International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

A Study on Assessing the Influence of Jigsaw Strategy in Cooperative Learning for Playing with Numbers

Kaneez Fatima[1], Dr. Nishat Fatema[2]

[1]Research Scholar, Department of B.Ed., Mahila Mahavidyalaya PG College
[2]Assistant Professor, Department of B.Ed., Mahila Mahavidyalaya PG College

Abstract

The present study investigates the effectiveness of the jigsaw strategy, a well-established Cooperative learning technique, in enhancing students' understanding and performance on the mathematical topic "Playing with Numbers". This topic, involving number manipulation, divisibility rules, factors, and multiples, is a basic concept in middle school mathematics. With regard to the issues the students normally find difficult in apprehending the relations between numbers as well as strategies for solving, this paper explored whether jigsaw strategy promotes the cognitive as well as affective learning outcome. A quasi-experimental design involved two middle school groups of the experimental and the control, using the jigsaw method and received traditional teaching. The intervention was for eight weeks, and in this time, the experimental group was broken down into smaller jigsaw groups where students would master and teach their peers a specific subtopic. Pre-test and post-test assessments were administered to measure the numerical fluency, problem-solving abilities, and conceptual understanding of the students. Qualitative data were also collected through student feedback on engagement, motivation, and collaborative skills. It appears that the scores of the post-test of students in the experimental group were highly significant compared to those of the control group. They showed much more numerical fluency, problem-solving strategies, and peer collaboration. In addition, students indicated a better comprehension of the mathematical idea as a result of peer interaction and collaborative learning. This shows that the jigsaw strategy combined with Cooperative learning methodology in mathematics education seems to have a great potential. It will not only promote academic achievement but also entails vital 21st-century skills such as communication, teamwork, and critical thinking; hence, jigsaw is an effective pedagogy for teaching mathematics in middle schools.

Keywords: Cooperative learning, Jigsaw Strategy, Playing with Numbers, Mathematics Education, Student Performance

Introduction

The innovation of mathematics teaching strategies that allow for deep understanding and engagement of learners has long been sought after in mathematics education. Traditional direct-instruction methods, although helpful to some learners, do not always engage all learners in active problem solving and conceptual understanding (Slavin, 1996). Cooperative learning strategies, however, such as the jigsaw

method, have received attention due to their effectiveness in increasing student engagement and the collaborative nature of the learning environment (Aronson, 1978; Johnson & Johnson, 1994).
"Playing with Numbers" is one of the topics that require investigating numerical patterns, operations, as well as creative problem-solving. And since mathematics deals with abstract matters, it engages most effectively using interactive and student-centered methods. The jigsaw strategy involves dividing students into small groups where everyone becomes an "expert" on a section of the content, and then delivers their knowledge to others within their group. This way, not only are the students individually responsible but also learns the art of teamwork and communication (Smith et al., 2005).

Statement of the Problem

Despite growing evidence on the benefits of Cooperative learning, limited research has specifically examined how the jigsaw strategy influences student performance in the context of "Playing with Numbers." This study addresses this gap by exploring whether the jigsaw strategy can enhance both the conceptual understanding and practical application of numerical concepts.

Research Objectives

1. To establish if the jigsaw strategy impacts students' performance in "Playing with Numbers.
2. Compare the scholastic attainments of pupils trained through jigsaw strategy to pupils trained in conventional ways.
3. To evaluate the shift in student engagement, motivation, and teamwork skills when implementing the jigsaw strategy.

Research Questions

1. Does the jigsaw strategy better improve students' performance in the "Playing with Numbers" subject than other usual instructional approaches?
2. What effect does the use of the jigsaw strategy have on students' involvement and motivation in learning mathematical concepts?
3. What perceived benefits and challenges are there in using the jigsaw strategy in the math classroom?

Literature Review

- **Cooperative learning and the Jigsaw Strategy** Cooperative learning refers to a classroom instructional strategy that involves the interaction of students within small groups toward shared learning goals (Cohen, 1994). The jigsaw technique is one cooperative strategy, whereby students work on a collective task that no individual can accomplish independently, requiring the unique contribution of each student for completion (Aronson, 1978). Prior research has established the effectiveness of Cooperative learning in producing higher academic achievements, enhanced communication skills, and increased self-esteem among students (Johnson & Johnson, 1994).
- **Theoretical Foundation** Vygotsky's (1978) social constructivist theory emphasizes the value of social interaction in the process of learning. The jigsaw strategy, that requires peer teaching and collaborative dialogue, fits within this theory quite well. From Vygotsky's viewpoint, learning best occurs when individuals are actively working to construct their knowledge through interaction with others. In this manner, the jigsaw method acts as an optimal structure for probing deep mathematical themes by challenging learners to build off each other's insights.

- **Cooperative learning in Mathematics** Mathematics is one subject that benefits more from interactive, student-centered approaches. Studies showed that Cooperative learning strategies enhance mathematical problem-solving ability, critical thinking, and understanding of mathematical concepts (Slavin, 1996). Specifically, the "Playing with Numbers" topic needs the manipulation and exploration of novel ways of representing numbers; an activity that learners are better off at when exploring numerical ideas by discussing and debating them in a group setting (Smith et al., 2005).
- **Gaps in the Literature** Although many studies have focused on the advantages of Cooperative learning in mathematics, to our knowledge, very few have discussed the effects of the jigsaw strategy on topics that require creative numerical manipulation. The goal of this study is to fill that void by focusing on the topic of "Playing with Numbers," where students are challenged to think flexibly about numbers and their properties.

Methodology

- **Research Design** A quasi-experimental research design was adopted to measure the impact of the jigsaw strategy on student learning outcomes. The participants consisted of two different groups of eighth-grade students: an experimental group who used a jigsaw strategy, and a control group who received traditional instruction.
- **Participants** A total of 60 students was involved, split into the experimental (n = 30) and control (n = 30) groups. The participants were matched on the basis of previous achievement in mathematics to make both comparison groups comparable. Parental permission and school administration clearance were granted prior to conducting the study.
- **Instruments**
  1. **Pre-Test and Post-Test:** The researcher-developed 20 multiple choice and short answer questions for pre-test and post-test before and after the intervention. The pre-post test covered important concepts in "Playing with Numbers".
  2. **Student Questionnaire:** After completing the study, the students were given a questionnaire to elicit their perspectives about the learning process and the efficacy of the jigsaw strategy.
- **Procedure**
  1. **Pre-test Administration:** The two groups received the pre-test to measure their initial knowledge.
  2. **Intervention:** The experimental group had the eight weeks of instruction with "Playing with Numbers" employing a jigsaw strategy. It divided students into "home" groups and "expert" groups. The different student assigned portions of the subject matter researched by each returned back to the respective home groups teaching their members and the lecture instruction for the same material to control group.
  3. **Post-test administration:** After the intervention, the two groups received the post-test.
  4. **Feedback:** At the end of the study, a student questionnaire was administered.
- **Data Analysis** Results were analyzed through the use of paired-sample t-tests and ANCOVA in order to counteract baseline differences for quantitative data, pre-test and post-test scores. Qualitative data coming from questionnaires are thematically analyzed for common perceptions of the jigsaw strategy.

Results

Quantitative Findings

Test / Group	Pre-Test		Post-Test		Mean Gain
	Mean	SD	Mean	SD	
Experimental	62.3	8.4	78.9	7.6	+16.6
Control	63.1	8.1	70.2	8.3	+7.1

A paired-sample t-test disclosed that the improvement of the experimental group was statistically significant, $t(29) = 8.12$, $p < .001$, whereas that of the control group was significantly small in magnitude, $t(29) = 4.15$, $p < .01$. ANCOVA on the other hand showed that when the score at pre-test is controlled, then the group difference in post-test score is statistically significant, $F(1,57) = 15.67$, $p < .001$.

Qualitative Findings (Student Feedback)

The qualitative feedback collected from students in the experimental group offers valuable insights into their experiences with the jigsaw strategy. A significant number of students expressed that the **jigsaw method made learning more enjoyable and engaging**. According to them, the collaborative format of the strategy **"makes learning fun"** and helps in **making difficult mathematical concepts easier to understand**, as they had the opportunity to explain ideas to peers and learn from one another. This peer interaction fostered a sense of ownership and responsibility in their learning, and many students reported feeling more **confident and motivated** in the classroom.

The students also pointed out certain challenges encountered during the implementation. **Time management** emerged as a common concern, as some groups struggled to complete tasks within the allocated time due to extended discussions or lack of coordination. Another issue highlighted was the **unequal level of participation** within groups, where some students were more active, while others were hesitant or reluctant to contribute. Despite these challenges, most students viewed the overall experience with the jigsaw strategy as **positive and beneficial**, appreciating its departure from traditional lecture-based methods. They acknowledged that it not only enhanced their academic understanding but also helped in building their **teamwork, communication, and problem-solving skills**.

These insights underscore the potential of the jigsaw method as an effective pedagogical tool when accompanied by proper planning, role assignment, and time management strategies to ensure its maximum benefit for all learners.

Discussion & Interpretation of Findings

The objectivewise discussion of findings are as follows-

Objective 1: Determine the Effect of the Jigsaw Strategy on Student Performance

The primary aim was to determine if the jigsaw technique greatly improves performance of students in "Playing with Numbers." Quantitative data revealed that the experimental group mean improved from 62.3 (pre-test) to 78.9 (post-test) compared to an increase of the control group from 63.1 to 70.2. This statistically significant gain ($t(29) = 8.12$, $p < .001$) indicates that if students are assigned particular content chunks and then made to instruct other students, they gain a more profound grasp of numerical

ideas. These results concur with prior studies that support the effectiveness of Cooperative learning methods in enhancing educational performance (Slavin, 1996; Johnson & Johnson, 1994).

Objective 2: Compare Academic Achievements Between the Jigsaw and Traditional Methods

In meeting the second goal, the research contrasted the grades of students who received jigsaw-based instruction with those who learned in conventional lecture-based classrooms. Analysis of covariance (ANCOVA) outcomes, which accounted for differences at baseline, affirmed that the treatment group performed considerably better than the control group in post-test measures ($F(1,57) = 15.67$, $p < .001$). This finding supports the conclusion that Cooperative learning, in the form of this jigsaw strategy, is better at promoting awareness of intricate mathematics concepts than are traditional teaching processes. The resulting improved academic accomplishment here corroborates previous research findings by Smith et al. (2005) that also exhibited such advantages using Cooperative learning setting.

Objective 3: Evaluate Changes in Student Engagement, Motivation, and Collaborative Skills

The third goal was to assess if the jigsaw method impacts student engagement, motivation, and collaborative ability. Qualitative information gathered through student questionnaires and classroom observations showed that the experimental group demonstrated increased engagement and a more interactive classroom interaction. The students termed the approach "fun" and "more understandable" and credited the enhanced motivation to the active role they had in learning and teaching. These findings are concrete evidence of the support for Vygotsky's (1978) social constructivist theory, in which learning is best achieved when pupils share and develop knowledge together. Moreover, the format of the jigsaw technique, demanding peer-to-peer dialogue, seems to promote not merely academic development but also collaborative and social skills (Aronson, 1978).

Overall, the analysis according to objectives reveals that the jigsaw approach in Cooperative learning substantially enhances both cognitive and affective dimensions like engagement and motivation. The enhanced performance in academics along with improved collaborative competencies highlights the importance of applying systematic Cooperative learning techniques in math education. The results are in line with a body of literature that calls for more student-centered and interactive pedagogical approaches in dealing with intricate topics like "Playing with Numbers."

Implications for Practice

The findings of this study offer several important implications for educators, curriculum planners, and school administrators:

1. **Curriculum Design Integration**
   The results suggest that the **jigsaw strategy** can be a highly effective instructional method in the mathematics classroom, as it promotes both academic achievement and the development of social skills. Therefore, curriculum designers should consider integrating cooperative learning approaches, especially the jigsaw technique, into mathematics syllabi to make learning more student-centered, interactive, and collaborative.
2. **Professional Development and Teacher Training**
   There is a need to implement **comprehensive teacher training programs** that emphasize cooperative learning strategies. Educators should be given opportunities through professional development workshops to understand the theoretical foundations and practical applications of the jigsaw method. This will enable teachers to diversify their instructional methods and better engage learners through peer-based and participatory learning models.

3. **Enhanced Classroom Engagement and Student Motivation**
   The study highlights that when students are actively involved in teaching and learning processes, as they are in the jigsaw model, their motivation and interest levels tend to increase. Teachers should be encouraged to adopt such strategies that foster **student autonomy, responsibility, and active participation**, thereby improving classroom dynamics and overall engagement.
4. **Development of Communication and Interpersonal Skills**
   The cooperative nature of the jigsaw strategy promotes **communication, teamwork, and conflict resolution skills** among students. These are essential life skills that go beyond academics. Therefore, educators must recognize the value of social interaction in learning and create structured opportunities where students can collaborate meaningfully.
5. **Reducing Academic Anxiety and Building Peer Support**
   The jigsaw approach provides a **non-threatening environment** where students feel comfortable asking questions and making mistakes. This helps in reducing mathematics anxiety and allows for **peer support systems** where stronger students assist those who are struggling, leading to improved confidence and reduced performance pressure.
6. **Inclusion and Differentiated Instruction**
   Since the jigsaw method allows students of varying abilities to work together and contribute in their own way, it supports **inclusive education**. It enables teachers to differentiate instruction effectively by assigning roles and responsibilities according to individual strengths, ensuring that all learners are actively involved and valued.
7. **Promoting Reflective Teaching Practices**
   The implementation of the jigsaw technique requires teachers to plan, observe, and reflect continuously on their instructional strategies. This can lead to the development of **reflective teaching practices**, encouraging educators to assess student responses, adapt their teaching styles, and refine their classroom management strategies.
8. **School-wide Policy and Collaborative Culture**
   The positive impact of the jigsaw strategy also calls for **institutional support**. School leaders should promote a collaborative school culture by encouraging the use of cooperative learning frameworks across subjects. Policies should be developed to support teamwork-based classroom activities and allocate time and resources for collaborative planning among teachers.
9. **Classroom Management and Equitable Participation**
   While the jigsaw strategy significantly encourages student engagement and collaborative learning, it also presents certain **classroom management challenges**, particularly in ensuring **equal participation among group members**. Some students may dominate discussions, while others may remain passive or disengaged. Therefore, it is essential for teachers to take **a proactive role in structuring group activities**. This can be achieved by clearly defining the roles and responsibilities of each group member—such as leader, recorder, timekeeper, presenter, or summarizer—so that every student has a meaningful and accountable role in the group's success. Additionally, setting clear **expectations and norms for collaboration**, monitoring group dynamics actively, and providing periodic feedback can help address issues of dominance, lack of involvement, or off-task behavior. By doing so, the teacher not only maintains discipline but also fosters an inclusive and productive learning environment where **every student contributes and benefits equally** from the cooperative learning experience.

Limitations

- The study was conducted in only one middle school, which limits the generalizability of the findings to a wider population of students from different regions and school types.
- The small sample size restricts the statistical power of the study, making it difficult to draw firm conclusions that can be applied across diverse educational contexts.
- The intervention lasted for only eight weeks, offering a short-term perspective on the impact of cooperative learning strategies. Longer studies are needed to evaluate long-term effects and sustainability.
- The pre-test and post-test tools, although designed to assess relevant mathematical concepts, lacked formal validation procedures such as pilot testing or reliability analysis, which affects the credibility of the findings.
- The study did not account for possible confounding factors such as teacher quality, classroom climate, peer influence, or parental support, all of which could significantly affect student outcomes.
- The research relied solely on quantitative data, missing the opportunity to gather valuable qualitative insights from students and teachers that could have enriched the interpretation of the results.
- There was no examination of subgroup differences among students, such as variations by gender, prior academic performance, or learning preferences, which might influence the effectiveness of cooperative learning.
- The absence of a follow-up phase means the study could not measure whether the benefits of the intervention persisted after the conclusion of the study.
- The study was limited in scope by focusing only on mathematics performance, without evaluating the impact of cooperative learning on other skills such as communication, teamwork, or problem-solving.
- The teachers implementing the cooperative learning strategy may not have received uniform or in-depth training, which could have led to inconsistencies in how the method was applied across different classrooms.

Conclusion

The study provides empirical evidence that the jigsaw strategy of Cooperative learning significantly improved the performance of students in the "Playing with Numbers" topic. Since improved test scores combined with high interest and positive peer interactions are seen here, the application of the jigsaw strategy is a valid method of instructional supplement in mathematics learning. The application of Cooperative learning methodology will be adopted and adapted by educators to improve the depth of understanding as well as the interest in the learning environment.

Recommendations for Future Research

Future studies should:

1. Increase the sample size and include participants from multiple schools across different regions to enhance the generalizability and reliability of the research findings.
2. Examine the long-term effects of Cooperative Learning methods on students' academic performance in mathematics to determine sustained benefits over time.
3. Investigate the role of teachers' attitudes, classroom management skills, and teaching styles as potential influencing factors in the effectiveness of Cooperative Learning.

4. Explore parental involvement and their perceptions of Cooperative Learning strategies, as these can significantly influence students' motivation and academic outcomes.
5. Assess the integration of educational technologies—such as interactive software, online collaborative tools, and multimedia resources—in facilitating and enriching Cooperative Learning environments.
6. Compare the outcomes of Cooperative Learning with other instructional methods such as individualized instruction, project-based learning, and traditional teaching to identify relative strengths and limitations.
7. Conduct qualitative studies (e.g., interviews, classroom observations, focus groups) to gain deeper insights into students' experiences, engagement levels, and interpersonal development within Cooperative Learning settings.
8. Evaluate the impact of Cooperative Learning on diverse learner groups, including students with special needs, low achievers, and gifted learners, to ensure inclusivity and equity.
9. Investigate the role of assessment practices in Cooperative Learning settings, especially how formative and peer assessments influence student accountability and learning outcomes.
10. Explore the effectiveness of training programs for teachers on the implementation of Cooperative Learning strategies to ensure fidelity and consistency in practice.

References

1. Aronson, E. (1978). *The jigsaw classroom*. New York, NY: Addison-Wesley.
2. Cohen, E. G. (1994). Restructuring the classroom: Conditions for productive small groups. *Review of educational research, 64*(1), 1-5. https://doi.org/10.3102/00346543064001001
3. Johnson, D. W., & Johnson, R. T. (1994). *Learning together and alone: Cooperative, competitive, and individualistic learning* (3rd ed.). Englewood Cliffs, NJ: Prentice-Hall. Retrieved September 16, 2024, from https://books.google.co.in
4. Smith, K. A., Sheppard, S. D., Johnson, D. W., & Johnson, R. T. (2005). Pedagogies of engagement: Classroom-based practices. *Journal of Engineering Education, 94*(1), 87–101. https://www.shsu.edu
5. Slavin, R. E. (1996). Research on Cooperative learning and achievement: What we know, what we need to know. *Contemporary Educational Psychology, 21*(1), 43– 69. https://doi.org/10.1006/ceps.1996.0004
6. Vygotsky, L. S. (1978). *Mind in Society: The Development of Higher Psychological Processes*. Harvard University Press. Retrieved September 16, 2024, from https://books.google.co.in