

Effects of Provided versus Learner-Generated Pictures on Chinese Reading Comprehension

I-Chen Wang

ABSTRACT

Concerning Computer Assisted Instruction (CAI), this research builds a “Provided Picture System” and a “Learner-Generated Picture System” based on related pedagogical principles. The effects and longevity of these two methodologies on improving students’ reading comprehension are compared through a teaching experiment. 96 fourth-grade students in a Taiwanese primary school were divided into the provided picture condition group (PPCG) and learner-generated picture condition group (LPCG) based on their reading comprehension test results. One-way ANOVA proved that the reading comprehension competency of these two groups was comparable. The PPCG was trained to read articles and examine pictures based on the articles’ themes by using the “Provided Picture System”. The LPGA was trained to read articles using the “Learner-Generated Picture System” before generating pictures corresponding to the theme of each paragraph. All students were required to take post-test and delayed post-test one and three weeks after the reading classes, respectively. Finally, paired-samples t-test was used to analyze the three test results. Analysis of the PPCG’s results indicated no significant difference in reading comprehension competency among the three tests before and after the experiment. In contrast, the LPCG’s reading comprehension competency improved significantly, and the effects persisted following the experiment. The results revealed that the learner-generated picture pedagogy was effective in improving students’ reading comprehension competency, superior to the provided picture pedagogy.

Keywords: Computer-Assisted Instruction (CAI), Learner-Generated Picture Pedagogy, Provided Picture Pedagogy, Reading

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I. INTRODUCTION

Reading is the foundation of education, and a basic requirement in one’s studies and life (Hamdan *et al.*, 2010). Through reading, students can acquire knowledge and life skills to strengthen their competitiveness and the national competitiveness, this would create more job opportunities to alleviate poverty and promote economic development (United Nations, 2014). However, to date, there are still more than 250 million students all over the world who have not acquired reading comprehension skills (United Nations, 2014). Therefore, how to improve students’ reading comprehension competency through teaching has become a key concern.

Recent studies targeting students’ reading comprehension primarily focus on the simultaneous presentation of textual and pictorial information (provided picture pedagogy), and its effects on reading comprehension based on Paivio’s (1990) dual-coding theory. Most research results demonstrated that the presentation of pictorial information has positive effects on textual comprehension (Fehr *et al.*, 2012; Türk & Erçetin, 2014). Moreover, it can improve students’ imagination,

inferential competency, and memory (Pike *et al.*, 2010; Schwamborn *et al.*, 2011). It can be concluded that the presentation of pictorial information plays a significant supporting role in acquiring reading skills.

van Meter *et al.* (2006) developed a learner-generated picture pedagogy according to the dual-coding theory. After reading articles, students were required to draw pictures that matched the main ideas of each respective article, to strengthen their comprehension of them. Other relevant studies (cf. Ainsworth, 2010; Leopold & Leutner, 2012; Schwamborn *et al.*, 2010; Mason *et al.*, 2013; Maderazo *et al.*, 2010) also proved that this pedagogy not only improves students’ literacy levels, but also promotes thinking and problem-solving skills, thereby making learning easier.

The above shows that both the provided picture pedagogy and learner-generated picture pedagogy are capable of improving students’ literacy levels. Previous studies generally examined these two methodologies separately, and few studies have compared both. Furthermore, most focused on investigating students’ understanding of texts and rarely examined the methodologies’ effects on student literacy. Hence, this research will investigate the effects and longevity

of both provided picture pedagogy and learner-generated picture pedagogy on students' reading comprehension.

II. LITERATURE REVIEW

The human learning process begins with instinctive thinking and learning inspired by the use of concrete objects and the viewing of images; knowledge is subsequently acquired via abstract textual explanation (Bruner, 1966). Therefore, imagery such as flashcards, pictorial cards, and picture books can be used to assist textual learning in the primary phase. In addition to visualizing textual content, the comprehension outcomes of pictures and texts can be compared to improve children's learning performance and promote learning motivation (Fehr *et al.*, 2012; Pike *et al.*, 2010; Schwamborn *et al.*, 2011). Through the support of CAI multimedia, Fehr *et al.* (2012) used a provided picture teaching method to facilitate students' vocabulary learning. Türk & Erçetin (2014) compared the simultaneous presentation of textual and pictorial information with the separate presentation of annotations using computers to determine their different effects on vocabulary learning. Both experiments proved that provided picture pedagogy could improve students' vocabulary learning abilities. Additionally, Tare *et al.* (2010) examined the effects of different types of pictures on children's comprehension of short stories, while Pike *et al.* (2010) studied the influence of meanings presented in pictures on the inferential abilities of children reading short stories. Both studies proved that easily identifiable pictures could accurately convey the theme of articles and simultaneously promote student comprehension.

Apart from using provided picture pedagogy to assist learning, learner-generated picture pedagogy can also promote student comprehension of educational content through the independent generation of pictures that match articles' themes (Stull, 2007). Gijlers *et al.* (2013), Leopold & Leutner (2012), and van Meter *et al.* (2006) applied learner-generated picture pedagogy to promote students' comprehension of science texts, and asked students to draw independently pictures that matched a lesson's theme. The results revealed that this pedagogy not only improved students' comprehension, but also promoted active thinking (Maderazo *et al.*, 2010). Moreover, students gained greater interest in learning and became more focused in class (Risko *et al.*, 2011); in parallel, their imaginations were also stimulated (Ainsworth *et al.*, 2011). Nevertheless, poor drawing skills can negatively impact students' comprehension of articles (de Vries & Lowe, 2010; Mason *et al.*, 2013). Consequently, Schwamborn *et al.* (2011) maintains that teachers should provide students with support (e.g., backgrounds, elements, paper cutting, and reference pictures) to mitigate the effects of poor drawing skills on reading comprehension when implementing a learner-generated picture pedagogy. Gijlers *et al.* (2013) and Schwamborn *et al.* (2011) provided students with support using computers, which assisted learners in producing accurate pictures quickly and conveniently. Both studies demonstrated that combining computer and learner-generated picture pedagogy can effectively improve student performance.

The above studies revealed that provided picture pedagogy and learner-generated picture pedagogy can improve students' comprehension of learning content. However, most studies on provided picture pedagogy focus on the learning of words and vocabulary, or on the basic comprehension of short stories among underperforming primary school students. Few studies have investigated the effects of this pedagogy on student literacy. Comparatively, studies on learner-generated picture pedagogy generally focus on junior and senior high school students' comprehension of science articles, and rarely other genres. Moreover, van Meter *et al.* (2006) found that fourth-grade students were unable to use learner-generated picture pedagogy effectively, although sixth-grade students could.

Therefore, the objective of this study is to improve levels of student literacy. We combined the provided picture pedagogy and learner-generated picture pedagogy with CAI separately to develop "Provided Picture System" and "Learner-Generated Picture System". The resultant systems were then implemented in a 13-week teaching experiment to investigate the pedagogies' effects on student reading comprehension and the longevity of the effects.

III. METHODS

To investigate the effects of provided picture pedagogy and learner-generated picture pedagogy on student reading comprehension, as well as the longevity of said effects, reading materials were selected and "Provided Picture System" and "Learner-Generated Picture System" were built according to each system's respective pedagogical principles. A teaching experiment was then conducted to compare differences in reading comprehension before and after the implementation of the methodologies.

A. Materials

The texts comprised 18 narrative and 6 expository articles of suitable difficulties selected from a list of fourth-grade extracurricular reading materials by four primary school reading teachers. Each article was divided into four paragraphs, and pictures matching each paragraph's theme were created. "Provided Picture System" and "Learner-Generated Picture System" were subsequently planned based on each system's respective pedagogical principles.

"Provided Picture System": Each article comprised four paragraphs and four pictures, with each picture corresponding to a specific paragraph's theme. The pictures and texts were presented simultaneously. After students finished reading, they were required to take a reading quiz comprising 10 multiple-choice questions.

"Learner-Generated Picture System": Text was initially presented in isolation accompanied by three categories beneath each paragraph: "background", "characters", and "objects". For each category, there were six picture options. Students were required to choose a picture corresponding to the theme of each category's paragraph to form a complete picture. After completing the pictures for all four paragraphs, students clicked the "finish" button, and the correct results were displayed. Students were then required to take a reading quiz comprising 10 multiple-choice questions.

B. Participants

Study participants included 96 (46 male and 50 female) fourth-grade primary school students aged 10-11 whose native language was Chinese. For the pre-test, participants took the Reading Comprehension Screening Test of Fourth Graders (RCST 4th) (Ko & Chan, 2006) and the Chinese Reading Comprehension Test (CRCT) (Lin & Chi, 2000). Participants were evenly divided into a provided picture condition group (PPCG) and a learner-generated picture condition group (LPCG) based on their test results, both of which included 23 males and 25 females. The PPCG's accuracy rate was 59.69% and 64.42% for the RCST 4th and CRCT respectively, while the LPCG's accuracy rate was 53% and 56% for the RCST 4th and CRCT respectively. Through one-way ANOVA, the p-value of the Test of Homogeneity of Variances ($0.96 > 0.05$; $0.64 > 0.05$) indicated that the test results of the two groups were homogeneous while the p-value of ANOVA ($0.11 > 0.05$; $0.07 > 0.05$) showed no significant difference in the results of the two groups. Therefore, the comprehension competency of these two groups was comparable prior to the experiment.

C. Reading Comprehension Tests

To accurately evaluate reading comprehension, the study employed the RCST 4th and CRCT, which are used by the Ministry of Education in Taiwan to assess primary students'. Both tests could be divided into two versions labeled A and B. Each version of the RCST 4th consisted of 32 questions composed of short sentences to test reading comprehension, while each version of the CRCT included 50 multiple-choice questions related to six different articles (three narrative and three expository). Three reading comprehension tests were conducted in this experiment, using test versions A, B and A sequentially. The duration of each test was one hour, and one point was awarded for each correct answer. The number of obtainable points for the RCST 4th and CRCT respectively were 32 and 50.

D. Procedure

All subjects participated in a 13-week teaching experiment. In week 1, participants were asked to complete the RCST 4th and CRCT-based pre-tests. Subjects were then divided into a PPCG and a LPCG in a manner that did not discriminate between their pre-test results.

The reading courses delivered to the PPCG and LPCG from week 2 to 8 of the experiment were identical, although the teaching methods differed. The "Provided Picture System" was used to promote the PPCG's reading ability, and group members were shown course content that presented textual and pictorial information concurrently. Three articles were assigned weekly, and participants were required to take a reading test after completing each one. In contrast, the LPCG used the "Learner-Generated Picture System", wherein participants read only textual content prior to generating pictures corresponding to each paragraph's theme. They were also assigned three articles per training session and required to complete a reading test.

In the tenth week, both groups completed the post-test, and the effects of the provided picture pedagogy and learner-generated picture pedagogy on subjects' literacy levels were compared. In the eleventh and twelfth weeks neither teaching

nor testing occurred. In the thirteenth week, a delayed post-test was administered to determine the long-term effects of the methods.

IV. ANALYSIS

Participants' scores for the three reading comprehension tests were collected. To ease data comparison and facilitate discussion, test results were presented in terms of accuracy (Table I). The PPCG and LPCG pre-test, post-test, and delayed post-test results were analyzed using a paired-sample t-test to determine the effects of provided picture pedagogy and learner-generated picture pedagogy and their longevity.

TABLE I: ACCURACY OF THE PPCG AND LPCG ON THE PRE-TEST, POST-TEST, AND DELAYED POST-TEST

Groups	Tests	M(%)	SD	95% CI	
PPCG (N=48)	Pre-test	RCST 4 th	59.70	0.21	[53.74, 65.66]
		CRCT	64.42	0.24	[49.67, 62.33]
	Post-test	RCST 4 th	58.14	0.25	[70.74, 81.21]
		CRCT	61.00	0.22	[68.96, 77.04]
	Delayed post-test	RCST 4 th	62.76	0.24	[72.88, 84.41]
		CRCT	62.00	0.24	[72.55, 82.53]
LPCG (N=48)	Pre-test	RCST 4 th	52.99	0.21	[46.99, 59.00]
		CRCT	56.00	0.22	[49.67, 62.33]
	Post-test	RCST 4 th	75.98	0.18	[70.74, 81.21]
		CRCT	73.00	0.14	[68.96, 77.04]
	Delayed post-test	RCST 4 th	78.65	0.20	[72.88, 84.41]
		CRCT	77.54	0.17	[72.55, 82.53]

The PPCG results (Table II & Table III) indicated that the RCST 4th and CRCT pre-test and post-test accuracy rates declined from 59.70% and 62.42% to 58.14% and 61%, respectively. The p-values were 0.58 and 0.17 (both > 0.05) respectively, indicating that there was no significant difference before and after the PPCG experiments. As for the post-test and delayed post-test comparison, the RCST 4th and CRCT accuracy rate increased from 58.14% and 61% to 62.76% and 62% respectively. The p-values were 0.06 and 0.47 (both > 0.05) respectively. The data revealed no obvious difference between the post-test and the delayed post-test, indicating that the provided picture pedagogy has limited effects on improving reading comprehension.

TABLE II: PRE-TEST AND POST-TEST PPCG LITERACY LEVELS

Tests	M(%)	SD	<i>t</i>	<i>p</i>	95% CI [LL, UL]	<i>p-value</i> 2-tailed	
RCST 4 th	Pre-test	59.70	0.21	-0.57	0.00	[-0.04, 0.07]	0.58
	Post-test	58.14	0.25				
CRCT	Pre-test	64.42	0.24	-1.40	0.00	[-0.02, 0.08]	0.17
	Post-test	61.00	0.22				

TABLE III: POST-TEST AND DELAYED POST-TEST PPCG LITERACY LEVELS

Tests	M(%)	SD	<i>t</i>	<i>p</i>	95% CI [LL, UL]	<i>p-value</i> 2-tailed	
RCST 4 th	Post-test	58.14	0.25	1.91	0.00	[-0.09, 0.01]	0.06
	Delayed post-test	62.76	0.24				
	Pre-test	61.00	0.22				
CRCT	Delayed post-test	62.00	0.24	0.73	0.00	[-0.04, 0.02]	0.47

Comparatively, the LPCG results (Table IV & Table V) showed that the pre-test and post-test accuracy rates increased from 52.99% and 56% to 75.98% and 73%, respectively. The p-values were both 0 (<0.05), indicating significant improvement in LPCG results. As for the post-test and delayed post-test comparison, RCST 4th accuracy increased from 75.89% to 78.65%, with a p-value of 0.20 (>0.05). The data revealed no obvious difference between the two tests. CRCT accuracy, on the other hand, increased from 73% to 77.54% with a p-value of 0 (<0.05), indicating obvious progress in the CRCT results. The above data suggests that learner-generated picture pedagogy is effective in improving and maintaining reading comprehension competencies.

TABLE IV: PRE-TEST AND POST-TEST LPCG LITERACY LEVELS

Tests		M(%)	SD	<i>t</i>	<i>p</i>	95%CI [LL, UL]	<i>p</i> -value 2-tailed
RCST 4 th	Pre-test	52.99	0.21	12.76	0.00	[-0.27, -0.19]	0.00
	Post-test	75.98	0.18				
CRCT	Pre-test	56.00	0.22	7.93	0.00	[-0.21, -0.13]	0.00
	Post-test	73.00	0.14				

TABLE V: POST-TEST AND DELAYED POST-TEST LPCG LITERACY LEVELS

Tests		M(%)	SD	<i>t</i>	<i>p</i>	95%CI [LL, UL]	<i>p</i> -value 2-tailed
RCST 4 th	Post-test	75.98	0.18	1.30	0.00	[-0.07, 0.01]	0.20
	Delayed post-test	78.65	0.20				
	Pre-test	73.00	0.14				
CRCT	Delayed post-test	77.54	0.17	3.46	0.00	[-0.07, -0.02]	0.00

V. DISCUSSION AND CONCLUSION

This study investigated the effects of provided picture pedagogy and learner-generated picture pedagogy on improving the reading comprehension of fourth-grade students and the longevity of said effects. Teaching experiments were conducted to examine the influence of the aforementioned pedagogies on the participants' literacy levels. The results failed to reveal any obvious differences in the PPCG's reading comprehension competency between the pre-test, post-test, and delayed post-tests. However, there was significant improvement in the LPCG's learning outcome, and the effects were maintained even after the teaching experiment concluded. Therefore, it can be deduced that the learner-generated picture pedagogy was superior to its provided picture counterpart.

The aforementioned conclusion is contrary to the findings of Tare *et al.* (2010) and Yu (2012), who maintain that provided picture pedagogy could improve learners' reading comprehension competency. Since learners in Tare and Yu's studies could compare pictorial and textual information to correct their understanding (Eitel *et al.*, 2013; Stalbovs *et al.*, 2013), the results indicated performance superior to the participants who read only text. This study focused mainly on provided picture pedagogy's effects on student literacy, and examined students' literacy levels following an eight-week provided picture pedagogy training program. The participants performed relatively poorly; this is likely because the test materials were not supplemented by pictures. Furthermore, the test questions and learning contents were unrelated.

Additionally, provided picture pedagogy emphasizes the simultaneous presentation of textual and pictorial information to facilitate students' understanding of texts. In such a situation, students may become overly reliant on identifying key points in texts using pictures; consequently, they struggle to improve their ability to comprehend independently pure text. To aid in the comprehension of textual content and also improve reading comprehension competency, this method could be adjusted to allow participants to read articles before pictures are presented (Canham & Hegarty, 2010).

On the other hand, the research results indicated that the learner-generated picture pedagogy could effectively improve literacy among fourth-graders. Although this pedagogy also uses a combination of textual and pictorial information, students' inferential and active thinking abilities were strengthened as the students read the texts and generated pictures matching each article's theme (Hedin & Conderman, 2010; Maderazo *et al.*, 2010). Consequently, the participants could apply the learned method to the text-only tests, thereby improving their study performance. However, van Meter *et al.* (2006) pointed out that even with additional support, fourth-grade students were unable to effectively apply the learner-generated picture method. In Meter's research, this support entailed providing participants with questions following the completion of their drawings to rationalize key points of the course, in addition to accurate pre-drawn pictures that students could examine for comparative purposes. However, it was more advantageous to assist students in generating pictures in an easy and fast manner than through the analysis of articles (Leopold & Leutner, 2012). Additionally, as students spend most of their time and efforts answering questions or drawing, their cognitive loading increases and their learning performance declines (Leutner *et al.*, 2009; Leopold *et al.*, 2013). Therefore, this research provided options for "backgrounds", "characters", and "objects" via CAI to help participants create pictures easily and quickly, while also providing correct pictures for comparison. By doing so, students' cognitive loading was reduced, thereby enabling fourth-grade students to use the method effectively and improve their learning performance.

VI. LIMITATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

The results of this study indicated that the learner-generated picture pedagogy produced effects superior to its provided picture counterpart. However, there are still several uncertainties that should be examined in future studies. First, due to insufficient test samples, we were unable to investigate the influence of these two pedagogies on readers of varying literacy levels. Second, this study only investigated the influences of these pedagogies on fourth-grade students; therefore, their effects on students in other grades could not be determined. Third, Canham and Hegarty (2010) suggests that reading textual information prior to viewing pictorial information should aid students in their comprehension of articles. In this study, however, the textual and pictorial information was presented to the PPCG simultaneously; consequently, we were unable to determine whether the effect on student literacy would be reduced if textual information were presented first.

To address the above concerns, future research should investigate the effects of provided picture pedagogy and learner-generated picture pedagogy on individuals of differing literacy levels or in different grades. Moreover, subsequent studies should examine the effect of presenting pictures prior to texts on student reading comprehension.

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