



STUDENTS' IMPROVED UNDERSTANDING OF LIMIT TRIGONOMETRIC FUNCTIONS THROUGH IMPLEMENTATION JIGSAW LEARNING

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Abstrak

Tujuan dalam pelaksanaan penelitian tindakan kelas ini adalah untuk mencapai keberhasilan siswa dalam belajar matematika, khususnya cara menyelesaikan Limit Fungsi Trigonometri dengan mengaplikasikan model pembelajaran Jigsaw. Subyek dalam penelitian ini adalah siswa kelas XII IPA 1 SMAN 1 Dawarblandong Kabupaten Mojokerto pada tahun pelajaran 2022/2023 dengan jumlah 36 siswa. Instrumen dalam penelitian ini menggunakan silabus, RPP, LKS, lembar observasi, dan lembar soal evaluasi. Metode analisis data menggunakan 2 siklus dengan masing-masing siklus terdiri atas 5 tahap yaitu Persiapan (*planning*), Pelaksanaan (*action*), Pengamatan (*observation*), Evaluasi (*Evaluation*), dan Refleksi (*reflection*). Hasil penelitian menunjukkan bahwa pembelajaran kooperatif model jigsaw memiliki dampak positif dalam meningkatkan prestasi belajar siswa yang ditandai dengan peningkatan ketuntasan belajar siswa dalam setiap siklus, yaitu siklus I 63,88% dan siklus II 94,44%. Penerapan metode pembelajaran kooperatif model Jigsaw mempunyai pengaruh positif yaitu meningkatkan motivasi belajar siswa yang ditunjukkan dengan hasil tes siklus II yang lebih baik dari hasil tes siklus I dan hasil observasi guru dan siswa.

Kata kunci: Model Pembelajaran Jigsaw; Limit Fungsi Trigonometri; Pemahaman Konsep

Abstract

The aim of implementing this classroom action research is to achieve student success in learning mathematics, especially how to complete trigonometry function limits by applying the Jigsaw learning model. The subjects in this study were students of class XII IPA 1 SMAN 1 Dawarblandong Mojokerto in the 2022–2023 school year, with 36 students. The instruments in this study were a syllabus, lesson plans, worksheets, observation sheets, and evaluation question sheets. The data analysis method uses two cycles, with each cycle consisting of five stages: preparation (*planning*), implementation (*action*), observation (*observation*), evaluation (*evaluation*), and reflection (*reflection*). The results showed that the jigsaw cooperative learning model had a positive impact on improving student achievement, which was marked by an increase in student mastery in each cycle, namely cycle I (63.88%) and cycle II (94.44%). The application of the Jigsaw cooperative learning method has a positive effect, namely increasing student learning motivation, as indicated by the results of the second cycle test, which are better than the first cycle test results, and the results of teachers' and students' observations.

Keywords: Jigsaw Learning Model; Limits of Trigonometry Functions; Concept Understanding



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INTRODUCTION

Improving the quality of education in Indonesia continues to be carried out by the government through two sides, namely curriculum and education programs. Currently, the government is intensively making changes in the form of curriculum changes to the Merdeka Belajar curriculum. Merdeka belajar curriculum is interpreted as a learning design that provides opportunities for students to learn in their own way so that they can learn calmly, relax, have fun, and show their natural talents (Rahayu et al., 2022).

This change also requires a change in the mindset of teachers through a shift in the application of learning models and methods that adapt to the situation. This is because, as teaching teachers, teachers are required to be able to implement the Pancasila student profile so that it can be embedded in students (Sari et al., 2020). These demands must be adjusted to the development of social dynamics where learning activities are centered on students and teachers as facilitators of learning.

The existence of the COVID-19 epidemic has destroyed all aspects of life, not only in Indonesia but throughout the world. The world of education is also one of the most affected because students receive learning materials online.

As a result, not all students can take part in it because of the many limitations of the facilities and infrastructure owned (Prayitno & Mutianingsih, 2021), including limited devices, quotas, and readiness to learn. This situation has an impact on mastering the concepts of the material studied. From the results of previous research (Prayitno & Mutianingsih, 2021), the difference in communication methods between online and offline does not have a significant influence. Because there is a principle, there is still multidirectional communication between teachers and students during the learning process. In fact, in class XII IPA 1 SMAN 1 Dawarblandong, when studying mathematics material, students' understanding of the concept of prerequisite material was not adequate.



As explained by Winanto (2022), students who have a good mastery of prerequisite knowledge find it certainly easier to learn the next material. In a situation like this, if students do not have good mastery of the prerequisites, it has implications for the teacher's task to repeat mastery of the prerequisite material. Like the material about the limits of trigonometric functions studied by grade XII IPA students, students feel that they do not know the concept of trigonometry at all as a prerequisite. In this situation, the guru has the role of choosing the appropriate learning model so that the concept of prerequisites can be embedded in his long-term memory. To overcome the obstacle of mastering prerequisite material about trigonometric concepts, it can be overcome by implementing jigsaw-type cooperative learning to improve students' understanding of the concept of trigonometric limit functions through classroom action research.

This jigsaw learning model is one type of cooperative learning that involves students actively and trains them to work together in a group (Anitra, 2021; Setiyono et al., 2020). Each group member is required to understand and explore something, then combine it with other group members to gain a complete understanding. Each student depends on their teammates to provide the information they need to perform well on assessments.

In principle, in the jigsaw-type cooperative learning process, there is a heterogeneous origin group, and then an expert group is formed to make students experts on an assigned topic. Furthermore, sharing information with friends in groups who discuss different topics in their home group (Setiyono et al., 2020; Jonah, 2020) This learning model was chosen by researchers as a solution to overcome students' understanding of the limits of trigonometric functions in class XII IPA 1 SMAN 1 Dawarblandong. Research to overcome problems encountered in the classroom through jigsaw-type cooperative learning has been conducted by several researchers (Anitra, 2021; Kahar et al., 2020; Setiyono et al., 2020; Jonah, 2020). The research shows that the implementation of jigsaw-type cooperative learning can overcome problems faced in the classroom. So the purpose of this study is to implement Jigsaw-type cooperative learning to improve understanding



of the concept of limit trigonometric functions in class XII IPA 1 SMAN 1 Dawarblandong Mojokerto.

METHOD

This class action research involved 36 students of grade XII IPA 1 SMAN 1 Dawarbandong Mojokerto for the 2022–2023 academic year and aimed to improve understanding of the concept of limit trigonometric functions. Classroom action research conducted by researchers involves five stages, namely preparation, action, observation, evaluation, and reflection. Data were collected through observation and tests using instruments, observation sheets, learning activities, and essay questions.

Based on the data collection model, researchers analyze the data in a quantitative and descriptive manner. The data was analyzed descriptively in the form of data from observations using observation instruments. Observation instrument to observe the implementation of jigsaw-type cooperative learning when applied. Furthermore, students are given test questions that are analyzed descriptively and quantitatively to obtain the completeness of learning outcomes individually and classically. The success indicator set by the researcher using the KKM used at SMAN 1 Dawarblandong for mathematics lessons is 65. Meanwhile, for classical completeness, the criterion of 8.5% of students has reached KKM. The cycle of action research is ended when the success indicator of learning completeness has been achieved.

RESULT AND DISCUSSION

Cycle I

Action research begins with the planning stage, where researchers collaborate with colleagues to prepare learning tools consisting of (1) learning plan I, which involves jigsaw-type cooperative learning; (2) LKS I, on the limit of trigonometric functions; (3) observation sheet I; (4) test I questions; and (5) supportive learning tools.



The action stage in cycle I was carried out on February 1, 2023, in class XII IPA 1 with a total of 36 students. Research acts as a mathematics teacher to teach the concept of limit trigonometric functions. The implementation process of jigsaw-type cooperative learning refers to the lesson plan that has been prepared. activities on the implementation of research. This implementation includes (1) carrying out discussion activities; (2) forming heterogeneous groups (origin); and (3) forming a group of four (four) people (experts).

During the implementation of jigsaw-type cooperative learning, observation is carried out simultaneously with the implementation of learning. During implementation, learning activities are observed by observers. Observers who play a role in this action research are Sampini, S.Pd., M.Pd., as a Class XI mathematics teacher, and Linduk Siswati, S.Pd., M.M.Pd., as a Class X math teacher. Based on the observations of the collaborator and the researchers themselves from observation sheets and daily notes, several weaknesses were identified: (1) understanding of the basic concepts of trigonometry at the previous grade level, which was still lacking; (2) lack of literacy possessed by students; (3) students feeling bored in the process of calculating; (4) less good at time management. Meanwhile, from the observation sheet of teacher activities, the results of teacher activities in planning are obtained at 70% (good), while in implementation 71% (good) is obtained, which means that the planned learning process and the implementation are carried out according to the procedure. Meanwhile, from the observation sheet of student activity vs. itas, 63% (good) results were obtained, while from the recapitulation sheet, test results were obtained as much as 63.88% (sufficient), or 23 students out of 36 were declared complete.

After implementation, researchers conduct evaluation (evaluation), namely test I questions, with the aim of determining the level of student success in the learning process that has been carried out. The data from research results in cycle I are presented in Table 1 below.



Table 1. First Cycle Test Results

No	Description	Cycle I Results
1.	Test average score	64,03
2.	Number of students who completed their studies	23,00
3.	Percentage of Learning completeness	63,88

From Table 1 above, the number of completed students is 23; for incomplete students, there are 13 students. It can be explained that by implementing the Jigsaw model of cooperative learning, the average value of student learning outcomes is 64.03 and student learning completeness reaches 63.88%, or there are 23 students out of 36 who have completed learning.

These results show that in the first cycle, classically, students have not completed learning because students who get a score of 65 are only 63.88% smaller than the desired percentage of completeness, which is 85%. This is because students still feel that the teacher is implementing the Jigsaw-type cooperative learning model.

Reflection in the implementation of learning activities obtained information from observations by observers about weaknesses and successes. The weaknesses in question include: (1) understanding of the basic concepts of trigonometry is still lacking; (2) there are many studies of tour literature owned by students; (3) students are saturated in the matter of counting; and (4) students are good at time management. As for the success, (1) the teacher has been able to arouse student motivation to explore mathematics, and (2) as many as 63.88% of students have been able to understand and solve the questions given. Because it has not met the classical completeness criteria set by the researcher, it continues in cycle II.

Cycle II

In cycle II, researchers designed learning by implementing jigsaw-type cooperative learning related to the application of limits to trigonometric functions in everyday life. For the planning, researchers prepare learning tools consisting of (1) Learning Plan II, which involves jigsaw-type cooperative learning; (2) LKS II,



concerning the limit of trigonometric functions in everyday life; (3) an observation sheet; (4) a test question II; and (5) a supportive learning lab.

The implementation (action) of learning activities for the second cycle was carried out on February 15, 2023, in Class XII IPA 1 with a total of 36 students. The implementation of jigsaw-type cooperative learning refers to the learning plan by paying attention to revisions in cycle I so that deficiencies in cycle I do not repeat themselves in cycle II, especially related to time management during the learning process.

Observation is carried out by saplings along with the implementation of learning. Based on the observations of collaborators and researchers themselves from observation sheets and daily records, the following results were obtained: (1) From the observation sheet of the teacher's activity, it obtained an average of 74% (good); (2) In the implementation, it obtained an average of 76% (good), which means that the learning process is in accordance with the procedure. (3) While from the observation sheet of the student's activity, it was obtained that the results of the activity were 72% (good), and (4) while for the recapitulation sheet, the test results were obtained at 77.22%, or 34 students out of 36 were declared complete.

Evaluation was carried out at the end of the learning process, with students given Test II about the limits of trigonometric functions in everyday life. Test questions are given to determine the level of student success in the teaching and learning process that has been carried out. The data from the research results in the second cycle shows that the number of students who have completed the course is 34, while the number of students who have not completed the course is 2. Data on the results of cycle II are presented in Table 2.

Table 2. Second Cycle Test Results

No	Description	Cycle II Results
1.	Test average score	77,22
2.	Number of students who completed their studies	34,00
3.	Percentage of Learning completeness	94,44



Based on the table above, an average test of 77.22 was obtained and 34 students had achieved complete learning outcomes. Classically, the completeness of learning has been achieved by 94.44%. The results in cycle II have improved better than cycle I. This shows that students have a good mastery of the concept of limit trigonometric functions.

Reflection to recite to the implementation of the cooperative learning process of the Jigsaw model. From the data obtained, it can be described that (1) During the implementation of jigsaw-type cooperative learning went well; (2) It is known that students are more active during the learning process; (3) Deficiencies in cycle I have improved and improved in cycle II so that they become better; (4) Student learning outcomes in cycle II have reached completion.

From the results of the analysis, the increase in learning outcomes in cycle II is influenced by an increase in the teacher's ability to motivate students in the implementation of Jigsaw-type cooperative learning. Students are accustomed to this kind of learning and students find it easier to understand the material provided. This is shown by the active role of students in learning mathematics with the limit material of trigonometric functions. Because it has met the criteria set by the researcher, which is at least 85% of students who meet the classical completeness criteria, this action research does not continue to the next cycle.

The results of this study show an increase in classical learning completeness which can be illustrated in the following graph.

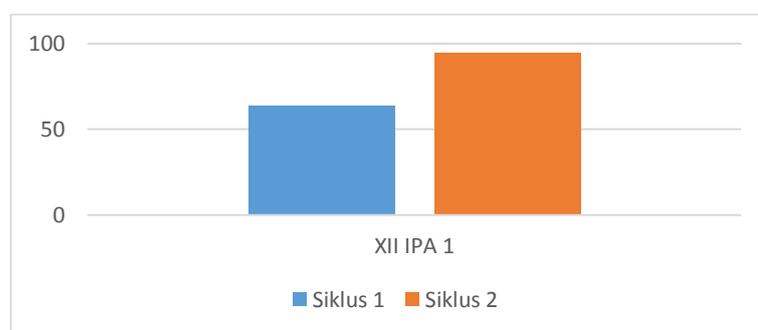


Figure 1. Classical learning completeness graph

In line with the research of Setiyono et al. (2020) and Anitra (2021), which stated the completeness of classical learning as a form of understanding students' concepts on trigonometric function limit material after implementing jigsaw-type



cooperative learning, In addition, there is a change in the behavior pattern of students, who no longer experience boredom in following the learning process in class. The weakness of this study is that students who have fulfilled the completeness of learning need reinforcement with the enrichment material. The questions given in the enrichment program should ideally be in the form of problem solving at a higher level than routine questions (Dewantara, 2019). The hope is given that problem-solving problems are able to explore students' abilities in arguing, comparing, evaluating, making decisions, and drawing conclusions. One form of problem with a form that is not routine is ill-structured problems. The form of ill-structured problems is suitable for teachers to embed the concept of limit trigonometric functions in a non-routine form. The goal can be to measure students' understanding of the concepts that have been learned (Prayitno et al., 2020, 2022). This situation requires teachers to be accustomed to providing meaningful learning to students, one of which is through jigsaw-type cooperative learning. In addition, teachers must also be able to design non-routine assignments as material for students to discuss with each other in groups. As stated by previous research (Mastuti & Prayitno, 2023), the designed tasks must be able to stimulate critical thinking and creative thinking skills. Teachers must be flexible in using their knowledge and understanding to master the material so that they are able to modify mathematics assignments in school mathematics books. The design of this task must use student reasoning, not only calculations, but also formulas and existing properties (Mastuti & Prayitno, 2023; Prayitno et al., 2018). The diverse tasks give students the opportunity to take on different roles and develop different skills. Thus, each student can learn optimally and complement each other when learning cooperatively (jigsaw type). Diverse task designs and appropriate references can help reinforce the effectiveness of jigsaw-type cooperative learning. Both can ensure that each student has a clear role and responsibility in learning, as well as allow them to learn from each other and complement each other (Chang & Benson, 2020; Dewantara, 2019).



CONCLUSION

From the results of learning activities that have been carried out for two cycles and based on all discussions that have been carried out, it can be concluded that the implementation of Jigsaw-type cooperative learning can increase students' understanding of the concept of limit trigonometric functions. This can be seen in the increase in classical student learning completeness in each cycle, namely cycle I (63.88%) and cycle II (94.44%).

The results of this study suggest other researchers implement jigsaw-type cooperative learning as an alternative to improve understanding of mathematical concepts. The cultivation of prerequisite material concepts needs special attention for students because it is a foundation for learning the next material.

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