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## The effect of the Jigsaw method on learning achievement in earth and space sciences among grade X students at SMK Muhammadiyah Mataram

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**Abstract.** *This study aims to determine the effect of the Jigsaw type cooperative learning model on the learning outcomes of 10th grade students at SMK Muhammadiyah Mataram in the Earth and Space material. The study used a pre-experimental method with a One Group Pretest-Posttest design. The sample consisted of one experimental class, which was class X TKJ, with 15 students. Data were obtained through learning outcome tests (pretest and posttest) consisting of 20 multiple-choice questions, and the hypothesis test analysis using a paired t-test with the help of SPSS yielded a result of  $0.00 < 0.05$ , so  $H_a$  was accepted, meaning that there is an effect of using the Jigsaw type cooperative learning model on the science/physics learning outcomes of 10th grade students at SMK Muhammadiyah Mataram, and there is also a significant difference. The average score increased from 53.33 to 85.25 in the pretest and posttest results. Thus, the Jigsaw type cooperative learning model is proven to have an effect on improving student learning outcomes in Earth and Space material. To apply this learning model over a longer period of time or on different material characteristics to observe the consistency of the Jigsaw model's effect on improving student learning outcomes at the vocational high school level*

**Keywords:** Jigsaw Cooperative Learning Model; Learning Outcomes; Earth and Space Sciences

### INTRODUCTION

Education is a systematic effort to develop the potential of students so that they have religious spiritual strength, self-control, personality, intelligence, noble character, as well as the skills needed for themselves and society. To achieve this profile, the learning process in schools must transform from merely transferring knowledge into an interactive and collaborative learning experience (Ayu P.P. et al., 2021; Elpisah et al., 2019; Tukiyantini, 2023). The teachers no longer act as the sole source of information, but rather as facilitators who guide students toward deeper conceptual understanding.

Cooperative learning has become one of the strategic solutions in building active student engagement. Students are encouraged to interact, communicate, and promote values of cooperation and mutual respect (Ghavifekr Simin, 2020; Konkaew et al., 2025). One cooperative learning technique considered effective is the Jigsaw type. This model has a specific characteristic of positive interdependence, where each student is responsible for a certain portion of the material and is obliged to convey it to other group members (Cahyani et al., 2025; Saripudin, 2023; Meiliyadi et al., 2026; Yusni et al., 2026). The principle of peer teaching in Jigsaw is often more effective than one-way teaching by the teacher because it creates an active learning atmosphere and fosters effective communication among students (Sujono, 2019).

The implementation of the cooperative model is very relevant in the Natural and Social Sciences (IPAS) subjects, particularly in the Earth and Space Science (IPBA) material. IPBA material covers wide and dynamic aspects, including geosphere dynamics such as the lithosphere, atmosphere, hydrosphere, and up to outer space (Tahmid et al., 2023). The

characteristics of this broad material require a learning model that can connect theoretical concepts with real-life phenomena. However, the complexity of this material often leads to misconceptions if it is not delivered through the proper sequence and method (Liliawati & Ramalis, 2009).

Based on the results of observations, particularly at SMK Muhammadiyah Mataram, shows that there is a gap between the expectations of the curriculum and the reality of learning. Based on the results of initial observations, the learning process in grade X is still dominated by conventional methods (lectures) and the use of learning resources is limited to textbooks or worksheets only. This causes students to tend to be passive, unfocused, and quickly feel bored. The direct impact of this condition is the low learning outcomes of students, where many daily test scores in IPAS subjects have not yet reached the Minimum Competency Criteria (KKM). Although students' interest in learning science is relatively high, the lack of innovative methods results in learning achievements that are not optimal.

Several previous studies reinforce the urgency of using the Jigsaw model. Gusmalinda (2022) found that the implementation of Jigsaw was able to increase students' learning activities by up to 16.54% at the vocational high school level. At other educational levels, Anggraini (2019) and Rasnawati (2017) also reported significant improvements in learning achievement after applying this model. The advantage of Jigsaw lies in its ability to enhance students' sense of responsibility and critical thinking skills through expert group and home group discussions.

Based on this background, this study aims to empirically test the effect of the Jigsaw-type cooperative learning model on students' learning outcomes in Earth and Space materials. The research focus is directed at grade X at SMK Muhammadiyah Mataram for the 2025/2026 academic year as an effort to overcome learning fatigue and improve the quality of students' academic achievement in Science and Social Sciences materials.

## METHOD

This study uses a quantitative approach with a one-group pretest-posttest pre-experimental design to determine the effect of the Jigsaw type cooperative learning model on student learning outcomes. The research sample consisted of 15 students from class X TKJ SMK Muhammadiyah Mataram, selected using purposive sampling technique.

**Table 1.** Research Design

| Pretest | Treatment | Posttest |
|---------|-----------|----------|
| Q1      | X         | Q2       |

Explanation:

X = Treatment in the experimental group using the Jigsaw-type cooperative learning model.

Q1 = Pretest, an initial test to determine students' initial ability before the treatment.

Q2 = Posttest, a final test to determine learning outcomes after the treatment.

The research was conducted in the odd semester of the 2025/2026 academic year at SMK Muhammadiyah Mataram. The independent variable of the study was the Jigsaw type cooperative learning model, while the dependent variable was students' IPAS/Physics learning outcomes. Data collection was carried out using learning outcome tests in the form of pretests and posttests with multiple-choice questions. The data were analyzed using descriptive and inferential statistics. Normality testing was conducted using the Shapiro-Wilk test, while hypothesis testing was performed using the Paired Sample t-test with a significance level of 0.05 and the assistance of SPSS software.

## RESULT AND DISCUSSION

The validity test was conducted to ensure the authenticity and accuracy of the research instrument. Data analysis was performed using SPSS software with a significance level of 5% ( $\alpha = 0.05$ ) and a critical  $r_{table}$  value of 0.514. A test item is considered valid if the calculated  $r_{value}$  exceeds the  $r_{table}$  value. Conversely, if  $r_{value} < r_{table}$ , the item is declared invalid. Based on these criteria, the results demonstrate that 20 items are valid.

**Table 3.** Instrument Validity Test Results

| No. | $r_{value}$ | $r_{table}$ | Category |
|-----|-------------|-------------|----------|
| 1   | 0,524       | 0,514       | Valid    |
| 2   | 0,578       | 0,514       | Valid    |
| 3   | 0,595       | 0,514       | Valid    |
| 4   | 0,536       | 0,514       | Valid    |
| 5   | 0,562       | 0,514       | Valid    |
| 6   | 0,521       | 0,514       | Valid    |
| 7   | 0,540       | 0,514       | Valid    |
| 8   | 0,537       | 0,514       | Valid    |
| 9   | 0,526       | 0,514       | Valid    |
| 10  | 0,568       | 0,514       | Valid    |
| 11  | 0,568       | 0,514       | Valid    |
| 12  | 0,559       | 0,514       | Valid    |
| 13  | 0,562       | 0,514       | Valid    |
| 14  | 0,568       | 0,514       | Valid    |
| 15  | 0,521       | 0,514       | Valid    |
| 16  | 0,587       | 0,514       | Valid    |
| 17  | 0,521       | 0,514       | Valid    |
| 18  | 0,525       | 0,514       | Valid    |
| 19  | 0,536       | 0,514       | Valid    |
| 20  | 0,520       | 0,514       | Valid    |

Once the instrument was declared valid, the next step was to conduct a reliability test. The results revealed a Cronbach's Alpha coefficient of 0.538. This value indicates that the research instrument has a moderate level of reliability; therefore, it remains acceptable for use in the data collection phase.

This study involved 15 tenth-grade students of TKJ at SMK Muhammadiyah Mataram as an experimental class. Learning outcome data were obtained through pretest and posttest to determine the effect of implementing the Jigsaw type cooperative learning model.

**Table 3.** Descriptive Statistical Results

| Statistics | Pretest | Posttest |
|------------|---------|----------|
| Mean       | 53,33   | 82,25    |
| Max Score  | 75      | 95       |
| Min Score  | 40      | 70       |
| SD         | 12,83   | 17,18    |

The descriptive statistical results indicate an improvement in student learning outcomes following the implementation of the Jigsaw model. The mean score increased from 53.33 in the pretest to 85.25 in the posttest. Increases were also observed in the minimum and maximum scores, demonstrating that the Jigsaw model is effective in enhancing student learning outcomes (Ridwan, 2015; Ridwan & Sumadi, 2017; Umar, 2020).

Following the descriptive statistical analysis, a hypothesis test was conducted to determine the effect of the Jigsaw cooperative learning model on student learning outcomes. This stage began with the Shapiro-Wilk normality test, which revealed that both the pre-test and post-test data were normally distributed, which indicated that the data were normally distributed with a value Sig. 0,332 and 0,333, both are bigger than 0,05. After ensuring the data followed a normal distribution, a paired-sample t-test was conducted. The result, with a Sig. (2-tailed) = 0,00 < 0,05 reveals a significant difference between the students' pre-test and post-test scores. Thus, the Jigsaw cooperative learning model is empirically proven to enhance student learning outcomes.

The results of this study indicate that the implementation of the Jigsaw technique has a significant positive impact on student learning outcomes in the Natural and Social Sciences (IPAS) subject, specifically on Earth and Space science materials for tenth-grade students. This success is rooted in the unique structure of Jigsaw, which fosters positive interdependence among students (Aulia et al., 2025). In this model, each student holds a "puzzle piece" of information that is crucial to their group; consequently, they are compelled to master the material and convey it clearly to their peers (Cahyani et al., 2025; Saripudin, 2023).

This is consistent with previous research indicating that the Jigsaw-type cooperative learning model is capable of improving student learning outcomes. A study by Rukmini and

Mafaza (2022) demonstrated a significant increase in learning achievement in physics subjects following the application of the Jigsaw cooperative model. Therefore, the findings of this study provide additional empirical evidence that the Jigsaw model is a relevant instructional strategy for enhancing academic achievement. Other previous research on the Jigsaw-type cooperative model has proven it to be highly beneficial for lower secondary physics education and strongly recommends its implementation in daily school practice (Blajvaz et al., 2022).

## CONCLUSION

The implementation of the Jigsaw cooperative learning model significantly improved the learning outcomes of tenth-grade students at SMK Muhammadiyah Mataram on Earth and Space topics. Statistical results showed a significance value of  $0.00 < 0.05$ , with the experimental class's average score rising from 53,33 to 85,25. This model is effective because it promotes active collaboration, individual responsibility, and peer teaching, making the learning process more meaningful. Beyond academic achievement, Jigsaw also successfully develops students' social skills, responsibility, and mutual respect within groups.

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