

Technology Enhanced Jigsaw Activity Design for Active Reading in English

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Abstract— Jigsaw learning is one of the popular cooperative learning methods which has been utilized in many English as Foreign Language (EFL) classrooms. In recent years, utilization of technology in education has accelerated. In this study, Jigsaw+, a new jigsaw learning approach with an e-book reader, was proposed to explore how the learning design can be applied for English vocabulary acquisition, reading comprehension, and students' engagement in group activities. A quasi-experimental study was conducted at a high school in Japan for advanced and standard class students. Participants read and comprehend a story in English through BookRoll, an e-book platform with an analysis tool embedded. Two research questions were investigated; 1) to what extent did Jigsaw+ affect students' English vocabulary knowledge and reading comprehension? and 2) to what extent did Jigsaw+ promote students' reading engagement in the jigsaw group activities? The results revealed that Jigsaw+ learning tasks assisted to improve students' vocabulary and reading comprehension for both the advanced and standard groups. Moreover, it facilitated students' engagements in activities. Some limitations of the study are also discussed.

Keywords—jigsaw learning, active reading strategy, cooperative learning, learning log

I. INTRODUCTION AND BACKGROUND

As we have been facing a critical transition in educational history due to the promotion of technologies in education, many teachers have been trying to seek effective teaching methods by taking advantage of using technologies. Cooperative learning is a potent learning strategy in which learners attempt to utilize both individual and social skills to accomplish the same learning tasks in a group. Jigsaw learning is one of the cooperative learning strategies, originally designed by Aronson [1], which not only aims to promote learning and leads students to actively participate in activities, but also enables students to boost their individual responsibility through the activities. Following the technique,

students are divided into groups and each student is given a part of a topic to be its expert. By working together, they construct a complete subject in a whole group. The effects of jigsaw techniques have attracted many stakeholders in educational fields as research subjects. Aronson's design of jigsaw learning has been favorably applied in many language learning classrooms and previous literature reported at least three main modified styles of the technique over the years: Jigsaw II developed by Slavin (1987), Jigsaw III developed by Stahl (1994), and Jigsaw IV developed by Holliday (2000) (not including reverse and subject jigsaw techniques).

While cooperative learning is popular for language learning, active reading strategy such as SQ4R (an extended version of SQ3R developed by Robinson [1]) is also common and favorably introduced in language classrooms. It is categorized into six phases as below:

- Survey: Grasp the overview of the text
- Question: Ask questions to themselves
- Read: Read the text
- Record: Take notes or write annotations
- Recite: Read aloud or recite the contents in their own words
- Review: Review and confirm what they have read

Since the existing jigsaw methods neither explored much technology affordances to conduct the activity nor its effectiveness has not been much verified by using log data while using the technology platform, we propose Jigsaw+ as a new version of jigsaw learning which incorporates active reading strategies in the tasks by using an e-book platform, BookRoll. Two research questions are as followed:

Q1: To what extent did Jigsaw+ affect a student's English vocabulary knowledge and reading comprehension?

Q2: To what extent did Jigsaw+ promote students' reading engagement in the jigsaw group activities?

II. JIGSAW+ LEARNING DESIGN

A. Technology enhanced learning environment

Bookroll was used as the main environment for conducting the Jigsaw+ learning activity. It is an e-book reader which can be viewed on devices with web browsers from anywhere and anytime [6]. It provides features such as a yellow and a red marker, a memo and a dictionary. DicoDico is a smart dictionary embedded in BookRoll [7]. Learners can use the yellow marker to highlight unknown words and the red marker for main or important ideas. By clicking a memo icon, learners can type or sketch their annotations on a particular page. Interactions in BookRoll such as annotations (markers and memos) and DicoDico (words searched and its context) are recorded as learning logs and visualised in a learning analytics dashboard in near real time. The vocabulary lookup allows us to have a look at students' dictionary use during a given period of time in ranking formats. A group formation system in the analysis tool enables teachers to choose the means to form groups, either automatic, or by setting grouping parameters. The system assists creating homogeneous, heterogeneous, or random grouping based on the students learning logs that are available in the parameterised grouping feature [8].

The above set of tools were used to orchestrate the Jigsaw+ activity which is described next.

B. Jigsaw+ Procedure

The basic procedure of Jigsaw+ student activities with type of platforms and SQ4R tasks are illustrated in Table 1.

1. Contents prediction: A learning material was created by compiling the pictures from the textbook put in order of the flow of the story. First, students looked at the title and the pictures to guess the contents of the story. Then they were asked to type their predictions in a memo and shared them in pairs. They could leave questions about the contents if any.

2. Jigsaw pre-activity: Students were divided into four groups which were formed by using the group formation system linked to the analysis tool. Each member of a group then read their own reading part in BookRoll individually. As they read, they could use a yellow marker to highlight unknown words and a red marker to highlight important or main parts of the reading. DicoDico dictionary was used to look up unknown words. The students were asked to leave memos in case they have any questions or want to take notes.

3. Jigsaw expert activity: Students moved to each expert group respectively. In each expert group, they had the same reading part and talked about their reading to confirm the contents. They answered four comprehension questions about their reading part in BookRoll, and typed their answers in a memo. At the end, a summary of their part was typed in English in a memo individually.

4. Jigsaw activity: Students moved back to their original group as in jigsaw pre-activity. In the jigsaw activity group, first they were asked to review the contents of their part by looking at their memos and answering questions in BookRoll to reconfirm their understanding. Those questions were similar to the ones done for the jigsaw expert activity. Main activity of this phase was to explain the contents of their part to other group members, and guess the flow of the story as a group. After confirming the whole story as a group, students were asked to type a summary of the whole story in the memo.

5. Review and evaluation: Students were asked to take a listening activity for better comprehension of the whole story.

TABLE 1. Jigsaw+ student activity procedure

Jigsaw+ Phase	Platform	SQ4R task
1. Content prediction	BookRoll using memo	Survey / (Question)
2. Jigsaw pre-activity	BookRoll using markers, DicoDico and memo	Question/Read/Record/
3. Jigsaw expert activity	BookRoll using memo	Read/Recite/Record
4. Jigsaw activity	BookRoll using memo	Read/Recite/Review
5. Review and Evaluation	In-class listening activity	Review

III. RESEARCH STUDY

The study was conducted in public high school in Japan. Based on their previous academic records, 62 participants were divided in two levels for their English class: standard (n=26) and advanced (n=36). Jigsaw+ activities were conducted over two days. On the first day the students were divided into groups and conducted their individual reading portion in the pre-jigsaw phase. The next day they conducted the rest of the Jigsaw phases. Each class is 50 minutes long.

Log data from BookRoll contained students' reading interactions and annotations during the different phases of the activity. From Moodle, the pre and post quiz scores were extracted as an English performance indicator. The purpose of the pre quiz was to form groups for jigsaw+ activities and evaluate the differences between pre and post quiz in terms of student's performance. There were ten multiple choice questions for each quiz. For the post quiz, vocabularies which students understood well on the pre quiz and did not mark or search during the jigsaw pre activity were removed, but the most searched words by DicoDico were added and remained; seven words were tested again and three new words were added on the post quiz. Normalized gain was used to assess students' performance in pre and post quiz in terms of English vocabulary. Two statistical independent t-tests were also conducted to measure whether the advanced and the standard classes were different from each other on the quiz scores.

To answer RQ1 for vocabularies, the quiz scores were analyzed. The scores improved significantly from pre to post quiz ($p < 0.001$) for both the advanced and standard group (see Figure 1).

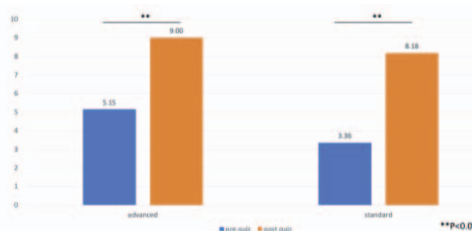


Figure. 1 Distribution of pre and post quiz score.

The average normalized gain score for the standard class was 69% which was in the *high average range*, while the one for the advanced class was 78% which was in the *high criteria* (see Table 2). It indicates that some of the active reading strategies of SQ4R were effective for promoting vocabulary learning. Comparing the normalized gain between the standard and the advanced group it was not significantly different ($p=0.11$) which is interpreted as the strategy didn't have a different effect on the advanced and standard group and both of their scores improved.

TABLE2. Normalized gain between pre and post quiz

Normalized gain score	Criteria*	Adv. # (%)	Stand. # (%)
Average gain		0.78	0.69
0.70<g<1.00	High	27 (79)	12 (54)
0.30<g<0.70	Average	5 (15)	9 (41)
0.00<g<0.30	Low	0	0
g=0.00	Stable	2 (6)	1 (5)
-1.00<g<0.00	Decrease	0	0

*(Hake, 1998[9])

Students' summaries in memos were examined by an English teacher to confirm how much they understood the contents. The total of 53 students (standard =21, advanced =32) wrote their expert-summaries. The whole summaries were written as a group, but some students wrote their summary individually (standard = 6, advanced = 9). It was observed from their summaries that they understood the contents, especially their expert part well.

To answer RQ2 related to the students' engagement, the feedback panel and real-time graph in the analysis tool were examined. Feedback panel shows the aspects of students' engagement such as browsing time, browsing achievement rate, the number of operations, the number of yellow and red markers, and memos used. The real-time graph shows the number of the students browsing per page per minute. The interface of the real-time graph is shown in Figure 2 as an example. Both the feedback panel and the real-time graph enable the teacher to visualize the students' engagement in reading activities.

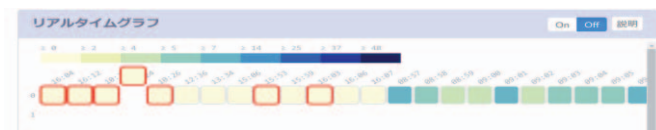


Figure. 2 Real time graph.

IV. DISCUSSION AND CONCLUSION

For this study, a quasi-experimental method was employed to investigate the effects of Jigsaw+ learning design for English reading skills and students' engagement in the reading activities. Overall, it was revealed that the designed techniques

enhanced students' vocabulary and comprehension, and promoted their engagement in the activities.

However, there are some limitations to be concerned. Overall, the number of the participants was not large enough, so as the length of the time spent on the study, to conclude the effectiveness of the learning design. However, it still sheds light on the focus of this study that two different level groups did not have significantly different effects due to the same Jigsaw+ learning activities and improved their performance and promoted engagement. We acknowledge that a different study design with a control group would be needed.

Verifying effectiveness of each active reading phase could not be measured properly. A question remains which type(s) of active reading strategies was/were the most effective in terms of vocabulary acquisition and reading comprehension. Rather, all methods appeared to be worked together to enhance the learning.

On the technology front we will continue to work with the participants and facilitate adoption of our learning analytics enhanced tools to study the influence of the specific implementation of group based active reading strategy on improving students' English skills in the long term.

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