



Effectiveness of Jigsaw Cooperative Learning Assisted by Augmented Reality on Pancasila Education Learning Outcomes

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ABSTRACT

Objective: Low learning outcomes in Pancasila Education are often related to teacher-centered learning and limited use of instructional technology. This study aimed to examine the effectiveness of the Jigsaw cooperative learning model assisted by Augmented Reality (AR) in improving students' learning outcomes. **Method:** The research employed a quantitative quasi-experimental design with a nonequivalent control group. A total of 52 sixth-grade students participated and were divided into experimental and control groups. Data were collected through pretest and posttest and analyzed using descriptive statistics, an independent samples t-test, and N-Gain analysis. **Results:** The findings revealed a significant difference in learning outcomes between the experimental and control groups, with a t-value of -2.917 , $df = 50$, and a significance value of 0.005 . The mean N-Gain score was 0.62 , which falls into the moderate category, indicating that the intervention was reasonably effective. **Novelty:** This study offers novelty by integrating the Jigsaw cooperative learning model with Augmented Reality in Pancasila Education, an approach that has been rarely explored. This integration provides an innovative instructional strategy that enhances learning outcomes while supporting the meaningful internalization of Pancasila values in line with 21st-century learning demands.

INTRODUCTION

Law of the Republic of Indonesia Number 20 of 2003 concerning the National Education System emphasizes that national education plays a strategic role in shaping national life and achieving national goals through the holistic development of students' potential, including aspects of faith, skills, knowledge, creativity, independence, as well as character and moral integrity. Education is not only oriented toward academic achievement but is also directed at developing democratic, responsible, and dignified citizens (Bhughe, 2022; Safitri et al., 2022). Within this framework, character education has become a central concern in formal schooling, as it supports the formation of social awareness, integrity, and respect for diversity, which are essential for sustaining national unity and civic life (Arif Rembangsupu et al., 2022; Nurgiansah, 2022).

In Indonesia, Pancasila Education serves as a foundational component of character education by promoting national values, civic responsibility, and social cohesion. However, despite its strategic role, Pancasila Education continues to face challenges related to low student engagement and suboptimal learning outcomes, particularly when instructional practices remain teacher-centered and rely heavily on conventional approaches (Martasari & Widodo, 2025; Safitri et al., 2022). These challenges have become more pronounced in the digital era, where students are increasingly accustomed to interactive and technology-enhanced learning environments (Astuti & Widodo, 2024; Sutrisno et al., 2023). Consequently, the need for instructional innovation that aligns with students' learning characteristics and contemporary educational demands has become increasingly urgent.

The implementation of the Merdeka Curriculum further reinforces the necessity of innovative instructional approaches in Pancasila Education. The curriculum emphasizes student-centered learning, contextual learning experiences, and the integration of digital technology to support meaningful learning and the development of students' cognitive, social, and affective competencies (Irawati et al., 2022; Rachmawati et al., 2022; Sutrisno et al., 2023). In this context, learning strategies that combine active participation with digital media are considered essential for enabling students to internalize Pancasila values in a more meaningful and applicable manner (Afiyah & Widodo, 2025). Recent studies have demonstrated that well-designed digital learning media can strengthen character education by providing interactive and contextual learning experiences that resonate with students' everyday lives (Adriannuh et al., 2023; Khairunnisa et al., 2023). However, learning in Pancasila Education still often encounters challenges, particularly in helping students understand and apply abstract moral values in real-life contexts.

One technological innovation that has gained increasing attention in educational research is Augmented Reality (AR). Augmented Reality has been widely reported to enhance learning quality by presenting interactive and contextual visual information that supports students' understanding of abstract concepts (Kaharuddin et al., 2023; Meilindawati et al., 2023). In value-based subjects such as Pancasila Education, where concepts such as norms, rights, obligations, and national values are often presented in abstract forms, AR can help transform these concepts into more concrete and contextual learning experiences. Empirical studies indicate that AR can significantly improve student engagement, learning motivation, and conceptual understanding across various educational levels (Indriani & Abidin, 2022). Therefore, the integration of AR in Pancasila Education is considered relevant to address the challenge of making value-based learning more interactive, contextual, and meaningful for students.

In parallel, cooperative learning models, particularly the Jigsaw model, have consistently been shown to improve learning outcomes, collaboration skills, individual accountability, and active participation through structured group-based learning (Alfiyah & Widiyono, 2024; Kristanti & Mukti, 2022; Mubayinah, 2023). The Jigsaw model promotes positive interdependence and peer teaching, creating an active and collaborative learning environment that enhances students' conceptual understanding and social interaction (Adijaya et al., 2023; Purwaningtyas et al., 2022). Recent studies further suggest that integrating cooperative learning with digital technology can strengthen instructional effectiveness by combining social interaction with interactive learning media (Carolina, 2022; Harefa et al., 2022; Rizali Rachim & Salim, 2024).

Despite the growing body of research on the Jigsaw cooperative learning model and the use of Augmented Reality as separate instructional approaches, empirical studies that integrate both methods in the context of Pancasila Education remain limited. Most previous research has focused on science, technology, and mathematics subjects, with relatively little attention given to character education and national values-based learning (Mubayinah, 2023; Wilsa et al., 2023). Furthermore, studies examining the effectiveness of Jigsaw learning assisted by Augmented Reality in Pancasila Education, particularly at the primary education level, are still scarce. This gap highlights the need for further empirical investigation to explore how the integration of cooperative learning models and immersive digital technology can enhance learning outcomes in Pancasila Education.

Therefore, this study aims to examine the effectiveness of implementing the Jigsaw cooperative learning model assisted by Augmented Reality media in improving students' learning outcomes in Pancasila Education. Specifically, this study seeks to determine whether the integration of Jigsaw learning and Augmented Reality leads to significantly higher learning outcomes compared to conventional instructional methods. By addressing this research gap, the study offers novelty through the combined application of cooperative learning and immersive technology in Pancasila Education, contributing empirical evidence to the development of innovative, student-centered instructional strategies that support both academic achievement and the meaningful internalization of Pancasila values in line with 21st-century educational demands.

RESEARCH METHOD

This study employed a quantitative approach using a quasi-experimental design, specifically the nonequivalent control group design. This design was selected because the researcher was unable to conduct full randomization of participants, as class assignments had already been determined by the school. The nonequivalent control group design is capable of providing empirical evidence that supports the relationship between the treatment (intervention) and the outcome (learning outcomes), while also reflecting real-world conditions in which certain variables cannot be fully controlled (K. Khairunnisa et al., 2023). The study involved two groups, namely an experimental group and a control group, each of which was administered a pretest and a posttest to identify differences in learning outcomes after the implementation of the treatment (Sugiyono, 2023). The research procedure was carried out through several stages, including the preparation stage, the implementation stage, and the final stage.

The study began with the identification of the population, which consisted of sixth-grade students at SD Negeri Wonotingal. The sample was then selected using purposive sampling techniques. Class VI A was assigned as the experimental group and Class VI B as the control group based on the school's class organization and the similarity of students' academic characteristics, as indicated by comparable previous academic performance. The research sample was divided into two groups, namely the experimental group (Class VI A) and the control group (Class VI B). Both groups were administered a pretest to determine students' initial abilities prior to the implementation of the treatment. Subsequently, the experimental group received Jigsaw cooperative learning assisted by Augmented Reality media, while the control group was taught using conventional learning methods. After the treatment was implemented, both groups were given a posttest to measure students' learning outcomes. The collected data were then analyzed using a normality test, a homogeneity test, an independent samples t-test, and N-Gain analysis to determine the improvement in learning outcomes.

The experimental group was taught using the Jigsaw cooperative learning model assisted by Augmented Reality, whereas the control group received instruction through conventional teaching methods. In the initial stage, the teacher presented the learning objectives and core materials of Pancasila Education and provided apperception activities to connect the learning content with students' everyday experiences. The teacher then divided the students into home groups consisting of members with heterogeneous academic abilities. Subsequently, each member of the home group was assigned a different portion of the learning material to be studied in depth. Students who were assigned the same material then gathered in expert groups.

At this stage, marker-based Augmented Reality (AR) media were implemented using the Assemblr Edu application. The AR content was accessed through printed image markers embedded in students' learning worksheets. When the markers were scanned using smartphone cameras, three-dimensional (3D) visualizations appeared on the device screen. Each student in the experimental group used a personal smartphone to access the AR content, ensuring that every learner could independently explore the assigned material. In cases where a limited number of devices occurred, students were allowed to share smartphones within small subgroups while maintaining individual responsibility for understanding and explaining their assigned topic. The AR materials presented Pancasila Education content related to norms, rights, and obligations through short contextual narratives. In these scenarios, 3D characters illustrated everyday situations that represent the application of social norms in daily life. Students interacted with the AR content by tapping the 3D characters, which activated audio dialogues explaining appropriate behaviors based on the values being studied. This interactive feature enabled students to explore contextual representations of abstract moral concepts through integrated visual and auditory elements. The use of AR was intended to support conceptual understanding and enhance students' engagement during group discussions in the expert group stage of the Jigsaw learning process.

After completing discussions in the expert groups, students returned to their respective home groups to share and discuss the material they had learned. This process encouraged active interaction, collaboration, and individual responsibility within the group. The teacher acted as a facilitator by monitoring group discussions, providing feedback, and clarifying misconceptions when necessary. In the final stage of the lesson, the teacher and students conducted a reflection on the learning content and related it to Pancasila values in everyday life. The learning session was concluded with a summary and reinforcement of the material. Meanwhile, the control group received instruction using conventional teaching methods that were teacher-centered, without the use of Augmented Reality media and without the implementation of the Jigsaw cooperative learning model.

The research was conducted under real classroom learning conditions to maintain the naturalness of the instructional process. The pretest was used to examine the equivalence of initial abilities between the two groups, while the posttest was used to measure students' learning outcomes after the implementation of the treatment (Nayeri et al., 2024). Data collection was carried out using a Pancasila Education learning outcomes test instrument developed based on learning competency indicators (Abraham & Supriyati, 2022; Lestari et al., 2023). The research instrument was subjected to validity and reliability testing prior to its use. The data obtained were analyzed using quantitative statistical techniques to determine the effect of the Jigsaw cooperative learning model assisted by Augmented Reality on students' learning outcomes.

RESULTS AND DISCUSSION

Results

This study involved sixth-grade students at SD Negeri Wonotingal, Semarang City, totaling 52 students who were divided into two groups. A total of 26 students in the experimental group participated in Pancasila Education learning using the Jigsaw

cooperative learning model assisted by Augmented Reality media, while 26 students in the control group received instruction using conventional learning methods.

Tabel 1. Descriptive Analysis Test of Learning Outcomes

Group	Test	N	Mean	Standard Deviation	Minimum	Maximum
Control	Pre-Test	26	56,38	11,07	40	76
Control	Post-Test	26	79,23	7,44	64	94
Experiment	Pre-Test	26	62,85	8,82	46	76
Experiment	Post-Test	26	85,69	8,50	70	100

The results of the descriptive statistical analysis indicate differences in learning outcomes between the two groups. At the pretest stage, the experimental group obtained a mean learning outcome score of 62.85 with a standard deviation of 8.82, while the control group recorded a mean score of 56.38 with a standard deviation of 11.07. After the treatment was implemented, the mean posttest score of the experimental group increased to 85.69 with a standard deviation of 8.50, whereas the control group achieved a mean score of 79.23 with a standard deviation of 7.44. These results indicate that the improvement in learning outcomes in the experimental group was higher than that in the control group.

Table 2. Normality test of learning outcomes

Normality Test (Shapiro-Wilk)		
	Statistic	Sig.
Pre-Test Control Group	0,935	0,103
Post-Test Control Group	0,941	0,144
Pre-Test Experiment Group	0,931	0,080
Post-Test Experiment Group	0,941	0,145

The normality test was conducted using the Shapiro–Wilk test to determine whether the data were normally distributed. The results indicated that the significance values (Sig.) for both the pretest and posttest data of the control group and the experimental group were all greater than 0.05. Therefore, the data distributions for both groups met the assumption of normality.

Tabel 3. Homogeneity test of learning outcomes

	Lavene Statistic	df1	df2	Sig.
Based on Mean	0,835	1	50	0,365

A significance value of 0.365 (based on the mean) was obtained. This significance value is greater than 0.05, indicating that the variances of the data between groups are homogeneous. Thus, the research data meet the assumption of homogeneity.

Table 4. Independent Sample T-Test of Learning Outcomes

	t	df	Sig. (2-tailed)	Mean Difference	SE Difference
Post-Test	-2.917	50	0,005	-6.462	2.215

Hypothesis testing was conducted using the Independent Samples t-test to determine differences in mean learning outcomes between the experimental group and the control group. The results showed a t-value of -2.917 with $df = 50$ and a significance value (Sig. 2-tailed) of 0.005. Since the significance value is less than 0.05, the results indicate that there is a significant difference in learning outcomes between the experimental and control groups. The mean difference value of -6.462 indicates that the mean learning outcome of the experimental group was higher than that of the control group.

Table 5. Descriptive Statistic N-Gain of Learning Outcomes

Descriptive Statistic N-Gain of Learning Outcomes				
	Minimum	Maximum	Mean	Standard Deviation
N-Gain Score	0,25	1,00	0,6184	0,21536
N-Gain Persen	25.00	100.00	61.8437	21,53628

Based on the analysis results, the mean N-Gain value was 0.62, with a minimum value of 0.25 and a maximum value of 1.00, and a standard deviation of 0.22. According to the N-Gain classification proposed by Richard R. Hake, where gain scores are categorized as high ($g \geq 0.70$), moderate ($0.30 \leq g < 0.70$), and low ($g < 0.30$), the obtained mean value falls into the moderate category, indicating that the implemented treatment was moderately effective in improving students' learning outcomes.

Although the N-Gain analysis in this study focuses on the experimental group, the comparison of learning improvement between groups can be observed from the posttest mean scores and the results of the Independent Samples t-test, which show that the experimental group achieved significantly higher learning outcomes than the control group. This suggests that the experimental treatment contributed to greater learning improvement compared to conventional instruction.

Discussion

The findings of this study demonstrate that the implementation of the Jigsaw cooperative learning model assisted by Augmented Reality (AR) resulted in significantly higher learning outcomes compared to conventional instruction. This conclusion is supported by the results of the Independent Samples t-test, which showed a significance value below 0.05, indicating a statistically significant difference between the experimental and control groups. These results suggest that a structured, student-centered learning approach that integrates cooperative learning and digital technology can enhance students' academic achievement in Pancasila Education.

The moderate N-Gain value (0.62) obtained in this study indicates that the applied instructional intervention was reasonably effective in improving students' learning outcomes. According to the N-Gain classification proposed by Richard R. Hake, this value falls within the moderate category. Although several previous studies on Augmented Reality in education have reported higher effectiveness levels, the moderate improvement observed in this study can be interpreted within the context of authentic classroom implementation. Unlike controlled experimental environments often used in AR studies, this research was conducted under real classroom conditions with limited intervention duration and varying levels of students' technological familiarity. These contextual factors may influence the magnitude of learning gains while still demonstrating meaningful improvements in students' understanding of Pancasila Education concepts. This finding suggests that while AR-supported cooperative learning has strong potential, its effectiveness may depend on instructional duration, technological readiness, and the nature of the learning content.

The significant improvement in the experimental group can be explained by the characteristics of the Jigsaw cooperative learning model, which emphasizes active participation, peer teaching, and shared responsibility. Through this model, students are encouraged to actively construct knowledge by explaining learning materials to peers, which strengthens conceptual understanding and retention. This explanation is consistent with previous studies reporting that Jigsaw-based instruction enhances

student engagement, collaboration, and deeper understanding of learning content (ELSAYED, 2022; Farida & Suyanto, 2023; Rashed et al., 2023). The cooperative structure also creates a supportive learning environment that promotes positive interdependence and individual accountability.

The integration of Augmented Reality further enhanced the effectiveness of the Jigsaw model by providing immersive and contextual learning experiences that support the peer-teaching process within the cooperative structure. In the Jigsaw model, students first study specific subtopics in expert groups and are later responsible for explaining the material to their peers in the home group. Augmented Reality supports this process by providing clear visual and contextual representations of the learning content, enabling students to better understand the material during the expert group discussion. As a result, students are better prepared to communicate and explain the concepts to their peers when they return to their home groups. This visualization is particularly beneficial in Pancasila Education, where concepts such as norms, rights, and obligations are often abstract for primary school students. By transforming these concepts into interactive and contextual visual scenarios, AR facilitates deeper conceptual understanding and strengthens the effectiveness of peer explanation within the Jigsaw learning process. This finding aligns with previous research indicating that AR-based learning environments can improve conceptual understanding and learning motivation through interactive visual representations (Febrianto & Aeni, 2024; Tetep et al., 2023). Visual representations provided by AR may also reduce cognitive load during explanation, allowing students to focus more on collaborative knowledge construction during peer-learning activities.

Beyond cognitive outcomes, the integration of cooperative learning and AR also has important implications for character education. The collaborative nature of the Jigsaw model fosters social interaction, mutual respect, and responsibility among students, while AR supports the contextualization of Pancasila values in everyday life situations. These learning conditions support the internalization of values rather than mere knowledge acquisition. This result is consistent with studies highlighting the role of interactive and contextual learning media in strengthening character education and social behavior (Bachrudin & Kasriman, 2022; Ningrum et al., 2023).

The findings of this study are particularly relevant within the context of the Merdeka Curriculum, which emphasizes student-centered learning and the development of the Pancasila Student Profile. The results indicate that innovative instructional strategies integrating cooperative learning and digital technology can support curriculum goals by fostering critical thinking, collaboration, and character development. Therefore, the Jigsaw cooperative learning model assisted by Augmented Reality can be considered a promising instructional alternative for Pancasila Education at the primary school level.

Despite these positive findings, this study has several limitations that should be considered. The moderate level of learning improvement suggests that factors such as duration of intervention, teacher familiarity with AR technology, and students' initial technological literacy may influence the effectiveness of the instructional model. Future research is recommended to explore longer implementation periods, different educational levels, and variations in AR content design to further enhance learning outcomes. Additionally, future studies may examine the impact of this instructional approach on affective and behavioral outcomes to provide a more comprehensive understanding of its effectiveness in character education.

CONCLUSION

Fundamental Finding : This study confirms that the integration of the Jigsaw cooperative learning model assisted by Augmented Reality significantly improves students' learning outcomes in Pancasila Education compared to conventional instruction. The significant statistical results and the moderate N-Gain value indicate that student-centered and technology-supported learning approaches are effective in enhancing academic achievement while facilitating more meaningful learning experiences. **Implication :** The findings provide practical implications for classroom practitioners, particularly teachers implementing the Merdeka Curriculum. Teachers can apply the Jigsaw cooperative learning structure by organizing students into home groups and expert groups, where each student is responsible for mastering and explaining a specific subtopic to their peers. Augmented Reality can be integrated during the expert group phase to help students explore learning materials through interactive visualizations, especially when studying abstract topics such as norms, rights, and obligations in Pancasila Education. By using simple mobile devices and AR-based learning media, teachers can create contextual learning scenarios that illustrate real-life examples of Pancasila values. One specific value that was successfully internalized is the value of responsibility, as reflected in students' ability to understand and demonstrate appropriate behaviors related to fulfilling their obligations in everyday life. Through the AR-based scenarios, students were exposed to contextual situations that required them to identify responsible actions, such as obeying classroom rules and completing assigned tasks. This approach not only supports students' conceptual understanding but also encourages collaboration, active participation, and the contextual internalization of civic values in everyday life. **Limitation :** However, this study is limited by its relatively short intervention period and its focus on a single school context, which may affect the generalizability of the findings. **Future Research :** Therefore, future research is recommended to investigate the long-term effects of this instructional approach across different educational levels, explore variations in Augmented Reality content design, and examine its impact on affective and behavioral learning outcomes to further optimize the effectiveness of Pancasila Education learning. Future studies are also encouraged to measure students' initial technological literacy prior to the implementation of AR-based learning, for example by using digital literacy assessment instruments or technology readiness questionnaires. Such measurements would enable researchers to examine whether students' technological familiarity moderates the effectiveness of AR-assisted cooperative learning environments.

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