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Creativity development through questioning activity in second language education

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Introduction: Creativity is an important 21st-century skill that also plays an important role in second language use and development. This study examined the effects of creative pedagogy centered on student questioning activities for second language learners' creativity, language proficiency, and questioning ability.

Methods: In the Japanese second language course, a creative activity intervention involving questioning activities was conducted for 81 university students. The students were taught how to ask higher-order questions, and they performed questioning activities and discussions about their questions after reading articles for eight lectures in 4 weeks.

Results: After the intervention, the quantity and quality of questions asked by participants increased and improved in the Questioning ability test. In the Creative thinking test, the three subscales of creative thinking (fluency, flexibility, and originality) improved after the intervention. In the Language proficiency test, there were also significant changes in vocabulary, grammar, and total scores after the intervention compared to before the intervention.

Discussion: The creative pedagogy significantly improved learners' creativity, second language performance, and questioning ability, with a particularly positive impact on questioning ability, representing innovative thinking skills. The findings of this study not only contribute to future research on the development of creativity in second language instruction and deepen the exploration of the development of questioning ability for innovative thinking skills.

KEYWORDS

creative pedagogy, questioning activities, creativity, second language, language proficiency

1. Introduction

Creativity is an important 21st-century skill that is key to success in work and life in modern society (Pásztor et al., 2015). Its importance has been recognized in many fields (Liao et al., 2018; Glăveanu and Kaufman, 2019). Given the important role that creativity plays, many areas of the curriculum have begun to focus on creativity development, including second language courses. In second language education, it is important to foster student creativity for two main reasons. First, the increasing global development needs for talent with 21st-century skills have prompted schools to adjust the education structure and strengthen the cultivation of students' creativity (Li, 2016). Second, creativity plays an important role in the use and development of second language (Jones, 2016). In the second language learning process, language internalization cannot be achieved simply through memorization and recall in abstract form but also through the learner's creative and critical analysis and evaluation of language learning materials (Li, 2016).

Thus, creativity may be a key point for second language learners. Therefore, developing creativity and creative thinking has become an important goal of second language education.

However, compared with other types of thinking skills, such as critical thinking and metacognition (Li, 2016), there is still a relatively small amount of second language research focusing on creative thinking (Dörnyei, 2014; Fernández-Fontecha, 2021; Fernández-Fontecha and Kenett, 2022). In particular, few studies have investigated the extent to which creative pedagogy has an impact on second language learners (Liao et al., 2018). Thus, it is necessary to explore how effective creative teaching can be implemented in second language classrooms to stimulate learners' creativity and facilitate learning the target language.

Question generation is a common cognitive activity used in teaching and learning to improve students' engagement (Salmon and Barrera, 2021), and other research has suggested that it helps students generate new ideas and inventions, as well as more rational solutions (Rothstein and Santana, 2017). As one of the solutions for obtaining novel ideas (Dyer et al., 2019; Barak et al., 2020; Barak and Yuan, 2021), question generation has the potential to increase creativity and higher-order thinking skills (Shodell, 1995). However, the effect of question generation in second language education on promoting students' creativity is unclear. Therefore, this study focused on constructing a creative pedagogy centered on student question-generating activities and examining its effects on second language learners' creativity, target-language learning, and questioning ability.

2. Related work

2.1. Creativity and second language education

Creativity is often described as the activity, process, and ability to generate novel and effective ideas or solutions to problems (Sternberg and Lubart, 1998; Mumford, 2003; Newton and Beverton, 2012; Ritter and Mostert, 2017). Previous research has demonstrated that creativity can be trained through education (Sannomiya and Yamaguchi, 2016; Tran et al., 2021), thus, teaching and learning of creativity has received much attention from the education community (Hernández-Torrano and Ibrayeva, 2020). The National Advisory Committee on Creative and Cultural Education (NACCCE) (1999) argued that creative teaching includes teaching creatively and teaching for creativity. The former focuses on using imaginative teaching methods to enhance the fun and effectiveness of learning, while the latter focuses on developing creative thinking and behavior in young people through teaching forms that promote creativity [National Advisory Committee on Creative and Cultural Education (NACCCE), 1999; Jeffrey and Craft, 2004]. Both are inextricably linked and are sometimes used simultaneously to develop students' creativity (Jeffrey and Craft, 2004).

Generally, the importance of creativity is not limited to disciplines such as the arts and sciences but also to other fields that require imagination and originality (Wang and Kokotsaki, 2018). Jones (2016) argued that creativity is important for developing and using second languages, and this is because the learning process requires using the target language in creative ways to solve problems, make connections, act, think, and perceive in specific ways (Jones, 2016).

However, in practical situations, although teachers are often aware of the value of creativity, there are various limitations and barriers to introducing creativity into actual classrooms (Spendlove, 2008; Wang and Kokotsaki, 2018), including limitations from terminology, curriculum organization, centrally defined teaching practices, and conflicts between policy and practice (Craft, 2003). Thus, appropriate pedagogy for integrating creativity education into other courses is necessary.

In previous studies, several researchers have attempted to integrate creative activities into the second language classroom, such as brainstorming (Liao et al., 2018), games (Cho and Kim, 2018), and creative writing (Tin, 2011; Fatemipour and Kordnaeej, 2014; Wang, 2018). For example, Liao et al. (2018) explored the effectiveness of a creative pedagogy based on brainstorming activities and found that it had positive effects on elementary school students' creative thinking (e.g., elaboration, originality, and abstractness of titles), learning motivation (e.g., affective and cognitive motivation), and English vocabulary by comparing the results of pre- and post-intervention questionnaires and creative thinking tests of the experimental and control groups. Wang (2018) explored the effectiveness of applying the creative problem-solving model in enhancing creativity in second language classes. Sixty-four high school students received a creative writing task intervention based on the creative problem-solving model, and the results demonstrated that their level of originality in creative thinking significantly increased. Overall, these studies have demonstrated the effectiveness of creative activities in the creative development of second language learners of different ages. However, except for Liao et al.'s (2018) research, most of these approaches did not examine whether the second language learning effect is maintained after integrating those creative activities. As these creative activities would take extra time from the original courses, it is necessary to develop an appropriate pedagogy to integrate creative education into second language courses so that the courses develop second language students' creativity and maintain the effect on language proficiency development. Liao et al.'s (2018) research only examined the impact of creative pedagogy on elementary students' English vocabulary gain. Compared with the elementary school curriculum, the goals of higher education courses are more complicated, so it is unclear whether their methods can be directly integrated into these courses.

Thus, in this study, we focused on students' questioning activities, which are common in second language courses, and proposed to enhance these activities to improve both students' creativity and language proficiency in higher education.

2.2. Student question-generating and second language education

Students' question-posing is a conventional method in education. Previous research has demonstrated that it improves students' recall ability (King, 1992; Bugg and McDaniel, 2012), comprehension performance (Bugg and McDaniel, 2012; Safarpoor et al., 2015), and problem-solving (King, 1991; Byun et al., 2014). In addition, such activity can also promote the development of higher-order thinking (Song, 2016), especially thought-provoking questions that require answers by inference or other means are more likely to arouse higher-level cognitive processing by the questioners and answerers (King, 1994, 2008). King (2008) indicated that generating thought-provoking questions requires cognitive processing, the questioner must make connections between the main ideas identified and *a priori* knowledge, and such questions can initiate deeper thinking and stimulate ongoing

discussion. To pose such questions, learners need to build collaboration and interaction, for example, by using Guided Reciprocal Peer Questioning (King, 2008), which can promote higher-order thinking and the effectiveness of complex learning group interactions (King, 1990, 1994). Dyer et al. (2019) pointed out that questions are an important catalyst for creative idea generation. People with strong questioning abilities can associate new knowledge with existing knowledge, question the status quo, and stimulate thinking by asking themselves or others questions that trigger higher-order cognitive activities. Dyer et al. (2008) found that innovators are more willing to ask questions than non-innovators, especially questions that challenge the status quo and the future. Asking such questions is one of the most likely behavioral patterns to generate new ideas (Dyer et al., 2008, 2019; Barak et al., 2020). Therefore, students' questioning activities have the value to be included in various courses.

For second language education, previous research has pointed out the effects of questioning activities on reading comprehension (Baleghizadeh, 2011) and writing ability (Etemadzadeh et al., 2013). Baleghizadeh's (2011) study, which explored the positive effects of student-generated questions on English students' reading comprehension skills, demonstrated that negotiated interactions and productive classroom discussions formed through peer-interactive questioning helped students comprehend the reading text. Furthermore, the role of feedback in supporting questioning activities in second language courses has also been investigated (Song et al., 2017). For example, Song et al. (2017) demonstrated that a system that provided customized feedback to student-generated questions promoted students' collaborative interaction, participation, and language proficiency. However, to the best of our knowledge, no research has investigated the relationship between questioning activities and creativity in second language education.

In addition, although much research has indicated the value of questioning activities, owing to the lack of questioning experience, most students do not develop the habit of asking questions and lack confidence in asking questions (Yu and Liu, 2005). Even when questions are generated, students tend to generate lower cognitive level questions, such as asking for facts, and have difficulty generating thought-provoking or high-level cognitive questions (King, 1990; Bates et al., 2014). Compared to the native language, it is even more difficult for students to ask questions in second language education. Although generating questions may help increase students' opportunities to practice language, there is little research focusing on student-generated questions in second language instruction (Song et al., 2017), and in particular, few studies have attempted to explore the effect of student-generated higher-order questions on learning (Foote, 1998).

2.3. The present study

Based on the mentioned research, creativity has the potential to be promoted in second language education by involving higher-order questioning activities. In the current study, we aimed to answer the following research questions:

1. Does a pedagogy intervention with questioning training support students in gaining the ability to ask higher-order questions?
2. Does such an intervention further improve students' creativity and second language ability development?

3. Methods

To answer the above research questions, we designed a second language course (see 3.2 for details) in which creative pedagogy centered on student questioning activities was used. Later, we conducted a pre- and post-test pre-experimental design study to examine whether pedagogy improves participants' questioning ability, questioning attitudes, creativity, and Japanese language proficiency.

3.1. Participants

In total, 81 sophomore students from a university in Dalian, China participated in this study. The Japanese language skills of the participants were equivalent to the N2 level of the Japanese-Language Proficiency Test. One participant withdrew from the study midway for personal reasons, and the final sample consisted of 80 participants (15 males and 65 females). All participants were specifically informed about the purpose, procedures, and rights of this experiment; participated voluntarily; and signed an informed consent form. Four Japanese language teachers from the same university served as research facilitators for a 4-week course for the participants. They had more than 10 years of experience teaching Japanese, and for this study, they were trained to carry out creative pedagogy centered on student question generation. This study was approved by the Life-Science Committee of Japan Advanced Institute of Science and Technology.

3.2. Procedures

The experiment was conducted in a Japanese course, and all participants received lectures on the same teaching content according to the teaching plan of the course. At the beginning of the experiment, considering that second language teaching is suitable for a small class size of 20–30 students, the participants were equally divided into three classes. The lectures were shared by four Japanese language teachers who act as research facilitators, and each teacher taught the same lecture for each class. Each teacher was responsible for two lectures. The teaching material comes from the textbook content of the Japanese course used by this university, covering articles on eight topics: Garbage reduction, Climate and Housing in Japan, Blood type and Personality, A Moment of Youth, Always Learning, Favorite Word, Japanese Food Culture, The Common Sense of Crow. Articles on these 8 topics were used in 8 lectures in turn, and one article was used in each lecture. Participants learned how to ask questions before engaging in formal teaching activities. The teachers taught participants Japanese expressions of different questioning styles based on the "Question Stems" (Table 1). Participants practiced asking questions in conjunction with the "Question Stems," and they learned the form of questions involving higher-order thinking, especially questions that challenge the status quo, by analyzing their questions with the teachers. After that, each class carried out the same classroom activities according to the following teaching sessions.

TABLE 1 Sample of "Question stems."

What do you think would happen if…?
What do you think would happen if not…?
Wouldn't…like this happen?
Is…no such possibility?
What happens in such a situation/time?
Is…an idea/practice that is appropriate?
Why…?
What is the purpose of doing…?
How much effect/meaning does…have?
What are the pros/cons of…?
What is the difference between…and…?
How does that relate to this…?

1. Question brainstorming: Participants were randomly grouped into groups of 5–6. After reading a Japanese article, the participants continuously brainstormed questions about that article within the group, and the questions were recorded on a question sheet. During the process, the participants did not receive any affirmative or negative comments or criticism from teachers or other participants. The purpose of designing question brainstorming is to actively engage participants in the learning process by making connections between new information and stored knowledge in a continuous process of question generation to establish meaningful learning (Liao et al., 2018). In addition, "possibility thinking" is fostered by increasing participant engagement and making the learning process more interesting (Cremin et al., 2006).
2. Question polishing and sharing: Based on the questions recorded in session 1, each group conducted an intragroup discussion to analyze whether their posed questions were higher-order questions. Later, they selected two higher-order questions to share with other groups. Afterward, the teachers and all participants discussed whether these shared questions involved higher-order thinking. They then selected two questions to be answered by the teachers and participants. This process further helped participants strengthen their knowledge of higher-order questions and gain experience in asking them.
3. Reflection: At the end of each lecture, each participant individually reconsidered the contents of the Japanese article and the questions and contents discussed in the lecture. Later, they wrote down as many questions as possible on another question sheet. This session encouraged participants to complete further reflections.

Each lecture lasted 90 min and was held eight times, spread over 4 weeks, two times a week.

3.3. Data collection and analysis procedures

Before and after the creative pedagogy intervention (hereinafter intervention), the participants completed a questioning ability test, creative thinking test, Japanese language proficiency test, and questionnaire on questioning attitudes.

3.3.1. Questioning ability test

During the pre- and post-tests, the participants were asked to read a Japanese article and ask as many questions as possible within the allotted time. Note that the articles in the two tests were different. The questions asked by the participants were examined in terms of quantity and quality. We followed the revised version of Bloom's Taxonomy developed by Anderson and Krathwohl (2001) and classified the participants' asked questions into six major categories based on the level of thinking required to answer: "remember," "understand," "apply," "analyze," "evaluate," and "create." The questions were divided into 19 subcategories based on the six major categories. All questions were classified by a psychologist and an experienced Japanese-language teacher, and the kappa coefficient of the classification results was used to examine the agreement rate of the classification. The results demonstrated a reliable agreement rate of 92.9%.

3.3.2. Questionnaire on questioning attitude

The questioning attitude questionnaire was used to examine participants' self-perceptions of their attitudes toward questioning, which was adapted from the Innovative Thinking Scale (Barak et al., 2020), including willingness to ask questions, questioning style, and questioning attainment. The questionnaire consists of ten items rated on a five-point Likert scale from 1 (strongly disagree) to 5 (strongly agree), and the items are listed in the Appendix. The scale was used to examine how the intervention affected participants' attitudes toward questioning.

3.3.3. Creative thinking test

The Torrance Test of Creative Thinking (TTCT), developed and designed by Torrance (1974), is the most widely used test of creativity internationally (Hee Kim, 2006; Althuizen et al., 2010). In the present study, the TTCT-Verbal, Unusual Uses, was used to test participants' creative thinking. In the pre- and post-test, the participants were asked to write as many interesting or unusual uses of "beer bottle" and "empty can" on their answer sheets. Creativity was assessed on three separate scales: (1) fluency (ability to generate many ideas), (2) flexibility (ability to generate more types of ideas/ability to generate a variety of ideas), and (3) originality (ability to generate unusual, new, or unique ideas) (Guilford, 1967).

Regarding flexibility, for "beer bottle" and "empty can," the two raters first designed their classification methods based on the participants' generated ideas. Later, we selected one suitable classification method from the two candidates, which contained 19 and 20 categories, respectively. Both raters categorized ideas based on the two classification methods. The kappa coefficient for "beer bottle" was 0.947, and the kappa coefficient for "empty can" was 0.957. We calculated the average number of idea categories for each participant as the final result based on the results of the two raters, and this was considered as the participant's flexibility.

For originality, the two raters designed a scoring standard that included each category's weight. For example, the category of liquid containers had low originality and was scored 1, and the category of in-depth use of materials had high originality and was scored 4. The scoring standards were consistent between the raters for "beer bottle" (ICC = 0.964) and "empty can" (ICC = 0.959). We calculated the weighted sum of the generated ideas for each participant separately based on the two scoring standards. The average weighted sum represents the originality of the participants.

3.3.4. Language proficiency test

The pre-test and post-test language proficiency tests used Japanese test papers with the same question type and difficulty but different content. The language proficiency test was designed based on Japanese-Language Proficiency Test, which is widely used in the world. Two Japanese teachers with more than 10 years of teaching experience selected the questions from a Japanese-Language Proficiency Test simulation question bank, and the other two other Japanese teachers with more than 20 years of teaching experience have proofread and adjusted the difficulty of the test papers to ensure that the difficulty is consistent. Each test paper contained 80 questions. Among them, there were 30 questions on vocabulary, 40 questions on grammar, and 10 questions on reading comprehension. The vocabulary consisted of two parts: choosing the correct pronunciation according to the kanji in use and choosing the appropriate words to complete the sentences. Grammar was the selection of appropriate grammatical items to make sentences complete and smooth. Reading comprehension involved selecting the most suitable answer to a question based on the content of the text. Experienced Japanese teachers graded the language proficiency test items. The questions in the test papers were all multiple-choice questions, and the answers were given by two teachers who set the questions. Finally, we calculated each participants' language proficiency test score based on the answers. We used the reliability formula KR-20 to analyze the reliability of the proficiency test, and the results were 0.628 (pre-test) and 0.779 (post-test). According to Fu et al. (2019) and Salvucci et al. (1997), the reliability was moderate.

4. Results

In this study, since all participants received the same teaching intervention, we tried to use the pre-test and post-test data of all participants as a paired sample to detect whether there was a significant difference between the two. We first tested the normal distribution of the sample data and found that a small part of the data was not normally distributed. Therefore, we used the Wilcoxon signed-rank tests to test whether there were significant differences between paired samples to ensure the accuracy of data analysis.

4.1. Questioning ability test

Changes in the ability to ask questions were examined in terms of the quantity and quality of the questions asked by participants. For each major category, subcategory, and total, Wilcoxon signed-rank tests were used to test the number of questions before and after the intervention. The total number of questions asked and the number of questions asked in each major category are listed in Table 2.

In terms of the total number of questions asked by the participants before and after the intervention, the number increased approximately twofold (pre-test: $M = 5.990$, SD = 1.627; post-test: $M = 11.700$, SD = 2.280). The Wilcoxon signed-rank tests demonstrated a significant difference in the number of questions before and after the intervention ($z = 7.739$, $p < 0.001$, $r = 0.865$). For major categories, the results demonstrated that there were significant differences before and after the intervention for questions in the "apply," "analyze," "evaluate," and "create" categories, which require a higher level of cognition ("apply": $z = 5.122$, $p < 0.001$, $r = 0.573$; "analyze": $z = 6.959$, $p < 0.001$, $r = 0.778$; "evaluate": $z = 4.129$, $p < 0.001$, $r = 0.462$; "create": $z = 6.396$, $p < 0.001$, $r = 0.715$). In contrast, questions in the "remember" and "understand" categories, which require a lower level of cognition, had no significant differences before and after the intervention ("remember": $z = 1.261$, $p = 0.207$, $r = 0.141$; and "understand": $z = 1.933$, $p = 0.053$, $r = 0.216$).

The six major categories of questions were further subdivided into 19 subcategories, as illustrated in Table 3. For the subcategories, the results demonstrated that "interpreting," "exemplifying," "inferring" and "explaining" in "understand," "implementing" in "apply," "attributing" in "analyze," "checking" and "critiquing" in "evaluate," and "hypothesizing" in "create" had significant differences before and after the intervention ("interpreting": $z = 2.371$, $p = 0.018$, $r = 0.265$; "exemplifying": $z = 2.324$, $p = 0.020$, $r = 0.260$; "inferring": $z = 3.819$, $p < 0.001$, $r = 0.427$; "explaining": $z = 2.574$, $p = 0.010$, $r = 0.288$; "implementing": $z = 5.476$, $p < 0.001$, $r = 0.612$; "attributing": $z = 6.898$, $p < 0.001$, $r = 0.771$; "checking": $z = 3.219$, $p = 0.001$, $r = 0.360$; "critiquing": $z = 3.400$, $p = 0.001$, $r = 0.380$; "hypothesizing": $z = 6.396$, $p < 0.001$, $r = 0.715$). In particular, both subcategories of questions in the "evaluate" category with high cognitive levels demonstrated significant differences before and after the intervention. However, for questions in the "create" category, which also requires high cognitive levels, significant differences were found only for questions in the "hypothesizing" category but not for questions in the "planning" and "producing" categories.

TABLE 2 Number of generated questions of each major category in the pre- and post-tests.

Item	*N*	Pre-test		Post-test		*z*	*p*	*r*
		M	SD	*M*	SD			
Remember	80	0.650	0.982	0.513	1.243	1.261	0.207	0.141
Understand	80	2.437	1.431	2.013	1.673	1.933	0.053	0.216
Apply	80	0.500	0.796	1.663	1.591	5.122	0.000***	0.573
Analyze	80	2.075	1.659	5.513	2.724	6.959	0.000***	0.778
Evaluate	80	0.163	0.514	0.700	0.920	4.129	0.000***	0.462
Create	80	0.075	0.265	1.300	1.391	6.396	0.000***	0.715
Total	80	5.990	1.627	11.700	2.280	7.739	0.000***	0.865

***$p < 0.001$.

TABLE 3 Number of generated questions for each subcategory in the pre- and post-tests.

Item		N	Pre-test		Post-test		z	p	r
Major category	Subcategory		M	SD	M	SD			
Remember	Recognizing	80	0.263	0.590	0.275	0.856	0.000	1.000	0.000
	Recalling	80	0.388	0.626	0.237	0.579	1.654	0.098	0.185
Understand	Interpreting	80	0.138	0.413	0.350	0.597	2.371	0.018*	0.265
	Exemplifying	80	0.138	0.381	0.025	0.157	2.324	0.020*	0.260
	Classifying	80	0.125	0.487	0.050	0.219	1.218	0.223	0.136
	Summarizing	80	0.250	0.563	0.275	0.636	0.102	0.919	0.011
	Inferring	80	1.363	1.362	0.525	0.900	3.819	0.000***	0.427
	Comparing	80	0.050	0.271	0.063	0.244	0.302	0.763	0.034
	Explaining	80	0.375	0.862	0.725	0.993	2.574	0.010*	0.288
Apply	Executing	80	0.150	0.393	0.188	0.480	0.557	0.577	0.062
	Implementing	80	0.350	0.713	1.475	1.396	5.476	0.000***	0.612
Analyze	Differentiating	80	0.313	0.628	0.350	0.713	0.272	0.785	0.030
	Organizing	80	0.213	0.469	0.325	0.689	1.394	0.163	0.156
	Attributing	80	1.550	1.340	4.838	2.655	6.898	0.000***	0.771
Evaluate	Checking	80	0.125	0.432	0.425	0.725	3.219	0.001**	0.360
	Critiquing	80	0.038	0.191	0.275	0.527	3.400	0.001**	0.380
Create	Hypothesizing	80	0.075	0.265	1.300	1.391	6.396	0.000***	0.715
	Planning	80	0.000	0.000	0.000	0.000	0.000	1.000	0.000
	Producing	80	0.000	0.000	0.000	0.000	0.000	1.000	0.000

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

4.2. Questionnaire on questioning attitude

An exploratory factor analysis was conducted on the questionnaire results of questioning attitudes to extract common factors from each group of variables and discover the correlations between the different items. The KMO value and Bartlett's sphericity test on the sample demonstrated a pre-test KMO value of 0.623 and a p-value of 0.000, indicating that the questionnaire data were suitable for a factor analysis. The questionnaire results were subjected to an exploratory factor analysis, and subscales were constructed based on the questionnaire (Table 4). The number of factors was set to three based on the results of the eigenvalues (>1). The maximum likelihood method was used for factor extraction, and Varimax was used as the factor rotation method. Based on the results, we defined the first factor as the "Elaboration of questions" consisting of one item. Factor 2 was defined as "Willingness to extend questions" and consisted of four items. Factor 3 had three items and was defined as "Awareness of questions."

Subsequently, for each factor, we calculated the factor score by averaging the scores of each item. Wilcoxon signed-rank tests were conducted to investigate the changes in factor scores before and after the intervention. The results (Table 5) demonstrated that there were significant effects of the intervention on "Elaboration of questions" and "Willingness to extend questions" (Elaboration of questions: $z = 3.348$, $p = 0.001$; Willingness to expand questions: $z = 2.293$, $p = 0.022$), but no significant effect was found on "Awareness of questions" ($z = 0.458$, $p = 0.647$).

TABLE 4 Exploratory factor analysis for questionnaire.

Question	Factor 1	Factor 2	Factor 3
Q1		0.415	
Q2	0.484		0.593
Q3	0.999		
Q4		0.541	
Q5			0.544
Q6			0.504
Q7	0.307	0.546	
Q8		0.393	
Q9		0.602	

Q10 with a load factor below 0.30 is not included. Extraction Method: Maximum Likelihood; Three factors extracted; five iterations required.
The gray shades demonstrate the largest loading factor for each question.

4.3. Creative thinking test

Wilcoxon signed-rank tests were conducted to compare changes in participants' creative thinking before and after the

intervention (Table 6). Fluency significantly improved, $z = 7.751$, $p < 0.001$, $r = 0.867$. Flexibility significantly improved, $z = 5.899$, $p < 0.001$, $r = 0.660$. Originality also significantly improved, $z = 6.414$, $p < 0.001$, $r = 0.717$.

4.4. Japanese language proficiency test

Wilcoxon signed-rank tests were used to compare the scores of each part and the total score of the language proficiency test before and after the intervention. The results are presented in Table 7. The effect of the intervention revealed a significant level for vocabulary, grammar, and the total score (vocabulary: $z = 6.872$, $p < 0.001$, $r = 0.768$; grammar: $z = 3.595$, $p < 0.001$, $r = 0.402$; total score: $z = 6.805$, $p < 0.001$, $r = 0.761$). However, there was no significant change in reading comprehension before and after the intervention (reading comprehension: $z = 0.991$, $p = 0.322$, $r = 0.111$).

5. Discussion

This study investigated the effectiveness of a creative pedagogy centered on student questioning activities in a Japanese language classroom at a university Dalian, China. The results demonstrated that second language learners' questioning ability, creativity, and language proficiency increased after the intervention.

TABLE 5 Score of factors in the pre- and post-tests.

	F1(Pre-test)-F1(Post-test)	F2(Pre-test)-F2(Post-test)	F3(Pre-test)-F3(Post-test)
z	−3.348	−2.293	−0.458
p	0.001**	0.022*	0.647

*$p < 0.05$; **$p < 0.01$.

5.1. Questioning ability

The results of the study showed that the creative pedagogy centered on student questioning activities can help improve students' questioning ability, which is partly consistent with previous research results (e.g., King, 1990; Hu et al., 2019). After the intervention of creative pedagogy, students' questioning ability improved both in quantity and quality. A possible reason is that the creative pedagogy provided the students with support and guidance in fostering the willingness to ask questions and improving their questioning skills. Fostering the willingness to ask questions mainly enhanced the students' active participation in questioning and promoting the development of questioning ability in terms of the number of questions asked. The session "Question brainstorming" during the intervention created a relaxed and open-minded atmosphere. In this atmosphere, the students were able to think and ask questions more freely and built their new ideas and new questions based on questions raised by others. In addition, improving questioning skills is mainly helpful to the development of the students' questioning ability in terms of questioning quality. Significant differences before and after the intervention in the questions of "apply," "analyze," "evaluate," and "create" reflected the effectiveness of the creative pedagogy in improving the quality of questioning. This may be due to the learning and use of "Question Stems" facilitated a wide range of refinement activities, such as reasoning and generalization, which helped the students not only understand and learn the superficial meaning of language materials, but also promote them to effectively connect the deep meaning of language materials with prior knowledge, expand the knowledge structure through in-depth thinking, and then ask more high-quality questions. It can be concluded that the creative pedagogy centered on students' questioning activities can improve students' questioning ability.

Moreover, different from the past literature, our creative pedagogy significantly changed the students' ability of asking questions in the sub-category "checking," "critiquing," and

TABLE 6 Results of the Creative Thinking Test in the pre- and post-tests.

Item	*N*	Pre-test		Post-test		*z*	*p*	*r*
		M	SD	*M*	SD			
Fluency	80	5.425	1.524	10.900	1.588	7.751	0.000***	0.867
Flexibility	80	4.781	1.263	6.463	1.544	5.899	0.000***	0.660
Originality	80	11.181	4.542	17.006	4.083	6.414	0.000***	0.717

***$p < 0.001$.

TABLE 7 Results of Japanese language proficiency test in the pre- and post-tests.

Item	*N*	Pre-test		Post-test		*z*	*p*	*r*
		M	SD	*M*	SD			
Vocabulary	80	19.038	3.309	24.225	3.048	6.872	0.000***	0.768
Grammar	80	21.013	4.670	23.813	6.408	3.595	0.000***	0.402
Reading comprehension	80	21.000	3.572	21.788	4.368	0.991	0.322	0.111
Total score	80	61.050	7.057	69.825	8.599	6.805	0.000***	0.761

***$p < 0.001$.

"hypothesizing." According to Barak et al. (2020) and Dyer et al. (2008, 2019), such kinds of questions challenging the status quo are related to innovative thinking skill. Our creative pedagogy might support the students in gaining this innovative thinking skill in three ways. First, in the question polishing process, the students participating in group discussions promoted their active and proactive thinking about the connotation and form of the questions that challenge the status quo and built knowledge through cooperation to deepen their understanding of such questions. Second, in the question sharing process, the students accumulated more valuable cognitive experience of the questions that challenge the status quo by participating in content analysis and tried to establish a relationship with their prior knowledge, break through the status quo in thinking, and construct personal knowledge to ask more such questions. Third, writing a question sheet before the end of each lecture provided the students with opportunities to reflect on the questions they asked and to strengthen what they have learned during the reflection process through their questioning practice.

Overall, this study provided evidence of the effectiveness of creative pedagogy on questioning ability, especially on questioning skills that represent innovative thinking skills.

5.2. Creativity

The finding that the three subscales of students' creative thinking showed significant differences before and after the intervention suggests that our creative pedagogy centered on student questioning activities enhanced the creativity of second language learners. These results confirm, to some extent, previous findings; for example, Liao et al. (2018) found that creative pedagogy facilitated the originality development of creative thinking in second language learners. In addition, creative activities contributed to the fluency and flexibility of students' creative thinking, which is consistent with the findings of Ritter et al. (2020), Sannomiya and Yamaguchi (2016), and Karakelle (2009).

The above results occurred might be a consequence of the process of asking questions challenging the status quo. While the students were referring to the "Question Stems" and asking such questions, it is possible that they learned how to break the rules, generate various unusual or unique ideas, and promote the original development of students' thinking. In addition, the question sharing process made the student exposed to various questions posed by other students, so it might be another opportunity for the students to acquire greater ideational fluency and flexibility. Overall, the effectiveness of creative pedagogy to positively impact creativity enhancement of L2 learners in higher education was demonstrated.

5.3. Language proficiency

The significant increase in students' second language scores after the intervention indicated that our creative pedagogy did not harm the development of students' language proficiency. Instead, it promoted students' improvement in vocabulary and grammar but did not significantly impact their reading comprehension ability.

During the interventions, the students creatively thought about, analyzed, and evaluated language learning materials using the vocabulary and grammar of the target language. While they generated questions that challenged the status quo and questioned the future to achieve thought elaboration, their creative use of second language was facilitated. Simultaneously, the students performed deep cognitive processing to integrate newly learned information with their prior knowledge (e.g., vocabulary, grammar, and content-related cognition of the target language). This process made the students conduct "meaningful learning," as defined by Ausubel (2012). Thus, the students were engaged in both creative use of the target language and "meaningful learning" during the intervention, which is likely to facilitate the better acquisition of the target language's vocabulary and grammar by learners. However, there was only a weak increase in reading comprehension ability and no statistically significant difference before and after the intervention, which is consistent with previous findings (Foote, 1998). This may be because the intervention lasted only 1 month, was conducted eight times, and reading comprehension improvement was not adequately supported. In general, our creative pedagogy intervention promoted second language proficiency, especially in terms of vocabulary and grammar.

5.4. Limitations and future research

Although the results of this study have demonstrated the effectiveness of creative pedagogy centered on student questioning activities in a specific setting, we recognize some limitations of this study. First, the intervention lasted only 4 weeks, for a total of eight sessions, and future researchers should consider longer and more frequent interventions. Second, this study was conducted with college students learning Japanese as a second language, and future research should consider the impact of creative pedagogy on a broader age group and more multilingual second language learners. Third, no comparison group was established in this study. Since this study was an exploratory experiment on the impact of student questioning activities on creativity, and student questioning activities were not covered in the participants' other courses, the validity of the experimental results was maintained to some extent. In the future, it is necessary to further improve the experimental design by designing a long-term creative pedagogy intervention experiment for second language learners of different languages and age groups and setting up an intervention group and a comparison group to examine the changes in second language learners' creativity more objectively.

6. Conclusion

This study provides important empirical evidence of the effectiveness of creative pedagogy for higher education in second language classrooms. This study's results demonstrated that creative pedagogy centered on student questioning activities promoted second language learners' creativity, language proficiency, and questioning ability. Moreover, the positive impact of creative activities conducted in the intervention on questioning ability, which represents innovative thinking skill, was also confirmed. Although this study had some limitations, it demonstrated the significant effects of the intervention. Given the paucity of empirical research on student questioning activities as interventions to enhance creativity in second language learners, this work goes some way to fill the gap in the literature. In

addition, exploring the ability to ask questions about innovative thinking skill is an innovative aspect of this study. Finally, our findings will contribute to future research on the development of creativity in second language teaching and learning.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by The Life-Science Committee of Japan Advanced Institute of Science and Technology. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

XY, T-YW, and TY contributed to methodology and visualization. XY performed the conceptualization, formal analysis, data curation, writing-original draft. T-YW and TY performed the supervision, writing-review and editing, project administration. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Appendix

Questionnaire on questioning attitude.
Notes: The questionnaire consisted of 10 items on a five-point Likert scale with a ranking from 1 (strongly disagree) to 5 (strongly agree).

1. Even when I take things for granted, I often have doubts.
2. If I feel doubt, I can express it clearly using appropriate language.
3. When I ask a question, I think about the wording (statement) before asking it.
4. I often ask people questions about things I do not understand.
5. When there is something I do not understand, I often ask myself questions to find the root of the problem.
6. For the questions I ask, the person being asked will actively answer them.
7. When I do not understand the answer to a question, I keep asking questions repeatedly to get to the root of the questions.
8. I often ask questions from a different point of view than others.
9. I often ask, "What would it be like if it were not like that?"
10. I am very interested in the questions that others ask.