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Improving Students' Mathematical Connection Skills Through The Think Talk Write (TTW) Type Cooperative Learning Model At Noemuti Public High School

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Abstract

This research aims to improve students' mathematical connection skills by applying a Think Talk Write (TTW)- type cooperative learning model to quadratic function materials. This research is a Class Action Research conducted in two cycles, each of which includes implementation planning, action implementation, observation, and reflection. The subjects in this study are 23 students in class X/A of SMA Negeri Noemuti. The data collection technique used a mathematical connection ability test and an observation sheet of learning activities. The results of the study showed that in the first cycle, the average score of students was 72.09 with classical completeness of 60.86. After learning improvements were made in the second cycle, the average student score increased to 84.22, with classical completeness reaching 100%. The results of the study show that the Think Talk Write model is able to improve learning activities, concept understanding, and students' ability to connect various mathematical concepts. Thus, the Think Talk Write cooperative learning model is used effectively to improve students' mathematical connection skills on the quadratic function material.

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INTRODUCTION

Mathematics is one of the subjects that has an important role in the development of science and technology. Mathematics learning aims not only to enable students to be able to calculate, but also to develop logical, critical, systematic, and creative thinking skills. Therefore, learning mathematics must be able to provide a meaningful learning experience. One of the essential skills that students must have in learning mathematics is the ability to make mathematical connections. This ability allows students to connect mathematical concepts with other concepts in mathematics as well as everyday life. Without the ability to make mathematical connections, students tend to understand mathematics in fragments and find it difficult to apply it in real-world situations.

Mathematics learning is the formation of a mindset in understanding and reasoning the relationship between these meanings. Opinion Amir M.z & Vebrianto, (2021) states that mathematics learning is a teaching and learning activity designed by educators in developing students' creativity in order to improve thinking skills, as well as building new knowledge which is a form of effort to improve mastery of mathematics material". Mathematics learning is the process of giving experience to students through a series of activities that are planned so that students gain competence about the mathematics material they are learning Yayuk, (2014). The learning referred to here is an educator's activity to

provide a learning experience to students so as to create pleasant learning conditions. The purpose of teaching mathematics is to instill a systematic, logical, critical, creative and consistent way of thinking so that they have a persistent and confident attitude.

Mathematical connections in general are internal (in mathematics) and external (outside mathematics) relationships. Internal relationships are the relationships between mathematical ideas and mathematics, whether they are being studied or other mathematics. External relations are the relationships between mathematics and other scientific fields outside of mathematics or in everyday life. Dewi, (2013: 284) revealed that the ability to connect mathematical concepts between mathematical concepts themselves and connect mathematical concepts with other fields (outside of mathematics). Therefore, according to Hendriana, (2017:83) explained, "high school students must have and develop mathematical skills, one of which is mathematical connections.

Indonesia routinely participates in the Programme for International Student Assessment (PISA) international study organized by the OECD to measure students' literacy skills, including mathematical literacy. Based on the results of PISA 2018, the average mathematics literacy score of Indonesian students is 379, still far below the OECD country average of 489, with a ranking of 73 out of 79 participating countries. These results show that the mathematical literacy ability of Indonesian students is still relatively low, especially in terms of reasoning, problem solving, and the ability to connect mathematical concepts with real-life contexts. Furthermore, based on the results of PISA 2022, the mathematics literacy score of Indonesian students was recorded at 366 with a ranking of 69 out of 81 countries. Although the ranking has improved, in terms of mathematics scores, Indonesian students still show worrying conditions and remain below the OECD average. This low achievement shows that Indonesian students still have difficulty in formulating contextual problems into mathematical models, applying appropriate mathematical concepts and procedures, and interpreting the results of solutions meaningfully. This condition shows that the mathematical connection ability of students in Indonesia still needs to be improved through the application of appropriate and meaningful learning models. Therefore, it takes skills that connect mathematical concepts/rules to each other or with real-world applications. The ability to connect mathematical concepts/rules with each other, with other fields of study, or with real-world applications is the definition of mathematical connection ability (Suherman, 2008).

Based on the results of initial observations at Nonyuti State High School, students' mathematical connection skills are still relatively low. Students have difficulty connecting concepts that have been learned with new concepts. In addition, students also have difficulty applying mathematical concepts in contextual problem solving. One of the causes of low mathematical connection ability is the use of learning methods that are still teacher-centered. One-way learning makes students less active in building their own knowledge. Therefore, a learning model that is able to actively engage students is needed. The Think Talk Write type cooperative learning model is one of the models that can be used to improve mathematical connection skills. This model emphasizes thinking, discussing, and writing

activities. Through this process, students build a gradual and meaningful understanding. Based on this background, this study aims to improve students' mathematical connection skills through the application of a *Think Talk Write type cooperative learning model*

Based on the above problems, a learning model is needed that not only emphasizes giving formulas or sample questions from the teacher, but also provides opportunities for students to actively think, discuss ideas, and rewrite their understanding. The *Think Talk Write (TTW) type cooperative learning model* was chosen because through the stages of thinking, speaking or discussing (speaking), and writing (writing), students are directed to build independent learning concepts, communicate their ideas with peers, and pour them into writing. In this way, it is hoped that students will better understand the meaning of concepts, be able to connect between concepts, and not just memorize formulas.

Some previous research results have also shown the effectiveness of the TTW model in improving students' mathematical connection skills. Research by Sulastri, Irawati, and Karlina (2017) found that the contextual approach with the TTW strategy had a positive effect on improving the mathematical connection ability of junior high school students. Similarly, Rafidah, Purwanto, and Antari (2020) reported that the application of the TTW model with a contextual approach significantly improved the mathematical connection ability of SMP Negeri 97 Jakarta students. Other research by Nurapriani (2016) and Lasmi (2015) also showed similar results that TTW strategies can help students understand the relationships between mathematical concepts and apply them in real-world contexts. Based on these findings, the TTW learning model is seen as appropriate to be used in improving the mathematical connection ability of Noemuti State High School students

The Think Talk Write (TTW) *learning model* is based on constructivist learning applied through thinking, speaking, and writing activities Isrok'atun & Rosmala, (2018). This learning model has steps that start from the thinking process, namely students build their own knowledge and look for ideas or solutions from contextual problems related to daily life or solve problems related to mathematical concepts and other disciplines Yamin & Ansari, (2012). The next step is to talk or communicate, sharing ideas or solutions that students find with their friends in the discussion group. The last step is for students to write down the ideas or solutions they get from the results of the discussion. The TTW steps of thinking, speaking, and writing described earlier can keep all students actively involved in the learning process. Active students are not only those who have superior abilities, but students who are less than superior also try to find ideas or solutions and convey them to Sulastri's group of friends, (2015). In addition, the TTW learning model was chosen because based on the results of research conducted by Sugandi (2011) and Nupriani (2016), the TTW learning model can significantly improve students' mathematical connection skills compared to conventional learning models. Therefore, the TTW learning model can be used as an alternative in developing students' mathematical connection skills.

Think Talk Write ***type cooperative learning model***

The TTW type cooperative learning model is a cooperative learning model that has three stages, namely thinking, speaking, and writing. The TTW type cooperative learning model aims to build thinking, reflection, organize ideas, and end by writing down the results based on the ideas that have been obtained from the results of discussions by Supandi, Waluya, Rochmad, Suyitno, & Dewi, (2018). In the thinking stage, students are required to be able to read mathematical texts whose problems are related to daily life, then students write small notes containing what is known about the given problem and the strategies used to solve the problem. Small notes made by students show that students have high confidence and motivation in solving math problems. After the student completes the thinking stage, the student moves on to the next stage, which is speaking. In the discussion stage, students are required to discuss and share information with peers about ideas and problem-solving strategies obtained at the thinking stage. The speaking stage also requires students to be confident in expressing opinions, increasing curiosity about problem solving that has been obtained at the previous stage in sharing ideas, information, and expressing opinions, of course there will be curiosity in students, about the most appropriate strategies to solve problems. At *the writing stage, students are trained to be confident in writing the results of their group discussions individually using their own language. Subconsciously, the results of solving mathematical problems written by students obtained through the TTW stage make students able to communicate verbally and write well and make students aware that mathematics is very close to daily life. This is what makes students have a strong desire to learn mathematics and think positively that mathematics is very useful in daily life (mathematical disposition). This TTW-type cooperative learning stage is expected to improve students' written communication skills and mathematical disposition.*

The TTW type cooperative learning model is a learning model consisting of heterogeneous groups consisting of 3-5 members. The TTW type cooperative learning model has three stages, namely thinking, speaking and writing. Huniker and Laughin (Sumirat, 2014) stated that the TTW student model is formed through the results of thinking, organizing ideas and testing ideas before students write answers. This learning model aims to build thoughts, reflect, organize ideas, and end by writing down those ideas. TTW has three stages, namely 1) students learn the subject matter (thinking); 2) students discuss learning outcomes (talk); and 3) students write down ideas obtained from the speaking (writing) phase (Supandi et al., 2018). Thinking activities are seen from students' activities in reading texts or stories about mathematical problems that contain contextual problems. Reading activities aim to facilitate discussion and understanding of concepts. In this activity, students also make small notes that describe the results of thinking about stories in their own language (Lukman, 2017). Making these notes aims to improve students' understanding of the subject matter (Ansari, 2016). After students do the Think stage, the next stage is Talk.

In the Talk stage, students are given time to discuss with their group friends about the results of the thinking along with small notes made in the Think stage. The talking activity begins by presenting

ideas to group friends, building theories or concepts together, exchanging ideas in finding solutions, and ending with problem solving. Think of activities supervised by teachers. The teacher functions as a facilitator if there is a wrong concept during lecture activities. At this stage, teachers can improve and assess the quality of students' thinking (Ansari, 2016). The next stage is the writing stage.

In the writing stage, students write down the results of the discussion in the form of the concepts used, correct the work, and write complete solutions based on the results of the discussion obtained at the previous stage in their own style. Writing activities also help students to improve their understanding of concepts and the relationships between concepts. In writing activities, teachers function to monitor students' mistakes, misunderstandings and assess students' abilities. The benefits of the TTW-type cooperative defense model are 1) sharpening students' visual skills; 2) train student interaction; 3) improve problem-solving ability; and 4) improve students' thinking skills. The results of the application of the TTW-type cooperative learning model in learning are that students become trained in oral and written communication as well as, increase confidence levels, and increase students' interest in mathematics.

According to Huda (2017), *Think-Talk-Write* is a strategy that facilitates the practice of spoken language and language writing fluently. The strategy first introduced by Huinker and Laughlin is based on the understanding that learning is a social behavior. The TTW strategy encourages students to think, speak, and then write down a specific topic. This strategy is used to develop writing fluently and practice the language before writing. TTW strategies allow students to influence and manipulate ideas before pouring them into writing. It also assists students in gathering and developing ideas through structured conversations. As the name suggests, this strategy has a syntax that corresponds to the order in it, namely thinking, speaking, and writing. Ginting & Sihombing, (2023) stated that *the Think-Talk-Write Type Cooperative Learning Model* is a learning model that basically emphasizes the construction of the process of thinking, speaking, and writing in each learning process, where the thinking process occurs in the activity of building and understanding a material through the learning material provided by the teacher, the speaking process occurs in discussion activities to gain the same understanding, And the writing process occurs in the activity of making a summary of concepts that students get and understand in the process of speaking.

Another thing conveyed by Vidiyanti & Indrayanti, (2022) the *Think-Talk-Write* Type Cooperative Learning model consists of three stages, namely the thinking stage, where students are given statements and advised to be given contextual problems or problems that exist in daily life and students think about the ideas they get from the given problems, how to solve them and what are the things that should not be done in solving problems; the talking stage, in which students reflect, compile, and examine problem-solving ideas through group discussion activities; and the writing stage, where students apply the results obtained from the previous two stages, namely by writing concepts related to existing problems, solution strategies, and solutions to these problems.

METHODS

This research is a class action research (PTK) conducted in two cycles. Each cycle goes through stages of planning, implementation, observation and reflection. The subject of this study is class X/A STUDENTS OF NOEMUTI STATE HIGH SCHOOL who are registered in the even semester of the 2025/2026 school year which totals 23 people consisting of 13 male students and 10 female students, the data collection techniques in this study include observation sheets and learning outcome tests. The data collection method in this study is by observation and learning outcome test data. The procedure in this study is carried out in several cycles and each cycle includes planning, action, observation, and reflection activities. The data analysis technique in this classroom action research is the analysis of observation data on student and teacher activities and the analysis of test result data. The analysis of test result data includes individual completeness and class completeness. The indicator of success in this study is that this study is said to be successful if the completeness in a class is more than or equal to 75% or students meet the completeness criteria, then the learning carried out by the teacher can be said to be successful, but if the completeness in the classroom is less than 75%, then the learning carried out by the teacher has not been successful

RESULTS AND DISCUSSION

Research results

The results of this class action research were obtained through two cycles, each consisting of the planning, implementation, observation, and reflection stages. The data collected included the results of tests on students' mathematical connection abilities and the results of observation of learning activities. In Cycle I, out of 23 students, there were 14 students who reached the Minimum Completeness Criteria (KKM), while 9 students had not reached the KKM. The classical completeness percentage is 60.86%, so it has not met the set success indicator, which is ≥75%.

These results show that students' mathematical connection skills are still relatively low. Students have difficulty in relating mathematical concepts, especially in relating algebraic forms of quadratic functions to their graphical representations and their application in the context of daily life. This shows that students' understanding is still fragmentary and not yet meaningful. After learning improvements were made in Cycle II, all students (23 people) achieved KKM with a classical completeness percentage of 100%. Thus, there was an increase of 39.14% from Cycle I to Cycle II.

This improvement shows that the application of a cooperative learning model of the Think Talk Write (TTW) type is effective in improving students' mathematical connection skills. In addition, there has been a change in students' learning activities who have become more active, involved, and able to relate mathematical concepts more systematically. The first cycle of research steps includes:

Table 1. Completeness of the student learning cycle 1

Cycles	Number of students	Students complete	Incomplete students
Cycle I	23	14	9
Cycle II	23	23	0

Table 2. Fittings upgrade

Cycle I	Cycle II	Improvement
60,86%	100%	39,14%

There was an increase in completeness by 39.14% which shows that the application of the TTW model has a significant impact on improving students' mathematical connection skills.

Learning completeness graph

Discussion of Research Results

This classroom action research aims to improve students' mathematical connection skills through the application *of a Think Talk Write (TTW) type cooperative learning model* to quadratic function material. The ability to make mathematical connections is one of the important skills in mathematics learning because it requires students to be able to connect various mathematical concepts, both between concepts in mathematics and with the context of daily life. Therefore, learning mathematics not only emphasizes mastery of procedures, but also understanding concepts thoroughly and meaningfully. The implementation of the research was carried out in two cycles, each of which consisted of the stages of planning, implementation of actions, observation, and reflection. Based on the results of the study, the application of the TTW type cooperative learning model showed an increase in students' mathematical connection skills from cycle I to cycle II.

The results of the students' mathematical connection ability test in the first cycle showed that the percentage of learning completeness of new students reached 60.86%, which was 14 out of 23

students who obtained scores above the KKM. This percentage is still below the classical completeness criteria set, which is 75%, so learning in the first cycle is declared unsuccessful. This data shows that students' mathematical connection ability in quadratic function material is still relatively low.

When viewed from the learning process in the first cycle, there are several obstacles that affect the low learning outcomes of students. At the *thinking stage*, most students are not able to build initial understanding independently. Students still have difficulty in associating the algebraic form of the quadratic function with its graph characteristics, such as determining the node point, the axis of symmetry, and the direction of the opening of the parabola. As a result, the initial ideas that students have are still limited and cannot yet be a solid basis for group discussions. According to Suherman (2008), the independent thinking stage is an important process in mathematics learning because students build initial understanding through mental activities such as observing, connecting information and formulating problem-solving ideas.

At the talk stage , the group discussion has not gone optimally. The results of observations show that student participation in discussions is still uneven. Only a few students actively express their opinions, while others tend to be passive and rely on more capable peers. This condition causes the exchange of ideas between group members to not take place optimally, so that students' mathematical connection skills have not developed optimally. According to Vygostsky (1978) in the theory of social constructivism, interaction and communication in group discussions play an important role in building understanding of concepts because students exchange ideas, provide explanations, and clarify their thoughts through discussion.

Furthermore, at the writing stage, students still have difficulty in pouring the results of thoughts and discussions into a systematic form of mathematical writing. The students' answers tended to be procedural and did not show the relationship between the concept of the quadratic function and the relationship with the context of the given problem. This shows that students are not used to communicating the results of mathematical thinking in writing well. According to Yayuk (2019), writing activities in mathematics learning help students organize their thinking, clarify their understanding of concepts, and communicate mathematical ideas systematically and logically.

Based on the results of reflection in cycle I, the researcher improved learning in cycle II by providing more targeted scaffolding at each stage in the TTW model. In the second cycle *of thinking*, students are allowed to read problems, understand information and think about solution ideas independently. Based on the results of the research, this stage helps students in activating initial knowledge and building an understanding of the concepts learned, so that students are better prepared in the discussion process. This shows that the independent thinking process has tools in building students' cognitive understanding. According to Yamin and Ansari (2012) who stated that *the Think stage* in the TTW model provides an opportunity for students to build knowledge independently through the process of understanding problems, identifying important information and developing solution strategies.

At the stage of the second cycle of talks. Students discuss with their peers to propose ideas, compare solution strategies, and correct misunderstandings. According to Huda (2017), it is explained that the TTW strategy is based on the view that learning is a social process, so that interaction and communication between students help clarify and develop ideas before they are expressed in writing. Through discussion, students not only understand the material, but also learn to communicate ideas logically and systematically. Vidiyanti and Indrayanti (2022) stated that *the conversation stage* is a process for students to reflect, compile, and check solution ideas through group discussions so that there is a common understanding.

In the writing stage of cycle II, students can write down the results of their thoughts and discussions in the form of answers or summaries of concepts. Based on the results of the research, writing activities help students strengthen their mastery of the concepts that have been learned. By rewriting the results of the discussion, students can reflect on their thought process more deeply. This is in line with the opinion of Ginting and Sihombing (2023), who stated that *the Write stage* in the TTW model is the process of pouring the results of understanding obtained from the *Think* stage, and *the Talk* stage into the form of writing so that the concepts learned become more structured and easier to understand.

The test results in cycle II showed a very significant improvement. The percentage of student learning completeness increased to 100%, where all students have achieved scores above the KKM. The increase from 60.86% in cycle I to 100% in cycle II shows that the application of the Think Talk Write (TTW) type cooperative learning model, accompanied by the provision of targeted scaffolding, is able to optimally improve students' mathematical connection skills.

In addition to the increase in test results, positive changes are also seen in the learning process. In cycle II, students appeared to be more active, confident, and enthusiastic in participating in learning. Interactions between students and students as well as between students and teachers take place more intensively and meaningfully. Students are not only able to solve problems, but also able to explain the relationships between the concepts used.

When viewed from the indicator of mathematical connection ability, students in cycle II have been able to relate the algebraic form of quadratic functions with their graphs and apply the concept of quadratic functions in contextual problems. This shows that students have understood the concept of quadratic functions in a more in-depth and integrated way.

The findings in this study are in line with the theory of constructivism which states that knowledge is built by students through active thinking processes and social interactions. The TTW-type cooperative learning model supports the knowledge construction process by giving students the opportunity to think independently, actively discuss, and write down the results of their thoughts. These three stages complement each other and help students build a meaningful understanding of concepts.

In addition, the results of this study also support the results of previous research which stated that the TTW learning model is effective in improving students' mathematical connection skills. This is

in line with the research of Sulatri et al. (2017), which shows that the contextual approach with the TTW strategy has a positive effect on improving students' mathematical connection skills. These findings are also supported by Rafidah et al. (2020), who report that the application of the TTW model with a contextual approach significantly improves students' mathematical connection skills. In addition, Nurapriani (2016) and Lasmi (2015) also show that TTW Strategies can help students understand the relationship between mathematical concepts and apply them in real contexts

Based on this discussion, it can be concluded that the application of the Think Talk Write (TTW) type cooperative learning model is able to improve students' mathematical connection ability in the quadratic function material. This success is shown by an increase in the percentage of student learning completeness from cycle I to cycle II, as well as positive changes in learning processes and activities. Thus, the TTW learning model can be used as one of the effective learning alternatives to improve the quality of mathematics learning.

Conclusion

Based on the results of class action research that has been carried out in class X/A of Noemuti State High School through the application *of the Think Talk Write (TTW) type cooperative learning model, it can be concluded that the application* of the Think Talk Write (TTW) *type cooperative learning model* can improve students' mathematical connection skills. This is shown through the improvement of student learning outcomes in each research cycle. In the first cycle, the percentage of student learning completeness reached 60.86%, which shows that students' mathematical connection ability has not reached the set success indicators. After learning improvements were made in cycle II, the percentage of learning completeness increased to 100%, thus meeting the indicators of research success.

The Think Talk Write *(TTW) learning model can encourage students' activeness in the learning process through the stages of thinking*, *speaking or discussing (*speaking), and writing (*writing),* so that students better understand the relationship between mathematical concepts and can connect mathematics with the context of daily life. The application of *the Think Talk Write* (TTW) learning model also has a positive impact on student cooperation, courage to express opinions, and students' confidence in the mathematics learning process. Based on these results, it can be concluded that the *Think Talk Write (TTW) type cooperative learning model is used effectively to improve students' mathematical connection skills.*

Recommendation

Based on the conclusions that have been obtained, the researcher gives the following suggestions:

1. For mathematics teachers, it is recommended to use *a Think Talk Write (TTW) type cooperative learning model as one of the learning alternatives, because this model can improve students' mathematical connection skills and encourage student activities and cooperation in learning.*

2. For schools, it is hoped that they can support the implementation of various innovative learning models, such as *Think Talk Write* (TTW), to improve the quality of learning and student learning outcomes, especially in mathematics subjects.
3. For the next researcher, it is recommended to develop this research on different mathematics materials or at other levels of education, as well as combine the *Think Talk Write* (TTW) model with more varied learning approaches or media

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