Majumdar, R. et al. (Eds.) (2025). Proceedings of the 1st International Conference on Learning Evidence and Analytics. Asia-Pacific Society for Computers in Education

Rethinking Jigsaw Method with Partially Engaged AI

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Abstract: The Jigsaw method is a collaborative learning approach that benefits students' accountability and teamwork achievement. However, the Jigsaw method causes students' cognitive overload, as the participants need to engage in both the expert group and the home group, and have to deal with different tasks. In this study, we propose an AI partially engaged strategy in which AI plays a role as a professional peer for responding to specific questions and constructing knowledge with students in the expert group. This study was conducted in a course with 38 university students, and the results indicate that students constructed related knowledge by showing significantly higher post-test results than the pre-test. This result suggests that in future developments of this topic, quantitative analysis of students' cognitive load can be conducted.

Keywords: Jigsaw method, collaborative learning

1. Introduction

Generative Artificial Intelligence (GenAI) has become an indispensable role in driving social and technological progress today, and we use the high-quality, efficient, and innovative characteristics of GenAI to propose more diverse solutions, redefine the way we create, execute, and solve problems, and take healthcare, engineering, art, finance, education (Cao et al., 2023), and other fields to higher levels. The function of GenAI is not only to assist teachers in grading, but also to analyze students' feedback after workshop through the results of GenAI grading combined with students' data in the learning process, and at the same time to analyze students' feedback after workshop, we can use GenAI to generate new data based on it (such as the knowledge generated by GPT) and the original data in the classroom to create a more effective and more relevant learning map to the needs of students. In addition, the data is then fine-tuned to improve the effectiveness of the grading mechanism so that teachers, students, and GenAI complement each other to create a better and more complete learning environment (Chiu, 2024).

In this study, we observed that AI might play an important role in a collaborative learning activity: the Jigsaw Method (Aronson, 1978). First, typical jigsaw method divides learning activities into two stages. Students will join the expert group, and learn specific knowledge with one another in the first stage. Afterward, students will return to their home groups and solve one challenge by combining the deliverables from different members. Typically, students will feel cognitive overload as individuals have to move between different groups (Sharma et al., 2025; Vives et al., 2025), results in low learning outcome accordingly. The reason we propose AI might be critical because we'd like to use AI, such as: ChatGPT, or any other large-language models join the expert group, as a peer learning with student. The strategy is different from the conventional jigsaw method as students will construct the specific knowledge with an expert, instead of a peer who might not on the same track. In this step, AI is only partially engaged the jigsaw activity and we have to evaluate the students' cognitive load by measuring students' learning outcome. To that end, we define the research questions as followings: **Is the workshop that collaborates with GenAI effective for students' learning outcomes?**

2. Methodology

2.1 Participants

The participants in this study consisted of 38 university students. Participants' backgrounds are related to literary history and administration, and the primary courses they take are related to culture and multimedia. Participants' ages range from 18 to 19 years. Participants are assigned into 10 groups of 3 to 4 people. To avoid the participants' prior knowledge affecting our experiment, specifically Plato's "Allegory of the Cave" as the subject for this workshop.

2.2 Experiment Process

The experiment was conducted as a workshop designed to guide participants through a series of learning activities focused on Plato's Allegory of the Cave. The session began with an opening segment, where students were introduced to the workshop format and randomly assigned to discussion groups by using ChatGPT. Each participant received a randomly assigned number, and ChatGPT was used to divide them into ten groups by using the prompt, "Please randomly divide numbers 1-38 into ten groups.

Following the grouping process, a pre-test was administrated to estimate prior knowledge of Plato's Allegory of the Cave. A brief introduction to the Allegory was provided before the participants completed a ten-question test. After the pre-test, ChatGPT was used to generate ten open-ended discussion questions related to the allegory, using the prompt, "Please give me ten open-ended questions about Plato's Allegory of Cave. " The questions were reordered with the first question asking the first group to introduce a complete story and the last group to deliver a summary, each group was assigned a specific question.

During the group discussion phase, participants were collaborating within their assigned groups, using ChatGPT-based chatbot as a supplementary tool to explore their respective questions. The responses were compiled and organized into a shared document using collaborative presentation software. The interaction of the participants and the chatbot was also collected in a prepared database. This was followed by a group presentation, where each group presented their findings and answers to the questions. The instructor led the discussions to reinforce the key concepts.

Figure 1. Experiment procedure

3. Result and Discussion

The workshop was designed to incorporate AI in facilitating discussion, generating questions, and assisting with summarization. Participants were randomly assigned to groups and engaged in collaborative learning tasks focused on Plato's Allegory of the Cave. Their understanding was estimated by a pre-test/post-test activity, with both tests containing ten questions to evaluate their comprehension before and after the workshop.

Table 1. *Summary of Pre-test and Post-test Results*

	N	Mean	SD	t
Pre-test	38	50.98	18.41	3.15**
Post-test	38	62.20	15.25	

**p<.01

Table 1 indicates the result of the statistical analysis comparing the pre-test and post-test scores. In the pre-test, the participants averaged 50.98 with a standard deviation of 18.41. In the post-test, the average score increased to 62.20, with a standard deviation of 15.25. The t-value shows the result of 3.15 and $p < .01$, which means that the difference between the pre-test and the post-test scores is statistically significant. Moreover, Cohen's d was calculated as 0.66, indicating a moderate-to-large effect size and suggesting that the AI-assisted learning process contributed meaningfully to students' conceptual understanding.

These results suggest that the learning activities with collaborative AI-assisted effectively enhanced participants' comprehension. Before the workshop, most of the participants lacked familiarity with Plato's Allegory of the Cave. However, participants gain knowledge through structured discussions by facilitating GenAI, AI-generated question assignments, and guided summarization tasks. The ability of GenAI to provide structured prompts, reduce reflection, and support group discussions played a crucial role in deepening engagement. The results indicate that AI-assisted activities not only helped students understand the allegory but also demonstrated the potential of GenAI as a valuable educational tool for interdisciplinary learning. All things considered, the findings confirm that AI-assisted learning strategies contribute to participants' improvement effectively, especially in subjects that involve abstract reasoning and conceptual understanding. The integration of GenAI enabled participants to engage with complex ideas in a more interactive and structured way, resulting in significant knowledge gains. The use of AI-assisted learning activities helps participants make major progress, demonstrating that collaborating with AI can be an effective strategy for improving learning outcomes.

4. Conclusion

GenAI or Artificial General Intelligence can support humans' routine tasks. Grading students' learning performance by their course summary is one example. This study applied a machine learning approach, or a large language model approach, to generate course summaries according to students' summaries and used an embedding model to quantify a student's learning performance by calculating the similarity between summaries. Even though the data in this study was collected from a practical learning environment, specifically, from a course where every student shows their final score ware, where students' participants are listed. However, the results still show no difference. This possibility causes this issue because the summary generated by the large language model may not contain the delivered information during the course. Or the design of the embedding model. Therefore, future work for this study is to generate new requirements, and we can continue this study by re-starting with a new type of data.

Acknowledgements

This work was supported by National Science and Technology Council, Taiwan under grants 113-2410-H-004-035- and 113-2410-H-007 -106 -MY2.

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