test for each cycle also showed that 64.52% of the many students in grades VII-2 experienced an increase in their total score to at least a good category from cycle I to cycle II. All indicators of

	research success have been fulfilled in cycle II so that the implementation of actions is stopped until cycle II.
KKM + STAD 4	Based on the results of the z test, it can be concluded that the subject matter of fractions whose learning uses the Student Teams Achievement Division (STAD) type coefficient model can be well understood. It is evident from the results of the calculation of the value of z obtained that z calculation = 1.5 is located in the interval (-Z 0.4900 to Z0.4900). Based on the results of the questionnaire given at the end of the study, data was obtained that the student opinion questionnaire was in the interval of 3< Xt < 5 {total number of answers (Xt= 4.0)}. So it can be concluded that students' opinions or responses to the application of the Student Team Achievement Division (STAD) type cooperative learning model on the subject of fractions are positive.
KKM + STAD 5	Based on the results of the research conducted at SMP Negeri 3 Batanghari, it can be seen that the average mathematical communication results of students in the experimental class are higher, which is obtained on average 77.66 and the control class is lower, which is obtained on average 73.19. This shows that the mathematical communication of students in grade VIII of SMP Negeri 3 Batanghari who use the Student *Teams Achievement Division* (STAD) Type Cooperative learning model is higher than the mathematical communication of students who use the conventional learning model.
KKM + STAD 6	Cumulatively, the category of students with 80% mathematical communication skills is at least Very Good in Cycle I by 22.3%. Furthermore, it continued to increase in Cycle II and Cycle III by 77.14% and 94.28%, respectively. In Cycle III, there is no longer a category of students with poor mathematical communication skills. The students' responses to mathematics learning using the STAD-type cooperative learning model on linear program materials who answered yes were 93.71%, while those who answered disagreed were 6.29%. It can be concluded that the response of students to mathematics learning for Linear Program material in grade XII IPS 1 MAN 1 Banjarmasin using the STAD type cooperative learning model is Very Good.

Based on the description of the journal and article chosen by the author as a reference material for the author to conduct this research, it can be seen that the application of the STAD-type cooperative learning model to improve students' mathematical communication skills that in each article and journal the communication indicators and syntax of the STAD-type cooperative

learning model are not always the same as found by the author. The analysis produced in the research from several articles can help find out the improvement of students' mathematical communication skills applied to the STAD-type cooperative learning model.

CONCLUSION

Based on the results of the research and a literature review of journals and articles, it shows that:

1. From each journal there are indicators of students' mathematical communication skills, where each indicator from the journal corresponds to the indicators of the author which can improve students' mathematical communication skills.
2. The STAD-type cooperative learning model is one of the factors or solutions for improving students' mathematical communication skills. Judging from each step or syntax that has been carried out, it is able to improve students' mathematical communication skills.
3. The application of the STAD-type cooperative learning model has a positive impact on improving students' mathematical communication skills.

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