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Implementing the Jigsaw Cooperative Learning Model to Suport Mathematics Learning Outcomes: A Qualitative Study at Eighth-Grade Student SMP Muhammadiyah Lumajang

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ABSTRACT

Mathematics learning in secondary schools is often characterized by teacher-centered instruction, resulting in limited student participation and suboptimal learning outcomes. This study aims to investigate the implementation of the Jigsaw Cooperative Learning Model in mathematics learning at SMP Muhammadiyah Lumajang. A qualitative descriptive approach was employed involving an eighth-grade mathematics teacher and students as research participants. Data were collected through classroom observations, semi-structured interviews, and documentation, and analyzed using the interactive model of Miles, Huberman, and Saldaña. The findings indicate that the Jigsaw Cooperative Learning Model was implemented systematically through lesson planning, expert-group discussions, peer teaching, and classroom evaluation. The implementation promoted active student participation, collaborative learning, and improved conceptual understanding of mathematics. Teacher competence, students' learning motivation, collaborative classroom interactions, and adequate learning facilities supported the implementation, while limited instructional time, differences in students' academic abilities, and varying levels of self-confidence were identified as the main challenges. The study concludes that the Jigsaw Cooperative Learning Model provides an effective student-centered learning environment that supports active engagement and contributes positively to mathematics learning in junior secondary education.

Introduction

Mathematics education plays a fundamental role in equipping students with logical reasoning, critical thinking, problem-solving, and decision-making skills that are essential for academic achievement and lifelong learning. Beyond mastering computational procedures, mathematics enables learners to analyze information systematically and apply quantitative reasoning in everyday situations. Consequently, improving the quality of mathematics instruction has become a major priority for educational systems worldwide. Despite continuous curriculum reforms, mathematics remains one of the subjects in which many students experience learning difficulties, resulting in low engagement and unsatisfactory academic achievement. These challenges have encouraged educators to adopt instructional approaches that actively involve students in constructing mathematical knowledge rather than passively receiving information (Cochon, 2023).

In many classrooms, mathematics instruction continues to rely predominantly on teacher-centered practices in which teachers explain concepts while students listen, take notes, and complete individual exercises. Although such approaches may efficiently deliver content, they often provide limited opportunities for learners to communicate mathematical ideas, collaborate with peers, or develop conceptual understanding through discussion. As a consequence, students frequently become passive participants in the learning process, reducing both learning motivation and academic performance. Similar classroom conditions were identified during the preliminary observation conducted at SMP Muhammadiyah Lumajang, where only a small proportion of students actively participated in classroom discussions, while most learners remained passive during mathematics lessons.

To address these challenges, student-centered instructional approaches have gained increasing attention in mathematics education. One of the most widely implemented approaches is cooperative learning, which emphasizes collaboration among students in achieving shared learning goals while maintaining individual responsibility for mastering instructional content. Cooperative learning encourages students to exchange ideas, negotiate meaning, solve problems collaboratively, and develop interpersonal communication skills that support both academic and social development. Systematic reviews consistently report that cooperative learning contributes positively to students' achievement, motivation, and classroom interaction across different educational levels. (Hijrilliawanni, 2023, Slavin, 2015).

Among various cooperative learning strategies, the Jigsaw Cooperative Learning Model, originally developed by Aronson (1978), has become one of the most extensively studied instructional models because of its unique structure that combines positive interdependence with individual accountability. In the Jigsaw model, each student first becomes an "expert" on a specific portion of the learning material through discussion within an expert group before returning to the home group to teach the material to peers. This instructional process requires every learner to actively participate in knowledge construction while simultaneously strengthening communication skills, collaborative competence, and responsibility for learning (Talkhan, 2025). Recent meta-analytic evidence

indicates that the Jigsaw method produces positive effects on academic achievement, learning motivation, and students' social relationships across multiple educational contexts, 9Gillies, 2023, Nalls, & Wickerd, 2023).

Recent empirical studies in mathematics education also demonstrate the effectiveness of the Jigsaw model in improving students' mathematical learning outcomes. Experimental research has shown that Jigsaw-based instruction enhances mathematical problem-solving ability, mathematical communication, critical thinking, and learning motivation compared with conventional instructional approaches. Likewise, several systematic literature reviews conclude that cooperative learning through the Jigsaw model consistently promotes active participation, conceptual understanding, and collaborative learning environments in mathematics classrooms (Rahmawati, 2023, Nurrohim & Susilo, 2025)

Despite the growing body of evidence supporting the effectiveness of Jigsaw learning, most previous studies have adopted quantitative or experimental research designs focusing primarily on measuring learning outcomes. Comparatively fewer studies have explored how the Jigsaw model is planned, implemented, and experienced within authentic classroom settings using qualitative approaches. Understanding the instructional process is equally important because successful implementation depends not only on the learning model itself but also on teacher competence, classroom interaction, students' participation, and contextual factors influencing collaborative learning. Exploring these aspects provides a more comprehensive understanding of why the Jigsaw model succeeds or encounters challenges in real educational practice.

This study addresses that gap by investigating the implementation of the Jigsaw Cooperative Learning Model in mathematics learning at SMP Muhammadiyah Lumajang through a qualitative descriptive approach. Rather than evaluating statistical effectiveness, the study focuses on four interconnected aspects: lesson planning, classroom implementation, students' learning experiences and outcomes, and the supporting and inhibiting factors influencing instructional implementation. The findings are expected to contribute practical insights for mathematics teachers seeking to implement cooperative learning strategies that foster active participation and meaningful learning experiences.

Method

This study employed a qualitative descriptive research design to explore the implementation of the Jigsaw Cooperative Learning Model in mathematics instruction for eighth-grade students at SMP Muhammadiyah Lumajang. A qualitative approach was selected because the study aimed to obtain an in-depth understanding of the instructional process, teacher and student interactions, learning activities, and the factors influencing the implementation of the cooperative learning model. Rather than measuring the effectiveness of the instructional model through statistical testing, the study focused on describing classroom practices and interpreting participants' experiences within their natural educational setting (Creswell, & Poth, 2018, Lincoln, & Guba, 1985).

The research was conducted at SMP Muhammadiyah Lumajang, East Java, Indonesia, during the second semester of the 2024/2025 academic year. The school was selected because it had implemented cooperative learning strategies in several subjects, including mathematics, making it an appropriate context for investigating the application of the Jigsaw learning model. The participants consisted of the eighth-grade mathematics teacher and eighth-grade students who participated directly in the learning activities. Additional information was obtained from school administrators when necessary. Participants were selected using purposive sampling because they possessed direct experience and sufficient knowledge regarding the implementation of Jigsaw-based instruction.

The research focused on four major aspects: (1) lesson planning for mathematics learning using the Jigsaw Cooperative Learning Model, (2) classroom implementation of the instructional procedures, (3) students' learning outcomes after participating in Jigsaw-based instruction, and (4) supporting and inhibiting factors affecting the implementation of the learning model. These four components served as the analytical framework throughout the research process.

Data were collected through three complementary techniques to enhance the credibility of the findings. First, classroom observations were conducted to document teacher activities, student participation, group interactions, collaborative learning processes, and overall classroom dynamics during mathematics instruction. Second, semi-structured interviews were carried out with the mathematics teacher and selected students to obtain detailed information regarding lesson planning, learning experiences, classroom challenges, and perceptions of the Jigsaw Cooperative Learning Model. Third, documentation techniques were used to collect supporting evidence, including lesson plans, instructional modules, students' learning assessment records, attendance lists, classroom photographs, and other relevant school documents.

In qualitative research, the researcher functioned as the primary research instrument responsible for planning the investigation, collecting data, interpreting findings, and drawing conclusions (Patton, 2015). To support the research process, several auxiliary instruments were employed, including observation guidelines, interview protocols, documentation sheets, audio recording devices, field notes, and digital cameras. These instruments facilitated systematic data collection while ensuring consistency across different sources of evidence.

The collected data were analyzed using the interactive qualitative analysis model proposed by Miles, Huberman, and Saldaña. The analysis consisted of four interconnected stages: data collection, data reduction, data display, and conclusion drawing. During data reduction, relevant information was selected, categorized, and organized according to the research objectives. The reduced data were then presented narratively to facilitate interpretation. Finally, conclusions were continuously verified throughout the research process by comparing evidence obtained from multiple data sources until consistent patterns emerged.

To ensure the trustworthiness of the research findings, triangulation techniques were employed. Source triangulation was conducted by comparing information obtained from teachers, students, and school documents. Method triangulation involved comparing evidence collected through observations, interviews, and documentation. In addition, time triangulation was implemented by collecting data at different periods to examine the consistency of participants' responses and classroom observations. These validation strategies enhanced the credibility, dependability, and confirmability of the research findings.

Results and Discussion

1. Lesson Planning for the Implementation of the Jigsaw Cooperative Learning Model

The findings revealed that the mathematics teacher conducted systematic instructional planning prior to implementing the Jigsaw Cooperative Learning Model. Lesson preparation involved designing lesson plans, preparing instructional materials, developing student worksheets, selecting learning media, and designing assessment instruments. Furthermore, students were organized into heterogeneous home groups, with each member assigned a different subtopic to be mastered in expert groups before teaching it to

their peers in the home groups. These preparations ensured that every student assumed both individual responsibility and collaborative accountability throughout the learning process (Gillies, R. M., Millis, B., & Davidson, N. (Eds.), 2023, Gillies, 2003).

The planning process observed in this study reflects the essential principles of cooperative learning, particularly positive interdependence and individual accountability. These principles emphasize that successful learning depends on every group member contributing actively while remaining individually responsible for mastering the assigned learning content. Consequently, effective lesson planning is a prerequisite for establishing meaningful collaborative learning experiences and ensuring balanced participation among students.

From the perspective of Social Constructivist Theory, instructional planning extends beyond administrative preparation and serves as a pedagogical strategy that creates opportunities for learners to construct knowledge collaboratively through interaction and dialogue. The organization of expert groups and home groups encourages students to negotiate meaning, exchange ideas, and explain mathematical concepts using their own language, thereby promoting deeper conceptual understanding.

These findings are consistent with the systematic review conducted by Vives et al. (2025), which synthesized more than forty years of research on the Jigsaw learning model and concluded that structured lesson planning, well-organized group formation, and clearly defined learning tasks are fundamental determinants of successful implementation and positive academic outcomes. Similarly, (Parsazadeh, N., Ali, R., & Rezaei, 2018). reported that effective planning, heterogeneous grouping, and well-distributed learning responsibilities significantly improve student participation and collaborative learning in mathematics classrooms.

Unlike many previous studies that primarily examined the effectiveness of Jigsaw through quantitative achievement measures, the present study provides qualitative evidence demonstrating how systematic instructional planning establishes the pedagogical foundation for successful collaborative learning in mathematics classrooms.

2. Classroom Implementation of the Jigsaw Coopeative Learning model

The classroom observations demonstrated that the implementation of the Jigsaw Cooperative Learning Model followed the prescribed instructional procedures. The lesson began with introductory activities during which the teacher reviewed prerequisite knowledge, explained learning objectives, motivated students, and introduced the learning procedures. Students subsequently worked within their home groups before joining expert groups according to their assigned learning topics. Following collaborative discussions in the expert groups, students returned to their home groups to teach the concepts they had learned. The lesson concluded with group presentations, classroom discussions, and evaluation activities.

The instructional process transformed classroom learning from a teacher-centered approach into a student-centered learning environment. Instead of acting as the sole source of information, the teacher assumed the role of facilitator by guiding discussions, monitoring group interactions, providing clarification when misconceptions emerged, and encouraging equal participation among students. Consequently, students became active participants in constructing mathematical knowledge through collaborative learning activities.

These findings support Social Constructivist Theory, which argues that knowledge is socially constructed through interaction, dialogue, and collaborative problem solving. During expert-group discussions, students actively negotiated mathematical meanings, exchanged ideas, and clarified conceptual misunderstandings before explaining the

material to their peers. The process of teaching classmates further reinforced conceptual understanding because students reorganized and elaborated their knowledge while responding to questions from group members.

The present findings are consistent with those reported by Vives et al. (2025), who concluded that the Jigsaw model promotes active interaction, cooperative learning, and positive interpersonal relationships among students. Likewise, a recent meta-analysis of cooperative learning in mathematics education found that cooperative learning strategies, including the Jigsaw model, produce moderate to large positive effects on students' mathematical achievement when teachers effectively facilitate classroom discussions and collaborative activities.

National evidence also supports these findings. Safari and Marlina (2024) concluded that the Jigsaw model enhances mathematical communication, collaborative learning, and student participation through structured peer interaction. These studies collectively demonstrate that the success of cooperative learning depends not only on the learning model itself but also on teachers' pedagogical competence in facilitating productive classroom interaction.

A significant contribution of the present study lies in its qualitative explanation of classroom interaction during Jigsaw implementation. Rather than focusing solely on learning outcomes, this study illustrates how collaborative learning develops naturally through structured peer teaching, active discussion, and teacher facilitation in authentic mathematics classrooms.

3. Student' Learning Experiences and Learning Outcomes

The findings indicated that the implementation of the Jigsaw Cooperative Learning Model positively influenced students' learning experiences. Classroom observations showed that students became more actively involved in asking questions, expressing opinions, discussing mathematical concepts, and assisting peers in solving mathematical problems. Teachers also observed increased student confidence and responsibility during classroom discussions and presentations.

The learning experiences observed in this study suggest that collaborative learning extends beyond improving academic performance by fostering communication skills, teamwork, and self-confidence. During peer teaching, students reorganized their knowledge, clarified conceptual understanding, and reinforced mathematical concepts while explaining learning materials to classmates. This process reflects meaningful learning because students actively constructed understanding rather than passively receiving information from teachers.

These findings are consistent with recent meta-analytical evidence demonstrating that cooperative learning significantly improves mathematics achievement, student engagement, and conceptual understanding. Similarly, the systematic review by Vives et al. (2025) reported that the Jigsaw learning model positively influences academic achievement, motivation, interpersonal relationships, and students' self-esteem across various educational contexts.

National systematic reviews also support these findings. Nurrohim and Susilo (2025) concluded that the Jigsaw model effectively improves students' mathematical critical thinking skills through collaborative discussion and peer interaction. Likewise, Rahmadani et al. (2023) found that the consistent implementation of the Jigsaw learning model positively affects mathematics learning outcomes across different educational settings.

Unlike previous quantitative studies that primarily emphasized achievement scores, the present study contributes qualitative evidence explaining how collaborative interaction,

peer teaching, and classroom communication facilitate students' conceptual understanding and active participation during mathematics learning.

4. Supporting Factors for Implementation of the Jigsaw Cooperative Learning Model

The study identified several factors that supported the successful implementation of the Jigsaw Cooperative Learning Model. These included teacher competence in managing collaborative learning, students' learning motivation, positive peer interaction, and the availability of adequate instructional facilities. Teachers demonstrated the ability to organize heterogeneous groups, facilitate discussions, and maintain productive classroom interaction, while students showed enthusiasm and willingness to collaborate throughout the learning process.

These findings indicate that successful implementation of cooperative learning depends not only on instructional procedures but also on teachers' pedagogical competence and supportive learning environments. Effective facilitation enables meaningful interaction among students and encourages equal participation during collaborative learning activities.

Previous research similarly emphasizes the importance of teacher facilitation in cooperative learning. Recent evidence suggests that teachers' instructional competence significantly influences students' engagement and collaborative learning outcomes. Furthermore, national literature reviews have identified student motivation, supportive classroom environments, and effective classroom management as critical determinants of successful Jigsaw implementation in mathematics education.

The findings therefore suggest that cooperative learning should be viewed as a comprehensive instructional approach requiring adequate teacher preparation, institutional support, and positive classroom culture rather than merely as a classroom technique.

5. Challenges in Implementating the Jigsaw Cooperative Learning Model

Despite its positive contributions, several challenges were identified during the implementation of the Jigsaw Cooperative Learning Model. The primary challenges included differences in students' academic abilities, limited instructional time, and variations in students' confidence when explaining mathematical concepts to their peers. Some students required additional guidance before they were able to participate confidently in peer teaching activities, requiring continuous teacher facilitation throughout the instructional process.

These findings indicate that implementing the Jigsaw model requires careful classroom management and instructional flexibility. Teachers need to provide scaffolding for students with lower prior knowledge while ensuring that more capable students remain actively engaged. In addition, effective time management is essential because the Jigsaw learning process involves multiple instructional stages, including expert-group discussions, peer teaching, classroom presentations, and evaluation activities.

These challenges are consistent with the systematic review conducted by Vives et al. (2025), which reported that variations in the effectiveness of the Jigsaw model are often associated with differences in implementation quality, teacher preparedness, classroom management, and student characteristics. National studies similarly identify heterogeneous student ability, limited instructional time, and the need for continuous teacher facilitation as common challenges in implementing cooperative learning in mathematics classrooms.

Nevertheless, these challenges should not be viewed as limitations of the Jigsaw model itself but rather as practical considerations requiring appropriate pedagogical strategies. With adequate preparation, teacher support, and classroom management, the identified

challenges can be minimized, allowing the Jigsaw Cooperative Learning Model to create meaningful collaborative learning experiences that promote both academic achievement and students' social development.

Conclusion

This study explored the implementation of the Jigsaw Cooperative Learning Model in mathematics learning among eighth-grade students at SMP Muhammadiyah Lumajang using a qualitative descriptive approach. The findings indicate that successful implementation of the Jigsaw model requires systematic instructional planning, including the preparation of lesson plans, learning materials, assessment strategies, and heterogeneous student grouping. During classroom implementation, the model transformed the learning process from teacher-centered instruction to a student-centered environment in which learners actively participated in collaborative discussions, peer teaching, and mathematical problem solving.

The study further revealed that the implementation of the Jigsaw Cooperative Learning Model positively influenced students' learning experiences by increasing classroom participation, collaborative interaction, communication skills, learning responsibility, and conceptual understanding. These findings support the view that cooperative learning not only enhances cognitive learning outcomes but also develops social and interpersonal competencies that are essential for twenty-first-century learning. Nevertheless, the successful implementation of the model depends on several supporting factors, including teacher pedagogical competence, student motivation, classroom management, and adequate learning facilities. Conversely, differences in students' academic abilities, limited instructional time, and varying levels of student confidence remain important challenges that require appropriate instructional strategies.

Theoretically, this study contributes to the literature by providing qualitative evidence that explains how the Jigsaw Cooperative Learning Model is implemented in authentic mathematics classrooms. While previous studies have predominantly focused on measuring the effectiveness of Jigsaw through quantitative approaches, the present study offers a deeper understanding of the instructional processes, teacher facilitation, and collaborative interactions that underpin successful implementation. These findings reinforce the principles of Social Constructivist Theory by demonstrating that meaningful mathematical learning is constructed through dialogue, peer interaction, and shared responsibility.

Practically, the findings suggest that mathematics teachers should carefully design cooperative learning activities, establish heterogeneous learning groups, and facilitate active classroom discussions to maximize students' participation and conceptual understanding. Schools are also encouraged to provide continuous professional development and adequate instructional resources to support the effective implementation of cooperative learning in mathematics education.

This study is limited to a single research site and a qualitative descriptive design; therefore, its findings should be interpreted within the context of the participants and learning environment investigated. Future studies are recommended to employ mixed-methods or quasi-experimental designs involving larger samples and diverse educational settings to examine both the implementation process and the effectiveness of the Jigsaw Cooperative Learning Model. Further research may also investigate the integration of cooperative learning with digital technologies and artificial intelligence to support collaborative mathematics learning in contemporary educational environments.

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