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# Enhancing Mathematics Achievement Through Cooperative Learning: A Study of The Jigsaw Technique in Exponent Multiplication and Division

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***ABSTRACT***

Motivating students and fostering deeper conceptual understanding remain key challenges in mathematics education, particularly with abstract topics such as exponent multiplication and division. Achievement gaps often result from traditional lecture-based methods that fail to address diverse learning needs. Cooperative learning strategies, especially the Jigsaw technique, have been shown to improve student engagement, peer interaction, and content mastery. The method promotes active participation, accountability, and deep comprehension through structured group collaboration, making it particularly effective for challenging mathematical concepts. This study investigates the impact of the Jigsaw technique on eighth-grade students' performance in exponent multiplication and division. A posttest-only experimental design was employed with 30 secondary school students. Data were collected through a researcher-developed posttest containing multiple-choice and short-answer questions aligned with national learning objectives. The data were analyzed using descriptive statistics (mean, percentage, standard deviation) and a one-sample t-test to evaluate statistical significance. The results demonstrated a significant improvement in student performance ($M = 15.13$, $SD = 2.10$, $t = 8.186$, $p < .05$), surpassing the 60% proficiency benchmark. These findings suggest that the Jigsaw method not only enhances mathematical understanding but also cultivates essential 21st-century skills such as critical thinking, communication, and teamwork.

## INTRODUCTION

Mathematics is one of the educational domains that is vital because it trains learners in numeric reasoning, problem resolution and analytical thought abilities (Agbata et al., 2024). But multiplication and division of exponents proves "difficult" for a lot of students since the idea is abstract. In conventional types of classes, students got disengaged, resulting in a passive learning and therefore a complex lack of understanding. There is a growing need for innovative teaching practices that enhance understanding and active participation in mathematics education." Cooperative learning, particularly the Jigsaw approach, has been widely studied for enhancing teamwork, critical thinking, and knowledge retention. However, its application in secondary mathematics, especially in exponent operations, remains underexplored. Student-centered learning is a key tenet of modern educational policy, and thus innovative teaching methodologies (Goodwin, 2024), such as the Jigsaw methodology, must be critically assessed to ensure that they adhere to pedagogical standards of the present day and improve student performance.

Jigsaw has been demonstrated to increase interest and understanding, but implementing Jigsaw for arithmetic is challenging (Sumianto, 2023). However, the presence of discrepancies in group

formation, task division and assessment can hamper the learning process in diverse educational settings. Students with worse math foundations might have difficulty with a peer education structure without scaffolding, leading to differences in understanding. This study investigates the impact of Jigsaw on the eight-grade student exponent multiplication and division. It offers educators, curriculum developers, and policy makers pertinent insight into how cooperative learning can enhance student engagement and academic success in the context of creative, student-centered mathematics education. These skills are crucial for addressing challenging academic issues and promoting originality in mathematics instruction. It has been demonstrated that cooperative learning techniques such as the Jigsaw method, enhance teamwork, promote student involvement and develop critical thinking skills. The Jigsaw approach particularly emphasizes collaboration and comprehension (Hanapi & Kamal, 2024), and it is a useful teaching method for difficult topics like exponent operations in mathematics classes. Mathematics enables individuals to operate in changing sociocultural contexts, according to the Ministry of Education (2017). Math is used. The Thai Basic Instruction Fundamental Curriculum (B.E. 2551) 2017 uses numbers, algebra, measurement, geometry, statistics, and probability. This broad framework encompasses the elements of critical thinking, mathematical communication, problem solving, and real-life application. These abilities allow students to apply arithmetic to real-life situations and distinguish themselves in an evolving world. Creative teaching methods are required to involve students. Education is becoming increasingly difficult. Cooperative learning using the jigsaw method enhances academic performance (Karina et al., 2024). Cooperative learning having students working in groups small and larger to achieve goals (Saputra et al., 2024). The jigsaw technique allows students to concentrate on various areas of the subject matter. What it does it integrates their respective knowledge. This strategy enhances students' understanding and fosters the teamwork, communication, and conflict-resolution skills necessary to make society a better place. Many domains of data notice Jigsaw learning recommend depth and understanding. The different subtopics put students into "home groups," followed by "expert groups. Research on the home groups subtopics is conducted by expert groups prior to reporting back to their home groups. Iterative learning refines both leadership and communication skills and ensures the material is fully processed by all students. New research evaluates the utility of Jigsaw for improving pupils' learning of mathematics. The pupils of the secondary level should know the multiplication as well as division by exponents. It connects traditional teaching practices to alternative practices focused on student learning outcomes. One of the studies goals is comparing students' academic performance to 60% proficiency. The academic performance of pupils before and after Jigsaw learning will be compared in the study. This criterion determines if the technique aligns with curriculum standards and has a positive impact on student outcomes. A student-centered, active learning policy supports cooperative learning approaches like the Jigsaw method in Thai education. Jigsaw-based learning improves students' academic achievement, critical thinking and engagement according to US and worldwide research (Zhan et al., 2024). Jigsaw-based classrooms enhance academic performance, teamwork and peer acceptance (Karina et al., 2024). This study examines whether Jigsaw aids students in understanding exponents. This research recommends collaborative learning and planned pedagogy for innovative teaching. It also joins math education teaching strategy discussion. This research reveals that cooperative learning in mathematics transforms academic performance and life skills and inspires educators to use evidence-based methods. This study emphasizes the need to address fundamental educational issues. It uses proven ways to align instruction with students' evolving needs and society's expectations.

National and international research has examined the use of cooperative learning methods, especially the Jigsaw technique in mathematics instruction. This literature review examines fundamental ideas, theoretical foundations. Previous research highlights the effectiveness of cooperative learning methods, particularly the Jigsaw technique, in enhancing student collaboration and engagement across disciplines. The Jigsaw technique has been widely studied in various educational contexts, including science and language education, where it has demonstrated its ability to foster collaboration, critical thinking, and deeper comprehension (Zhan et al., 2024). However, its application in mathematics education, especially for abstract concepts like exponent operations, remains underexplored. In cooperative learning, students collaborate in small groups to achieve a common objective. According to (Shvets et al., 2024), cooperative learning strategies foster independence and responsibility in students which aids in their social and intellectual growth. The Jigsaw cooperative learning technique is gaining in popularity because of its structure and participation.(Rahmi et al., 2024); (BR & Kuning, 2023) developed the jigsaw method, which divides learning exercises into interconnected parts. Following their placement in "home groups," we separate students into "expert groups" according to their subtopics. Expert groups study the subtopics before teaching students in their home groups. This method assures comprehension and engagement while developing cooperation abilities. The Vygotsky theory of social constructivism supports the jigsaw approach (Chaudhary, 2024). This approach emphasizes social

interaction in cognitive development. Through peer involvement, scaffolded learning, and shared problem-solving, students create knowledge together. Bloom's Taxonomy emphasizes higher-order thinking skills as learning goals (Azizah, 2023). These skills include analysis and synthesis. Mathematical reasoning, problem-solving, and analytical thinking are essential for academic and professional success, and mathematics supports them (Hitt et al., 2010). The Thai Ministry of Education (2017) focuses on algebra, geometry, and probability skill development in mathematics. Mathematics education is essential, but instructors must overcome several challenges. These include student disengagement, abstract concept confusion and practical application issues. These challenges require unique teaching methods that can bridge the gap between curricular material and students' real-world experiences. Jigsaw, which promotes active engagement and deep mathematical understanding, is a possible option. The Jigsaw technique improves children's math learning by promoting active engagement, responsibility, and structured peer teaching throughout its stages studies (Adji et al., 2023). During the "expert group" phase, students become responsible for mastering specific subtopics, which enhances critical thinking and independent problem-solving (Fitriana et al., 2023). When returning to their "home groups," they explain what they have learned to their peers, reinforcing their conceptual understanding through teaching—a process shown to deepen retention and comprehension of abstract ideas (Rahmawati, 2018). In the context of mathematics education, this structure encourages students to articulate reasoning, resolve misconceptions through peer discussion, and collaboratively apply knowledge to problems, as demonstrated in Jigsaw-based classrooms with improved math attitudes and performance (Yemi et al., 2018). These phases of learning demonstrate Jigsaw's educational adaptability and its capacity to technically enhance mathematical achievement by aligning student-centered activity with deep processing of mathematical content. To understand algebra and calculus, use exponents. Because algebra and calculus are abstract and mathematical in nature, college students often struggle with them. Research shows that using jigsaws and other cooperative learning tools can alleviate these concerns. These techniques promote student collaboration and problem-solving. Mbacho (2013) studied how the Jigsaw approach may teach secondary school students about exponents. The study indicated that students have a deeper understanding of the material and higher retention rates than ordinary course students. The Jigsaw technique's collaborative nature allowed students to challenge misconceptions and clarify ambiguities in a supportive group setting (Townsend et al., 2024). Teaching arithmetic with the Jigsaw approach has many advantages (Yoo & Son, 2015). First, it emphasizes active learning by making students take responsibility for their subtopics. This fosters ownership and accountability which motivates and engages. Second, the strategy develops soft skills like teamwork, communication, and conflict resolution which are important to academic and professional success. The Jigsaw approach minimizes student achievement gaps, according to research. Through pairing students with different levels of competency, strategy ensures that students with lower skills receive guidance from classmates and that students with higher skills share their knowledge. Diverse educational principles encourage adapting instruction to student needs. The Jigsaw method is the most successful but has major downsides. The learning process depends on efficient group dynamics; nequal engagement may compromise it. Teachers must carefully plan and supervise programs to support all students. The Jigsaw strategy's long-term effects on students' academic achievement and math attitudes need further study. We may also study Jigsaw's technology use. We should consider using technology for resource sharing and group communication. According to the study, the Jigsaw technique enhances students' mathematical aptitude, particularly in complex concepts such as exponents. This method encourages group learning. It enhances academic performance and life skills. The jigsaw method works for creative math teachers. This study expands upon earlier research on cooperative learning in secondary mathematics.

## METHODS

This study aims to investigate how the Jigsaw technique affects secondary school students' academic performance in mathematics. More precisely, the study focuses on the ideas of exponent division and multiplication. The methodology explains research design, participants, materials, procedures and data analysis techniques. These were used in order to ensure the study's completeness and reliability.

### Research Design

This study uses an experimental design and applies a posttest-only model to only one group. By measuring the students' performance following the implementation of the intervention, this approach assesses how well the Jigsaw technique improves student accomplishment. The lack of a control group

facilitates comprehension of the study, but it also allows researchers to learn more about the direct effects of the teaching method. The study looked at the relationship between students' academic accomplishment in mathematics, specifically the properties of multiplication and division of exponents (dependent variable) and cooperative learning using the Jigsaw technique (independent variable). In Figure 1, the conceptual framework is displayed.

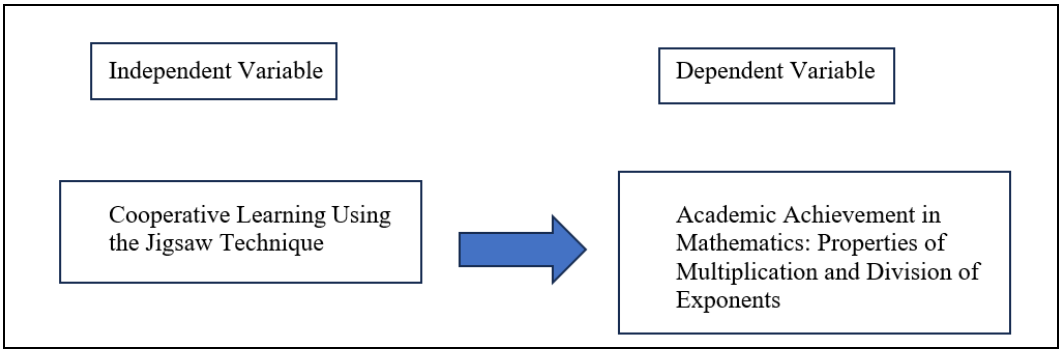


**Figure 1.** Conceptual Framework of the Study

Figure 1 is as follows. The conceptual framework illustrates relationship between the independent variable—the Jigsaw method for cooperative learning—and the dependent variable—academic achievement in mathematics. We assess the effectiveness of the Jigsaw technique in enhancing students' comprehension and performance in exponent multiplication and division. The characteristics of these two mathematical procedures are the main subject of the study. This framework highlights the manner in which the teaching style affects the students' outcomes and forms the basis for the research design and analysis.

**Participants**

Students enrolling in Phibun Uppatham School's eighth grade (Matthayom 2) in Bangkok, Thailand, made up the targeted demographic. The purposive sampling technique selected a sample of thirty students enrolled in Class 2/3 during the first semester of the academic year 2024. We selected the class based on student availability and logistical feasibility to ensure consistent student participation. We divided the students into groups based on their academic performance in mathematics, as determined by their midterm exam scores, to ensure a diverse sample. To maximize the benefits of peer learning which cooperative learning frameworks encourage, each group included a fair mix of high achievers, average achievers, and kids with poor achievers.

**Materials**

This project employed a range of tools to make the jigsaw approach useful for teaching math. We created four lesson plans on exponent multiplication and division, each concentrating on a different subtopic. We followed a systematic schedule within these lesson plans to preserve regularity and focus for 60 minutes each session. To match lesson topics, we made four activity papers. To encourage collaborative and participatory learning in "expert groups" and "home groups," we designed these worksheets. The classes were based on Thailand's 2017 Basic Education Core Curriculum (B.E. 2551) reform assuring relevance, standardization and alignment with national educational standards. We assessed teaching strategy effectiveness with well-developed posttests. We tested students' arithmetic knowledge with multiple-choice and short-answer questions. Subject matter experts checked the test for accuracy, suitability, and cognitive alignment with learning objectives.

**Procedures**

This study was carefully prepared and implemented to use Jigsaw and get reliable data. The researcher prepared and analyzed learning objective-aligned lesson plans and activity sheets. To meet educational requirements, subject matter experts reviewed these resources for clarity and relevance. The classroom stressed "home groups" and "expert groups." Students studied Jigsaw's framework and active involvement. Two weeks of Jigsaw instruction. The instructor started each class by outlining the arithmetic and real-world applications. The teacher placed students in fair "home groups," based on academic ability. The same subtopic researchers formed "expert groups." Expert group students used exercise papers for subtopics. Teacher encouraged discussion and cleared up ambiguities. Students shared their results in home groups after expert groups. Each group member taught their subtopics to

classmates after learning the topic. Each session ended with teacher highlighting key ideas and answering questions. The professor covered all four lessons' syllabus. Students took posttests on exponent multiplication and division. Students had 60 minutes to examine a standardized test. While a standardized posttest was used to evaluate the mathematical competency of the participants, the present study also analyzed various soft skills development such as communication, teamwork, and critical thinking that are imperative in cooperative learning approaches (i.e. Jigsaw). Complete data was collected through a mixed-method approach. Following preset evaluation criteria, the teacher and three research assistants evaluated students' participation, quality of the interaction, and collaborative problem-solving strategies in the expert and home groups during learning segments. A Likert-scale questionnaire based on self-assessment was taken by students to evaluate their skill development with this intervention, mainly in the areas of cooperation, explanation in mathematics, and carrying out peer evaluation.

Students also did peer assessments to enhance the accuracy and dependability of their analyses by assessing their classmates' group discussion participation and mathematical idea communication. Teachers also provided students feedback on their thinking and collaboration, which showed their growth. Using information from direct observations, self-evaluations, peer assessment, and the teacher's perspective combined, this study provided an improved evaluation of the impact of Jigsaw on academic performance and social skill development. These results reaffirm that student, collaborative learning non all finite develops ace yearnings 21st. Future research needs to involve longitudinal studies that may explore how much these skills are retained and how effective the intervention is in relation to the long-term retention of these skills over time, thus adding to the pedagogical implications of cooperative learning in mathematics education. We examined the data to see how Jigsaw influences student learning. This thorough approach ensured the study's accuracy and reliability.

**Data Analysis**

We utilized descriptive and inferential statistics to evaluate posttest data to see if the Jigsaw technique improved student academic performance. We used mean, percentage and standard deviation to summarize student performance. These figures showed how well students comprehended exponent division and multiplication after intervention. We compared the students' average results to the 60% requirement to assess their ability. Inferential statistics, especially a single-sample t-test, validated the results. We tested the students' mean posttest score for significance above 60%. We set the statistical significance level at 0.05 to guarantee a thorough analysis. The researcher used this analytical method to learn how the Jigsaw strategy affected students' math performance. These data showed the Jigsaw method's educational effectiveness.

**Limitations**

The constraints may have affected the results and generalizability. The lack of a control group makes it difficult to compare Jigsaw to other teaching methods. Additionally, the investigation was quick. Long-term effects on student progress and memory may have been overlooked. Jigsaw relies on group dynamics; therefore, it requires everyone to cooperate and participate equally. Variations in student participation and dedication may have affected results consistency. These limitations indicate areas for improvement and recommend future study to improve robustness and applicability of comparable studies. This methodology emphasizes collaboration, comprehension, and critical thinking, making it ideal for evaluating the Jigsaw Method's impact on students' maths skills. This study explores how creative teaching methods can improve mathematics instruction and advance cooperative learning research.

## RESULT AND DISCUSSION

During the intervention, students participated in various collaborative activities designed to enhance their understanding of exponent multiplication and division. These activities required active engagement and problem-solving, which fostered a deeper comprehension of the mathematical concepts. Figure 2 and 3 provides some examples of activity sheets completed by students during the implementation of the Jigsaw technique. This activity focuses on solving problems related to the division and multiplication of exponents, illustrating the application of cooperative learning in mathematics. After conducting a posttest, it was found that Jigsaw learners performed better in understanding multiplication of the same base exponents and division of same base exponents. The posttest results (M = 15.13, SD = 2.10) showed a statistically significant improvement ($t$ = 8.186, $p$ < .05), aligning with previous studies on the benefits of peer collaboration in mathematics learning (Santria & Hendriani, 2024). Similarly,

Karina et al. (2024) pre-releases found jigsaw-based learning promotes problem-solving and engagement in math. This study found that while children performed well overall, some students demonstrated performance variability — meaning that students with poorer foundational skills may require more scaffolding. Fitriana et al. (2023) concluded that Jigsaw creates knowledge gaps if students from less wealthy backgrounds struggled with the subject of expert in the study.

Besides improving academic performance, this study also revealed that the Jigsaw learning process enhanced students' soft skills. Through structured participation in both expert and home groups, students developed teamwork by collaborating to construct shared understanding. Communication skills were reinforced during the peer-teaching phase in home groups, where students were required to clearly explain mathematical concepts to their teammates. Critical thinking was fostered in expert groups, where learners had to analyze subtopics, identify key ideas, and synthesize knowledge before sharing. These outcomes were observed during classroom interactions and confirmed through self-assessment surveys, indicating that the cooperative structure of Jigsaw promotes essential soft skills in addition to conceptual learning. These results complement (Shvets et al., 2024) vouch that higher order thinking flourishes when peer contact is structured. A number of students struggled at articulating mathematical reasoning, indicating that they need more help from an instructor or structured reflection on the activity building. These data indicate that the Jigsaw method enhances both math and soft skills. The results are encouraging, but more research is needed to determine whether Jigsaw leads to long-term retention of arithmetic and whether technology can foster more effective cooperation.

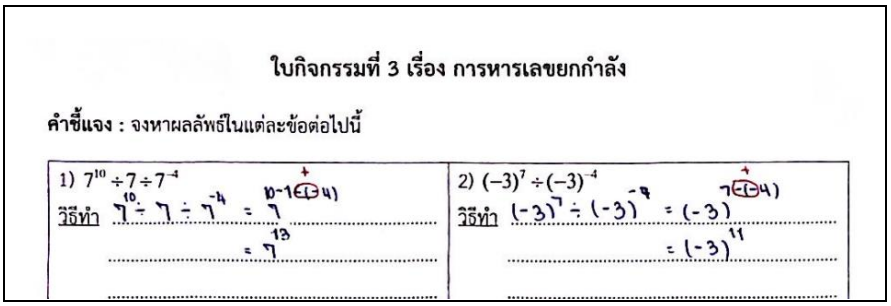


**Figure 2.** Example of A Student Activity Sheet on Division and Multiplication of Exponents

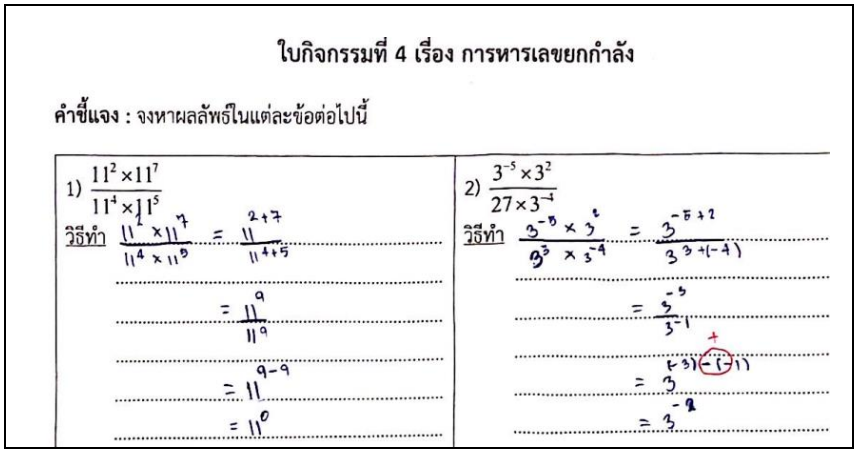


**Figure 3.** Example of a Student Activity Sheet on Division and Multiplication of Exponents

Performance of eighth-grade students in mathematics specifically in the areas of multiplication and division of exponents. Following the implementation of the intervention, we analyzed the results using both descriptive and inferential statistics to gain insight into the students' performance. After administering posttest, students received a mean score of 15.13 out of 20 (75.66%). This result surpassed the established minimum competency level of sixty percent for this subject. Table 1 provides a detailed statistical analysis of the posttest scores, including the mean, standard deviation, percentage of the mean, and significance level, to illustrate the overall performance of the students.

**Table 1.** Statistical Analysis of Posttest Scores for Grade 8, Class 2/3 Students

| Sample Group | Number of Students | Full Score | Score Mean | S.D. | % of Mean | t | Sig (1-tailed) |
|---|---|---|---|---|---|---|---|
| Grade 8, Class 2/3 | 30 | 20 | 15.133 | 2.09652 | 75.6665 | 8.186* | .00 |

* Statistically significant at the 0.05 level

Following the implementation of the Jigsaw technique in mathematics instruction, Table 1 displays the posttest results of thirty students in Grade 8, Class 2/3. The posttest results revealed a significant improvement in students' performance ($M = 15.13$, $SD = 2.10$, $t = 8.186$, $p < .05$), indicating that the Jigsaw technique effectively enhanced their understanding of exponent operations. While there are some minor variations among individuals, most students consistently perform. The t-test result was 8.186, which was significant at the 0.05 level ($p = .00$), indicating that the mean score was significantly higher than the benchmark. This illustrates how effective the Jigsaw technique is in promoting greater academic achievement especially when it comes to understanding the properties of exponent multiplication and division. According to the research, it seems that cooperative Jigsaw strategy enhances comprehension through peer interaction and active engagement. This aligns with the collaborative learning tenets. Even while the results are promising, there is a significant degree of performance variation indicating that certain children may need extra support. When combined, these findings provide proof that the Jigsaw method may be a useful teaching tool for improving arithmetic instruction and tackling challenging material. Because the findings' standard deviation was so low, it was evident that most students continued to perform at a consistent level. We used a one-sample t-test to determine whether the mean score significantly differed from the benchmark. At a significance level of 0.05, the test results showed that the students' performance was statistically higher than the necessary threshold.

**Performance Distribution**

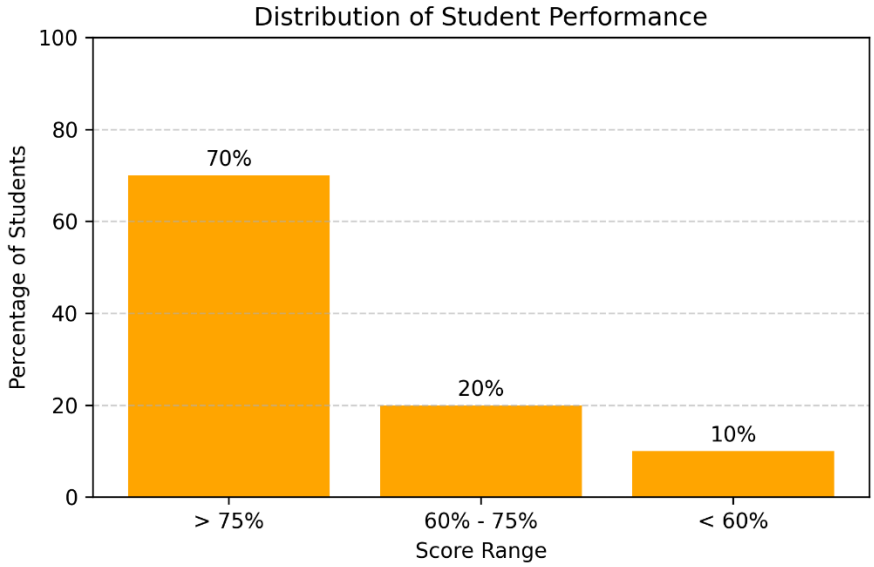


**Figure 4.** Distribution of Student Performance Based on Posttest Scores. The Majority of Students (70%) Scored above the 75% Threshold, indicating a High Level of Comprehension, while 10% Fell Below the Minimum Proficiency Level of 60%

We conducted a more thorough examination of the students' performance distribution to gain a deeper understanding of the range of learning outcomes. Seventy percent of the students scored better than seventy-five percent, indicating that they have understood the topic and have a high level of comprehension. Furthermore, 20% of the students demonstrated adequate performance by receiving scores in the range of 60% to 75%. Ten percent of students received scores below the required minimum of sixty percent suggesting that these students have room to improve. The study's findings suggest that the Jigsaw approach can enhance students' overall performance and cater to a range of distinct learning requirements. This discussion will cover the theoretical foundations of cooperative learning, the broader

significance of the Jigsaw technique in the field of mathematics education, and the implications of these findings in relation to earlier research.

**Alignment with Previous Research**

The findings of this study complement previous research by addressing a specific gap in the application of the Jigsaw technique to the teaching of exponent operations in secondary school mathematics. While prior studies have demonstrated the effectiveness of Jigsaw in enhancing students' critical thinking (Muliawan, 2023) and conceptual understanding in analytical geometry (Cantos et al., 2016), few have explored its targeted impact on abstract algebraic content such as exponents. The present study contributes new insights into how the structured peer-teaching stages of Jigsaw can improve students' mastery of exponent rules. Additionally, research by Santria and Hendriani (2024) reinforces the broader effectiveness of cooperative learning over traditional methods, validating the adaptability of the Jigsaw technique across mathematical domains. This study therefore extends the current body of knowledge by demonstrating that Jigsaw not only supports general academic achievement, but also effectively facilitates the learning of specific mathematical content that is often considered cognitively demanding.

**Effectiveness of the Jigsaw Technique**

The students' comprehension of exponent operations improved significantly following the implementation of the Jigsaw technique. This structured cooperative learning method was carried out over four sessions, each focusing on a subtopic of exponent rules. In each session, students were initially divided into "home groups," then reassigned into "expert groups" to study specific subtopics such as multiplication of like bases or zero exponents. In their expert groups, students collaborated, used activity worksheets, and received teacher scaffolding to clarify core concepts. Afterward, they returned to their home groups and taught their subtopic to peers. This process reinforced their conceptual understanding through explanation, while also improving peer-to-peer interaction and reasoning. Classroom observation confirmed that students in expert groups engaged in problem-solving and clarifying misconceptions before teaching, which elevated their confidence and accuracy in content delivery. Posttest results support this process: students achieved a mean score of 15.13 out of 20 (75.67%), significantly above the 60% benchmark ($t = 8.186$, $p < .05$). This demonstrates the effectiveness of the Jigsaw process not only in fostering deeper understanding but also in facilitating measurable academic improvement. Overall, the reciprocal structure of the Jigsaw model fostered collaboration, critical thinking, and stronger engagement with mathematical reasoning.

**Addressing the Needs of Diverse Learners**

The low standard deviation of scores indicated strong performance consistency, which was significant. This suggests that the Jigsaw technique reduced student achievement gaps. Students who failed in traditional settings benefited from peer aid and a collaborative learning atmosphere. These students wanted big environmental gains. This is consistent with past research that showed the method could improve educational equity. However, only a small fraction of students scored below 60%, suggesting that the strategy may not suit all kids' needs. Some students may need scaffolding or alternative teaching methods to supplement Jigsaw learning. To support the students, future studies may include digital tools or visual representations.

**Implications for Mathematics Education**

This study affects math instruction in numerous ways. The Jigsaw method's success in this context emphasizes cooperative learning in education. Traditional teaching techniques which emphasize individualized instruction may not address students' different requirements or build higher-order thinking skills which are essential for classroom and professional success. The study also emphasizes active math learning. Jigsaw math is easier for students to understand and retain. Jigsaw turns students into active learners. Particularly when studying complex topics such as exponents, a superficial understanding could potentially lead to errors and impede research. Third, the study suggests that cooperative learning may prepare students for teamwork. Jigsaw teaches students skills businesses want. These skills include communication, cooperation, and conflict resolution.

**Limitations and Future Directions**

Even though the results are encouraging, it is important to acknowledge the limitations imposed on the study. Jigsaw is hard to compare to other teaching methods because there is no control group. Furthermore, the short duration of the study likely hindered a thorough examination of intervention's long-term effects on children's academic performance and attitudes towards mathematics. Potential

future research could address these issues more successfully by extending the study's duration and adding a control group. We could carry out longitudinal studies to provide insightful information on how the Jigsaw technique alters students' learning paths over time. Additionally, looking at the idea of integrating technology into the Jigsaw approach as a whole could increase its efficiency. Digital platforms, for instance, might facilitate resource sharing and collaboration among students which is particularly advantageous in larger or more diverse classes.

**Broader Significance of the Findings**

Research shows the Jigsaw technique's value in mathematics training improving cooperative learning studies. The results show cooperative learning improves academic performance and life skills. Jigsaw operates across courses and educational situations as educators globally seek new approaches to modern education. The Jigsaw technique can help Thailand achieve its student-centered and active learning goals according to the study. Other schools and teachers can use and tweak the study's model to improve math instruction. In a regional situation, we demonstrate method's value. This study found the Jigsaw approach helps students comprehend exponent multiplication and division. The strategy improved academic performance and satisfied students' different needs by encouraging active involvement, peer learning and teamwork. These findings add to the increasing body of research on cooperative learning and provide immediate insights for teachers looking to innovate. These findings should inform Jigsaw technique research in mathematics education and other areas.

## CONCLUSION

This study investigated whether Jigsaw could enhance the arithmetic abilities of eighth-graders. We studied specific mathematical aspects of exponent division and multiplication. The Jigsaw technique dramatically improved student performance. The students' average posttest score of 75.66%, over the 60% competency criterion, corroborated this claim. These findings show that cooperative learning methods particularly the Jigsaw approach improve academic performance and soft skills like problem-solving, teamwork, and communication. The Jigsaw technique's distinctive structure stimulates active engagement, peer teaching and reciprocal accountability, making it useful in this research. Through collaborative learning in expert and home groups, students improved their leadership, teamwork and mathematical understanding. The strategy greatly reduced achievement gaps in children with most performing well. However, a tiny minority of students failed to meet the performance threshold, suggesting the need for further help to ensure that all students benefit from this strategy. Math education needs unique teaching methods that go beyond teacher-centered approaches as these findings show. These methods are different from what students have learned. The study shows how Jigsaw approach may fulfill varied children's needs and deepen their mathematics understanding. This strategy also helps students prepare for team-oriented 21st-century organizations by being collaborative. Despite the positive results, trial's short duration and lack of a control group necessitate further research. Future studies should study the jigsaw technique's long-term effects, its applicability to various mathematical subjects, and how technology could improve it. If educators focus on these areas, they may develop and improve cooperative learning ways for students worldwide.

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