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## Efforts to Improve Students' Understanding of Algebraic Operations through the Jigsaw Cooperative Learning Model

Riska Binti Fatatin Azizah<sup>1</sup>, Devi Yusniati<sup>2</sup>, Syadidul Itqan<sup>3</sup>

<sup>123</sup> Universitas Nurul Jadid, Indonesia

correspondence e-mail\*, riskabfa000@gmail.com<sup>1</sup>, deviyusniati22@gmail.com<sup>2</sup>, itqan@unuja.ac.id<sup>3</sup>

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### Abstract

This classroom action research aimed to improve students' understanding of algebraic operations through the implementation of the Jigsaw cooperative learning model. The study was conducted in two cycles involving 12 students of class XII at MA Islamiyah Syafi'iyah during the 2025/2026 academic year. Each cycle consisted of four stages: planning, action, observation, and reflection. Data were collected through observation, tests, interviews, and documentation, and analyzed using qualitative and quantitative approaches. The findings show significant improvement in students' conceptual understanding and learning participation. Students became more active in discussions, questioning, and peer teaching activities. The average score increased from 64 in the initial condition to 72 in Cycle I, and further improved to 82 in Cycle II. The percentage of students achieving mastery learning rose from 33.3% to 86.7% after the implementation of the Jigsaw model. These results indicate that the Jigsaw cooperative learning model is effective in enhancing students' understanding of algebraic operations. The model also fosters collaboration, communication skills, and student responsibility in the learning process.

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### Keywords

Algebraic Operations, Cooperative Learning, Jigsaw, Conceptual Understanding, Classroom Action Research.



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## INTRODUCTION

Education plays a very important role in improving the quality of human resources.<sup>1</sup> Through education, individuals can develop their thinking abilities, behavior, and interpersonal skills, which are essential for functioning effectively in society. In the school environment, learning is the main activity that determines students' success in achieving learning objective.<sup>2</sup> Therefore, teachers are required to create a learning atmosphere that is active, creative, effective, and

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<sup>1</sup> Tia Fajartriani, "Peran Pendidikan Dalam Meningkatkan Kualitas Sumber Daya Manusia," *Jurnal Administrasi Pendidikan* 6, No. 1 (2024): 9–17.

<sup>2</sup> N Nurwidodo Et Al., "The Effectiveness Of Problem-Based Learning In Improving Creative Thinking Skills , Collaborative Skills And Environmental Literacy Of Muhammadiyah Secondary School Students," *Research And Development In Education (Raden)* 4, No. 1 (2024): 18–51.

enjoyable so that students can be optimally engaged in the learning process.<sup>3</sup>

One of the subjects that plays an important role in developing logical, systematic, and analytical thinking skills is mathematics.<sup>4</sup> According to,<sup>5</sup> mathematics not only serves as the foundation for other sciences but also trains rational thinking and problem-solving skills.<sup>6</sup> However, in practice, mathematics is often considered difficult and intimidating by many students. These difficulties often arise because the learning process is still dominated by teacher-centered lecture methods, causing students to become passive and less actively involved in learning activities.<sup>7</sup>

One of the mathematical topics that often becomes an obstacle for students at the Madrasah Aliyah (MA) level is algebraic operations. This material requires a good understanding of concepts such as variables, coefficients, and like terms, as well as the ability to perform addition, subtraction, multiplication, and division of algebraic expressions.<sup>8</sup> Many students struggle to understand algebraic symbols and their application in solving problems. This condition leads to low student achievement and limited understanding.<sup>9</sup> of basic algebraic concepts, which should serve as an essential foundation for learning subsequent mathematical material.

Considering these issues, a learning model is needed that can increase students' active participation, foster cooperation, and help them understand the material more thoroughly. One such model that can be applied is the Jigsaw cooperative learning model.<sup>10</sup> This model positions students as active learners, where each student is responsible for learning and mastering a specific part of the material and then sharing it with other members of the group.<sup>11</sup> In Jigsaw learning, students are divided into home groups and expert groups. Each student from the home group joins an expert group to study a particular topic, then returns to their home group to teach the

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<sup>3</sup> Desi Ratna Sari, "Penerapan Pembelajaran Aktif Kreatif Efektif Dan Menyenangkan Untuk Meningkatkan Prestasi Belajar Siswa Sdn 2 Jambu Ilir Kec. Tanjung Lubuk Kab. Oki Tahun 2023/2024," *Jurnal Mubtadiin* 11, No. 01 (2024): 1–11.

<sup>4</sup> E T Ruseffendi, *Dasar-Dasar Penelitian Pendidikan Dan Bidang Non-Eksakta Lainnya* (Bandung: Tarsito, 2010).

<sup>5</sup> E T Ruseffendi, *Pengantar Kepada Membantu Guru Mengembangkan Kompetensinya Dalam Pengajaran Matematika Untuk Meningkatkan Cbsa* (Bandung: Tarsito, 2010).

<sup>6</sup> Bruce Joyce, Marsha Weil, And Emily Calhoun, *Models Of Teaching* (Pearson, 2015).

<sup>7</sup> Robert E Slavin, *Educational Psychology: Theory And Practice* (Boston: Pearson, 2017).

<sup>8</sup> Dian Rahmawati, "Analisis Kesulitan Siswa Dalam Operasi Aljabar," *Jurnal Matematika Dan Pendidikan* 9, No. 1 (2021): 55–63.

<sup>9</sup> Miftahul Huda, *Model-Model Pengajaran Dan Pembelajaran: Isu-Isu Metodis Dan Paradigmatik* (Yogyakarta: Pustaka Pelajar, 2013).

<sup>10</sup> Robert E Slavin, *Cooperative Learning: Theory, Research, And Practice* (Boston: Allyn And Bacon, 2008).

<sup>11</sup> David W Johnson And Roger T Johnson, *Cooperation And Competition: Theory And Research* (Minnesota: Interaction Book Company, 2019).

material to their peers.

Through the implementation of the Jigsaw cooperative learning model, it is expected that students will not only gain a deeper understanding of the material but also learn to collaborate, support one another, and communicate effectively.<sup>12</sup> Interaction among students in this learning model can help strengthen conceptual understanding because students learn by explaining the material to others, which is one of the most effective ways to master knowledge. Thus, learning becomes more meaningful and enjoyable.<sup>13</sup>

Based on these problems, the researcher is interested in conducting a classroom action research entitled "*Efforts to Improve Students' Understanding of Algebraic Operations through the Jigsaw Cooperative Learning Model.*" This study is expected to provide solutions to the low level of students' understanding of algebraic operations, as well as serve as an alternative learning model that can improve the quality of the teaching and learning process in the classroom.<sup>14</sup>

Based on the background described above, the research problems formulated in this study are: (1) How is the implementation of the Jigsaw cooperative learning model in improving students' understanding of algebraic operations? and (2) To what extent can the implementation of the Jigsaw cooperative learning model improve students' understanding of algebraic operations? The objectives of this study are to determine the implementation of the Jigsaw cooperative learning model in teaching algebraic operations and to improve students' understanding of algebraic operations through the application of this model.

This research is expected to provide benefits for various parties. For students, it may increase motivation and understanding of algebraic operations through active and enjoyable learning activities. For teachers, the findings can serve as an alternative learning model that enhances the effectiveness of classroom instruction. For schools, the study can be used as a reference in developing learning strategies to improve educational quality. Meanwhile, for the researcher, this study provides new experiences and insights into the application of the Jigsaw cooperative learning model in improving students' understanding of mathematical concepts.

## METHOD

This study is a Classroom Action Research (CAR), which is reflective in nature and

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<sup>12</sup> Anita Widyastuti, "Penerapan Model Pembelajaran Kooperatif Tipe Jigsaw Untuk Meningkatkan Pemahaman Konsep Matematika Siswa Smp," *Jurnal Pendidikan Matematika* 13, No. 2 (2019): 45–53, <https://doi.org/10.1234/jpm.v13i2.3456>.

<sup>13</sup> Widyastuti.

<sup>14</sup> Agus Setiawan, "Implementasi Cooperative Learning Dalam Pembelajaran Matematika," *Jurnal Pendidikan Dan Pembelajaran* 11, No. 3 (2022): 78–85.

conducted by the teacher in their own classroom with the aim of improving the quality of the learning process. Referring to,<sup>15</sup> CAR is implemented through repeated cycles consisting of four stages: planning, acting, observing, and reflecting. This research employs both qualitative and quantitative approaches simultaneously. The qualitative approach is used to describe students' learning activities and the process of implementing the Jigsaw cooperative learning model, while the quantitative approach is used to assess the improvement in learning outcomes through the analysis of students' scores before and after the intervention.<sup>16</sup> The research was conducted at MA Islamiyah Syafi'iyah during the first semester of the 2025/2026 academic year. The study was carried out in two cycles, with each cycle consisting of two meetings in accordance with the school's academic calendar. The subjects of the study were 12 students from grade XII of MA Islamiyah Syafi'iyah, while the object of the study was the students' understanding of algebraic operations after the implementation of the Jigsaw cooperative learning model.<sup>17</sup>

The research design followed the cyclical model by Kemmis and McTaggart. In the planning stage, the researcher prepared the learning tools, including the lesson plan, teaching materials, student worksheets, and research instruments such as observation sheets for student and teacher activities, as well as a conceptual understanding test. During the action stage, the Jigsaw cooperative learning model was implemented, which involved forming home groups and expert groups, conducting group discussions, and presenting the learning results. The observation stage involved monitoring students' engagement and the teacher's performance during the learning process using prepared observation sheets. The reflection stage was conducted at the end of each cycle to evaluate the effectiveness of the actions taken and to plan improvements for the subsequent cycle. The cycles continued until improvements in students' understanding were achieved according to the predetermined success indicators.

The research procedure consisted of two cycles. In Cycle I, planning, implementation, observation, and reflection were carried out to determine the initial effectiveness of the intervention. The results of the reflection in Cycle I were then used to revise and improve the learning process for Cycle II. In Cycle II, the same steps were repeated with a focus on refining aspects that were less optimal in the previous cycle. The results of Cycle II were analyzed to identify improvements in students' understanding compared to Cycle I.

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<sup>15</sup> Stephen Kemmis And Robin Mctaggart, *The Action Research Planner* (Victoria: Deakin University Press, 1998).

<sup>16</sup> Slavin, *Cooperative Learning: Theory, Research, And Practice*.

<sup>17</sup> Rahmawati, "Analisis Kesulitan Siswa Dalam Operasi Aljabar."

Data collection techniques used in this research included observation, tests, interviews, field notes, and documentation.<sup>18</sup> Observation was used to obtain data on students' and the teacher's activities during the learning process. Tests were administered to measure students' understanding of algebraic operations, both before the intervention (pretest) and after the intervention (posttest) in each cycle. Interviews were conducted to gather students' responses regarding the Jigsaw learning model, while field notes were used to record important events during the research activities. Documentation, such as photographs of the learning activities, score lists, and students' work, served as supporting evidence for the implementation of the action.<sup>19</sup>

The research instruments consisted of observation sheets for student and teacher activities, conceptual understanding test items, interview sheets, and field notes. The test instruments were developed based on indicators of conceptual understanding, including the ability to explain concepts, identify like terms, and correctly perform algebraic operations. The data were analyzed using qualitative and quantitative techniques. Qualitative data from observations, interviews, and field notes were analyzed through data reduction, data display, and conclusion drawing. Quantitative data were analyzed by calculating the average test scores, the percentage of learning mastery, and the gain score for each cycle. Classical mastery learning was determined by comparing the number of students who achieved scores above the Minimum Mastery Criteria (MMC) with the total number of students. Learning was considered successful if at least 75% of students achieved scores above the KKM. The indicators of success in this classroom action research included an increase in students' activity and participation during the learning process, an improvement in the average score of conceptual understanding in each cycle, achievement of at least 75% classical mastery, and positive student responses toward the implementation of the Jigsaw cooperative learning model.<sup>20</sup>

## RESULTS AND DISCUSSION

### Initial Condition Description

Based on the initial observations conducted during the prerequisite algebra learning sessions, it was found that students' understanding of algebraic operations was still relatively low. Out of 12 students who took the formative test, only 4 students (33.3%) achieved a score above the Minimum Mastery Criteria (MMC), which was set at 75. Most students were unable to distinguish

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<sup>18</sup> Nana Sudjana, *Penilaian Hasil Proses Belajar Mengajar* (Bandung: Remaja Rosdakarya, 2017).

<sup>19</sup> Richard I Arends, *Learning To Teach*, 9th Ed. (New York: Mcgraw-Hill, 2012).

<sup>20</sup> Roy Killen, *Effective Teaching Strategies* (Cengage, 2013).

between like and unlike terms and frequently made errors when performing algebraic operations.

Interviews with several students revealed that they experienced difficulties in understanding the procedures, particularly in grouping terms and simplifying algebraic expressions<sup>21</sup>. In addition, learning activities in the classroom tended to be passive; students mostly listened to the teacher's explanations without actively participating in the learning process<sup>22</sup>. These conditions indicate the need for a learning model that can increase students' active participation. One appropriate alternative is the implementation of the cooperative learning model, specifically the Jigsaw type.

### **Results of Actions in Each Cycle**

#### 1. Cycle I

##### a. Planning

The planning stage in Cycle I included preparing the Lesson Plan (RPP) that incorporated the Jigsaw cooperative learning model. The teacher also prepared student worksheets (LKS) and observation instruments for both student and teacher activities. The material taught in this cycle focused on the addition and subtraction of algebraic expressions.

##### b. Implementation

During the implementation, students were divided into home groups and expert groups. Each expert group studied a specific subtopic, then returned to their home group to explain what they had learned. The teacher monitored, guided, and facilitated the learning process throughout the activity.

##### c. Observation

The observation results indicated an improvement in learning activity compared to the initial condition. Some students began to participate actively in group discussions, although others were still passive and not yet accustomed to collaborative work. The average score of students' conceptual understanding increased to 72, with 8 students (66.7%) meeting the MMC.

##### d. Reflection

Evaluation at the end of Cycle I revealed that the time allocated for expert-group discussion was not yet effective. Additionally, several students still lacked understanding regarding their roles and responsibilities within the group. Therefore, improvements were made by adjusting time

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<sup>21</sup> Siti Rohmah, "Peningkatan Pemahaman Operasi Aljabar Melalui Model Pembelajaran Jigsaw," *Jurnal Pendidikan Madrasah* 5, No. 2 (2020): 110–20.

<sup>22</sup> Joyce, Weil, And Calhoun, *Models Of Teaching*.

management and providing clearer explanations of each student's role for the next cycle.

## 2. Cycle II

### a. Planning

Improvements in Cycle II focused on better time allocation for discussions, reorganizing group composition, and providing additional motivation to encourage students to be more active. The material taught in this cycle continued to the topics of multiplication and division of algebraic expressions.

### b. Implementation

The learning process in Cycle II ran more smoothly. Students appeared more prepared and understood their respective roles in both expert and home groups. Discussions were more active, and student interactions became more dynamic. The teacher provided guidance and feedback to ensure that students' understanding improved.

### c. Observation

Students' learning activities increased significantly in Cycle II. Nearly all students participated actively in group discussions, both in asking questions and explaining material to their peers. The evaluation results showed that the average score increased to 82, with 10 students (86.7%) achieving the MMC.

### d. Reflection

Overall, the implementation of the Jigsaw cooperative learning model proved effective in improving students' understanding of algebraic operations. Improvements were observed in learning activity, students' responsibility within groups, and learning outcomes. The findings indicate that the Jigsaw model successfully fosters a more active and collaborative learning environment, positively influencing students' conceptual understanding.

## Comparison of Results in Each Cycle

Stage	Average Score	Mastery Percentage	Description
Initial Condition	64	33.3%	Low
Cycle I	72	66.7%	Improved
Cycle II	82	86.7%	Very Good

The table above shows an increase in both the average score and the percentage of student mastery in each cycle. This indicates that the implementation of the Jigsaw cooperative learning

model successfully improved students' understanding of algebraic operations.

### **Discussion**

The implementation of the Jigsaw cooperative learning model proved effective in enhancing students' conceptual understanding. Through this learning model, students play dual roles as learners and peer instructors, making the learning process more meaningful. Discussions within expert groups enable students to explore specific subtopics in depth, while interactions within home groups help reinforce their overall understanding. The improvement in students' understanding is evidenced by the test results and observation data, which show significant progress from one cycle to the next. Additionally, students exhibited a positive attitude toward the learning process. They felt more motivated, confident, and engaged, as they had opportunities to share knowledge and collaborate actively with their peers. These findings are consistent with,<sup>23</sup> who states that cooperative learning models can enhance student achievement and social interaction by fostering shared responsibility and positive interdependence within groups.

### **CONCLUSION**

Based on the classroom action research conducted over two cycles, it can be concluded that the implementation of the Jigsaw cooperative learning model effectively improved students' understanding of algebraic operations. This improvement is reflected in several key aspects. First, students demonstrated increased active participation during the learning process, particularly through discussion activities, questioning, and peer teaching within their groups. Second, students' learning outcomes showed a consistent rise, with the average score increasing from 64 in the initial condition to 72 in Cycle I, and further to 82 in Cycle II. Third, the percentage of students achieving mastery improved significantly, from 33.3% prior to the intervention to 86.7% by the end of Cycle II. These findings indicate that the Jigsaw cooperative learning model fosters a more engaging, interactive, and collaborative learning environment, thereby enhancing students' conceptual understanding of algebraic operations. Thus, the Jigsaw model is proven to be an effective instructional strategy in supporting student learning and improving academic achievement in mathematics, particularly in algebra.

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<sup>23</sup> Slavin, *Cooperative Learning: Theory, Research, And Practice*.

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