

On the Learning of Chinese Aspect Marker *le* through Interactive

Multimedia Program *

多媒體互動課程對華語時貌標記「了」學習成效之研究

謝慈惠 Hsieh, Tzu-Hui
國立嘉義大學外國語言學系
Department of Foreign Languages
National Chiayi University
s0951072@mail.ncyu.edu.tw

吳俊雄 Wu, Jiun-Shiung
國立嘉義大學外國語言學系
Department of Foreign Languages
National Chiayi University
wujs@mail.ncyu.edu.tw

鐘樹椽 Chung, Shu-Chuan
國立嘉義大學數位學習設計及管理學系
Department of E-learning Design and Management
National Chiayi University
tschung@mail.ncyu.edu.tw

Abstract

The Chinese aspect marker *le* has long been considered very difficult for CSL learners. Therefore, we created an computer-based interactive multimedia CSL program of the perfective *le* based on the linguistic studies of the perfective *le* [3,25,26,28,29] and explored its effectiveness. Results of this study didn't show that the multimedia program as a self-learning tool outperform the printed materials significantly. Nevertheless, the result indicated that both the interactive multimedia program and the printed materials within their own groups do have significant effects on the members of the individual groups. This significance is the evidence supporting that the CSL program of *le* based on linguistic generalizations is effective.

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摘要

時貌標記「了」一直為中文為第二外語學習者的困難點之一，所以本研究根據語言學研究設計「了」之多媒體互動課程，並探討此多媒體課程對中文為第二外語學習者的學習成效。結果顯示，作為自學工具的多媒體課程相較於紙本，並沒有顯著的學習成效，然而，多媒體課程和紙本在其各別所屬之組別中學習表現的顯著差異，說明這個「了」課程對中文為第二外語的學習者有所助益。

Keywords: Chinese Aspect Marker *le*, Chinese as a Second Language Learners, Interactive multimedia program

關鍵詞：時貌標記「了」，中文為第二外語學習者，多媒體互動課程

1 Introduction

The perfective *le* has a high frequency of occurrence in Mandarin Chinese [5]. The perfective *le* in Chinese is difficult to Chinese as Second Language (hereafter CSL) learners. Chao [5] investigated how much a 30 year-old British man comprehended the perfective *le* by a fill-in test and found that the subject made mistakes frequently. Kao [13] examined the usage of the perfective *le*, the durative *zhe* and the experiential *guo* of a corpus consisting of Chinese inter-language of students abroad and also found that most errors are about the perfective *le*, compared to the other two. Furthermore, Li [18] found that CSL students mistakenly treat the perfective *le* as English past tense.

According to [14], [19], [21], [25], [28], [29], etc., the perfective *le* can go with four situation types, which are Achievement, Accomplishment, Activity, and stage-level State, and the interaction of *le* with different types leads to different interpretations, such as completion, termination, and inception. In light of [5, 13, 18, 31], the perfective *le* is quite difficult to CSL learners. Li [18] and Yeh [31] further suggested that linguistic studies about the interaction of the perfective *le* with verbs be utilized in CSL learning and teaching. Thus, we created a CSL program of the perfective *le* based on the studies of the perfective *le* with four situation types [3, 25, 26, 28, 29].

Several studies [1, 4, 6, 12, 30] have noted that multimedia through technology can help with language learning and instruction. Although Computer Assisted Language Learning (CALL) has been widely accepted as a useful educational tool for four decades, the application of CALL on Chinese started late from 1995 [22]. According to Zhang [34], CALL programs on grammar need to be explored because it is a less common addressed area. Thus, we digitalized the CSL program of the perfective *le* as a computer-based interactive multimedia program in which we took Form Focused Instruction¹ (FFI for short) as our approach and Concise Narrated Animation² [23] as the concept of multimedia presentation. Few studies, if any, have reported the effects of Computer Assisted Language Learning on CSL grammar. Therefore, we examined whether the interactive multimedia program designed in the study is effective in CSL learning the perfective *le*. We predicted that this interactive multimedia program is effective and if applied correctly, it is far more efficient than the printed

¹ In terms of acquisition of language as a second language grammar, Ellis [9] points out “focusing on linguistic form aids the acquisition of grammatical knowledge”. Thus, we used Form Focused Instruction and draws attention to the forms and structures of the perfective *le* as the approach of the CSL program.

² Concise Narrated Animation (CNA), a simple way to present multimedia, reminds us of ignoring the unneeded materials shown in multimedia and showing the most important part of ready-to-learn knowledge.

materials.³ Two questions were explored. First, in contrast with the printed materials, is the interactive multimedia program designed in the study more effective on helping CSL learners with comprehension of the perfective *le*? Second, if the interactive multimedia program proves positive, is it more useful in terms of syntactic behavior or the semantics of the perfective *le* learning? We hope that the study can contribute to unraveling the effect of Chinese multimedia program on grammar as a self-learning tool and provide teachers with a teaching tool for efficient instruction.

The remainder of the paper is organized as follows. In Section 2, we present methodology including participants, instruments, data collection and data analysis. Section 3 reports results and discussion. Results were presented with various analyses following each of these descriptive sections. Discussion included the effect of the interactive multimedia program vs. the printed materials, assessment of the interactive multimedia program and the printed materials as multimedia in presentation modes [23]. Finally, Section 4 concludes this study.

2 Methodology

This study chose a quantitative method to investigate the effect of interactive multimedia program on Chinese Aspect Marker *le* learning. Based on the research goal, this study examined if the multimedia interactive program is more efficient and effective than the printed materials on Chinese Aspect Marker '*le*' learning.

In addition to the CSL program for the instruction and practice of *le*, a questionnaire, a pretest, and a posttest were used in the study. The CSL program included the interactive multimedia program and its printed materials. Multimedia in the interactive program means presentation using auditory and visual material. For example, the interactive multimedia program used audio narration and animation to present the content in the CSL program designed in the study. A questionnaire is to know the background of all participants. The result of the pre-test and posttest were analyzed, using Independent T-test to determine the effect of the interactive multimedia program.

All participants were divided into two groups. One is the control group and the other the experimental group. The control group studied the perfective *le* through the printed materials and the experimental group through the interactive multimedia program. The major difference between the multimedia program and the printed materials is the way to present the contents in the CSL program of the perfective *le*. The printed materials present the target sentences by the printed text and pictures, while the interactive multimedia by audio narration and animation. Figure 1 shows the research design.

³ The printed materials contain hard copies of the interactive multimedia program designed in the study. They include target sentences and pictures retrieved from the animation of the program.

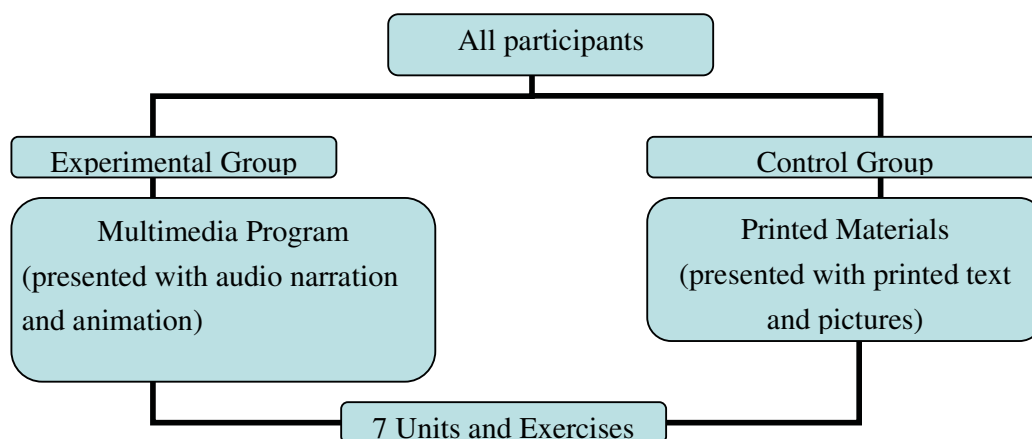


Figure 1. The Research Design

2.1 Participants

Thirty four participants for this research were selected from the population of CSL students enrolled at the CSL program in National Chiayi University and other CSL institutes in Taiwan, and overseas compatriots in Brunei and Australia⁴. All of them learned Mandarin Chinese as a second language. Twenty of the participants were female and fourteen were male. They came from various countries. Thirteen of them come are from Thailand, four Indonesia, four Korean, three the U.S.A., two France, one the U. K., one Japan, one Honduran, one Mongolia, and one Philippine. Besides, two overseas compatriots are in Brunei and one is in Australia. The amount of time that the participants have studied Mandarin Chinese ranged from half a year to three years. Also, all of them have learned the perfective *le*. Their ages ranged from eighteen to fifty-seven years.

These 34 participants were divided into two groups randomly, 17 students for each. One is the control group learning the perfective *le* through the printed materials and the other experimental group through the interactive multimedia program. In order to establish the homogeneity of the two groups, we calculated the average scores of the pretest of these two groups respectively out of a maximum score of 100 and got the mean score of the control group 48.63, and that of the experimental group 55.49, as shown in the following Table 1. Also, results of the independent T-test indicated no significant differences ($t = -1.845$, $p > .05$) between the two groups. Therefore, the level of comprehension of the perfective *le* with four situation types between the control group and the experimental group is roughly the same.

Table 1. Independent T-test Results on the scoring between the two groups in the pretest

Group	N	M	SD	t
Control	17	48.63	19.97	-1.845
Experimental	17	55.49	12.70	

Note: Maximum score=100, $p > .05$.

2.2 Materials and Instruments

⁴ These three overseas compatriots don't speak Mandarin at home, and nor do they study in Chinese school. That is to say, Mandarin Chinese is not their native language. They study Chinese by themselves.

The experiment consists of two parts. One is learning materials, i.e. the CSL program of the perfective *le*, including interactive multimedia program and the printed materials. The other parts are the pretest and the posttest. In the following 2.2.1, the design of the CSL program and its content validity were discussed. Then in the following 2.2.2, the pretest and the posttest were introduced. In addition, their item difficulty (P) and discrimination (D) indexes and reliability were also examined through a pilot test.

2.2.1 The CSL Program of the Perfective *le*

The content in the CSL program is about the interaction of the perfective *le* with four situation types. The CSL consisted of seven units, seven to sixteen target sentences for each unit. Both Unit 1 and Unit 2 contained seven sentences showing the interaction of the perfective *le* with Achievement. Unit 3 and Unit 4 presented sentences with Accomplishment *le*, consisting of ten and eight sentences respectively. Both Unit 5 and Unit 6 were composed of eight sentences with Activity plus *le*. As to Unit 7, there are sixteen sentences with State *le*. The negative evidence column next to the target sentences showed error sentences, which were also included in the CSL program.⁵ The patterns of target sentences in every unit came from the representative literature [3, 14, 19, 21, 25, 26, 28, 29]. Words in the CSL program are chosen from the Mandarin 800 words for beginner provided by the Steering Committee for the Test of Proficiency-Huayu (SC-TOP).⁶ We picked up verbs for these 800 Chinese words and classified them into four situation types based on the following tests.

In the CSL program, we had two exercises following every unit. Every exercise contained five to eight items. Most of these items were from the target sentences. The form of these exercises was designed according to two content objectives as follows: (i) Learners are able to comprehend the interpretations of the interaction of the perfective *le* with four situation types, and (ii) Learners are able to know the collocation of the perfective *le* with four situation types. For example, *Kàn dònghuà, Xuǎn jùxíng* ‘Choose the sentence that corresponds to the animation’ could fit the objective (i) and *Jùxíngtiánkōng* ‘Insert *le* in the right place’ conform to (ii).

As above mentioned about the content of the CSL program, we digitalized it as the interactive multimedia program and collected it in a Compact Disc as the instrument of the experimental group. In the multimedia program, the target sentences were presented with animation and audio-narration.

Also, the multimedia program obeyed seven principles⁷ for the design of multimedia message/presentation [23]. Thus, we showed every target sentence by words and animation for multimedia principle. The target sentences were near the animation for spatial contiguity principle and were presented with their corresponding animation at the same time for temporal contiguity principle. In order to meet coherence principle, on the screen are only animation and its corresponding target sentence. We used audio narration for modality

⁵ According to [11], the positive input is not sufficient to reset a parameter for L2 learners and thus the alternative approach negative evidence can help.

⁶ According to The Steering Committee for the Test of Proficiency-Huayu (SC-TOP), those who have learned Chinese more than half a year are familiar with these 800 words, see the following website.
http://www.sc-top.org.tw/download/800Words_Beginners.pdf.

⁷ The multimedia principle is to use words and animation rather than words alone, the spatial contiguity principle to place printed words near corresponding pictures, the temporal contiguity principle to present words and their corresponding animation at the same time, the coherence principle to avoid unneeded adjuncts, the modality principle to present words as narration rather than on-screen text, redundancy principle to avoid adding on-screen text to a concise narrated animation, and the individual difference principle to consider the students’ background.

principle and avoid any redundant text to the animation for redundancy principle. This program was designed for CSL learners who have learned Chinese for at least half a year. In so doing it leads to fit individual difference principle.

On the other hand, the printed materials as the instrument of the control group represented target events by pictures. The pictures in the print materials were retrieved from animation of the interactive multimedia program. The major difference between the multimedia program and the printed materials is their presentation. The multimedia program presented the target sentences with animation and the audio narration on the screen while the printed materials presented them with pictures on paper. Besides, in Exercise, the interactive multimedia program offered the instant feedback. Once the users click on the right answer, the computer will give positive feedback immediately. On the contrary, the users who practice in Exercise of the printed materials have to check their answers with the Answer Sheet attached. They cannot get an immediate feedback.

In order to establish content validity of the CSL program designed in the study, we invited four scholars whose inputs and feedback were useful. Three of the scholars are linguists and the other one specializes in Computer Assisted Language Learning and E-learning. They were invited to review the instruments including the interactive multimedia program, the printed materials, and the following pretest and posttest. They judged the appropriateness of target sentences and their presentation. Thanks to their help, the content validity of the CSL program can be built.

2.2.2 Pretest and Posttest

Both the pretest and the posttest consisted of sixteen true/false and fourteen multiple-choice questions in Mandarin.⁸ In terms of testing understanding of the perfective *le* with four situation types, true/false questions in each test was given to the subjects for grammatical judgment while multiple-choice for the semantic comprehension. When the test took place, these questions were shown on the projector/computer screen. The true/false questions were shown one by one while the multiple-choice were presented three choice items and each clips⁹ based on which the participants answered for each question. These questions in each test were mostly picked up from the target sentences in the CSL program designed in the study. As previously mentioned, their content validity was established as a result of the review of the scholars. Next, the item analyses¹⁰ of these two tests were performed to establish their internal consistency through a pilot test, discussed as below. In addition, their reliability was calculated by Cronbach's Alpha.

This pilot study was given to 20 CSL learners who study Mandarin in Taiwan. They are 14 males and 6 females. The amount of time they have studied Mandarin Chinese ranged from three month to six years. Also, all of them have learned the perfective *le*. Their age ranged from eighteen to fifty years. They were given the pretest and posttest simultaneously and also asked to complete a questionnaire for their L2 background. They spent 10 minutes on the pretest and then 10 minutes the posttest without any discussion based on the slides we designed in advance. They did these tests according to what they saw on the

⁸ According to [10], the learning outcomes can be measured in a formal grammar test including a multiple-choice and a grammaticality judgment task.

⁹ Thanks to two undergraduate students Xiao, Yu-Wun and Chao, Hui-Jiun in Department of Foreign Languages of Chiayi University for their performance in the video clips.

¹⁰ When it comes to Item Analysis, test items are listed according their degrees of difficulty (easy, medium, and hard) and discrimination (good, fair, poor). These distributions provide a quick overview of the test, and can be used to identify items which are not performing well and which can perhaps be improved or discarded.

projector/computer screen on which questions were shown one by one. After the tests, the scores of the true/false and that of multi-choice in each test were calculated separately by the percentage of correct answer out of a maximum score of 100. Then, item difficulty (P) and item discrimination (D) indexes of the true/false and that of the multiple-choice were examined respectively in each test. For the item difficulty index (P), the higher the value is, the easier the question is.¹¹ For the item discrimination index (D), the higher the value gets, the better the item differentiates among participants on the basis of how well they know the materials being tested.¹² Regarding the result of item difficulty and discrimination on true/false questions in the pretest, the mean difficulty is .47 and the mean discrimination is .45. The results indicate that true/false questions in the pretest are difficult and determinable. The results of pretest on multiple-choice questions in which the mean difficulty is .48 and the mean discrimination is .53, present that multiple-choice questions in the pretest are difficult and distinguishable among students' performance on the test. As to the results of true/false in the posttest, the mean difficulty is .37 and the mean discrimination is .20 while on multiple-choice, the mean difficulty .31 and the mean discrimination is .24. The results indicate that the true/false and the multiple-choice in the posttest are quite difficult with positive discrimination.

Overall, both pretest and posttest on true/false or multiple-choice questions are difficult and differentiable to participants' knowledge of the perfective *le* with four situation types.¹³ Regarding the reliability¹⁴ of the pretest and posttest, it was established by the Cronbach's alpha. The greater the reliability is, the stronger the relative number of positive relationship among the questions would be. High reliability means that the questions of a test tended to "pull together." Participants who answered a given question correctly were more likely to answer other questions correctly. In the pilot study, the Cronbach's alpha of the pretest is .68 and that of the posttest is .60. Generally speaking, the results show that both the pretest and the posttest are reliable of testing comprehension of the perfective *le* with four situation types.

2.3 Procedures

Before the experiment, all participants were given the pretest for 10 minutes. The participants were tested on their knowledge of Chinese the perfective *le* with four situation types in terms of semantics and the syntactic behavior. Twenty-seven participants were tested in their Mandarin class, and seven participants online.¹⁵ Those tested in the class were given the printed paper while those online were offered the website¹⁶ on which they took the pretest. All of them were instructed to make a grammatical judgment for 16 True/False questions and semantics judgment for 14 multiple-choice questions. These questions were shown one by one on the projector/computer screen. Thus, they answered them according to questions presented on the screen. In addition, they are informed that it is not allowed to discuss in the test.

¹¹ In practice, item difficulty is classified as "easy" if the index is 85% or above; "moderate" if it is between 51 and 84%; and "hard" if it is 50% or below.

¹² Generally speaking, item discrimination is identified as "good" if the index is above .30; "fair" if it is between .10 and .30; and "poor" if it is below .10.

¹³ Four questions of item discrimination indexes are negative. As suggested by scholars, the negative value of these four questions might be as a result of participants' uncertain about the answer. Thus, their answering these questions was not out of their understanding of the perfective *le*.

¹⁴ The reliability of a test refers to the extent to which the test is likely to produce consistent scores. In practice, their approximate range is from .50 to .90 for about 95% of the classroom.

¹⁵ Seven participants who had difficulty in coming in person for taking the test accepted the online test.

¹⁶ We had our tests post on the website, see <http://student.ncyu.edu.tw/~s0954185/LS.html>.

After the pretest, participants were randomly divided into two groups, the experimental group and the control group, with an equal number of participants (N=17) in each group. To begin with the experiment, the experimental group received the CD which contains the multimedia program while the control group the printed materials. The period of learning the perfective *le* through the multimedia program for the experimental group or printed materials for the control group is seven weeks. After that, all participants took the posttest.

Those tested in the class got the printed paper while those online were provided the website on which they took the posttest. All of them were informed to make a grammaticality judgment for 16 True/False questions and semantics understanding for 14 multiple-choice questions. Being similar to the pretest, these questions in the posttest were shown one by one on the projector/computer screen. Meanwhile, participants answered them by reading the questions shown on the screen. Besides, the researcher avoided the discussion between participants.

2.4 Data analysis

After the data collection, the pretest was calculated, using the percentage of correct answers out of a maximum 100. As we noted before, we used an independent T-test to establish the homogeneity between the control group and the experimental group. The result showed that there was no significant difference between the two groups before using CSL program. In addition, the posttest was also computed by using percentage of correct answers out of a maximum 100.

For Research Question One, we examined if the multimedia program involved in the experimental group is more effective than the printed materials in the control group in terms of comprehension of the perfective *le* with four situation types. We used Paired T-test to examine the performance within these two groups. Then, the Independent T-test was employed to compare the performance between two groups.

For Research Question Two, if the result of Research Question One is positive, we investigated if the multimedia program is more useful in terms of the syntactic behavior or the semantic comprehension of the perfective *le* with four situation types. As has been discussed, the true/false questions tested understanding of the perfective *le* in terms of its syntactic behavior; the multi-choice questions addressed semantics. Thus, the score of the true/false and that of multiple-choice questions in the experimental group based on the pretest and the posttest were calculated respectively by the percentage of the correct answers out a maximum 100. The paired T-test was used to compare the experimental group's performances on the syntactic behavior to that on the semantic of the perfective *le*. The independent variable was the experimental group and the dependent variable was the difference between the pretest and posttest in terms of true/false and multiple-choice questions.

3 Results and Discussion

In this section, we answered Research Question One: In contrast with the printed materials, is the interactive multimedia program designed in the study more effective on helping CSL learners with comprehension of the perfective *le*? First, a paired T-test was used to examine performance of members within each group. The result showed the effectiveness either of the interactive multimedia program or of the printed materials although participants' responses through investigation by questionnaire¹⁷ showed that not all of the participants used the CSL

¹⁷ The purpose of the questionnaire is to understand how often participants used the interactive multimedia program or the printed materials and whether they used it.

program. For example, eight people used the multimedia program and eleven learned the perfective *le* through the printed materials.

Then, an Independent T-test was performed to compare performances between the interactive multimedia group and the printed materials group. The results revealed that the interactive multimedia program as a self-learning tool on 8 experimental subjects didn't outperform more significantly than the printed materials on 11 control subjects. That is to say, the answer to Research Question One is negative. However, the result of the paired T-test for the performance of members within each group proved that the CSL program designed in the study is effective no matter how it is presented: it can be represented in words and pictures, on the one hand, and audio-narration and animation, on the other hand. This implied that the CSL program created in the study on the basis of linguistic studies is useful for the CSL learning of the perfective *le* with four situation types. Also, the mean score obtained from the result suggested that the CSL learning of the perfective *le* is not easy.

Although the answer to Research Question One is negative, we still make further inquiry into Research Question Two: If the interactive multimedia program proves positive, is it more useful in terms of the syntactic behavior or the semantics of the learning of the perfective *le*? A Paired T-test was performed to compare the effect of the syntactic behavior and that of the semantics in terms of learning through the interactive multimedia program. Also, we investigated the difference between the performance of the syntactic behavior and the semantics in the printed materials since we found its effectiveness within group. Thus, two Paired T-tests were employed and the results revealed that there is no significant difference between the performance of the syntactic behavior and the semantics either in the multimedia program or in the printed materials. What these findings implied is that the CSL program designed in the study was equally involved the learning of the syntactic behaviors and the semantics of the perfective *le*.

Finally, we assessed the interactive multimedia program by the criteria of a good CALL program for CSL, proposed by Zhang [34] and discussed the specific questions of the program itself based on the participants' responses from the survey as previously mentioned. In addition, we considered the printed materials as a kind of multimedia in "presentation modes" based on Mayer [23] three views of multimedia. That may be the reason why there is the significant difference between the multimedia program and the printed materials.

3.1 Effects of interactive multimedia program and printed materials

For Research Question One, we used an Independent T-test to investigate if the interactive multimedia program is more effective than the printed materials as a self-learning tool in terms of the learning of the perfective *le* with four situation types. Before that, a Paired T-test was employed to examine the effect of the interactive multimedia program and the printed materials. We did a survey through questionnaires as previously mentioned in order to know the frequency of participants' using the CSL program designed in the study as a self-learning tool. However, their responses were obtained: Not all of the participants used the CSL program. For example, 8 experimental subjects used the interactive program and 11 control subjects used the printed materials.

Thus, we showed the Paired T-test results of 8 experimental subjects on the learning of the perfective *le* through the interactive multimedia program and 11 control subjects through the printed materials. The Paired T-test results of 8 experimental subjects in Table 2 indicated there was a significant difference ($t = -3.845$, $p < .05$) between the mean scores of the pretest ($M=49.58$) and the posttest ($M=62.50$). The Paired T-test results of 11 control subjects in

Table 3 indicated there was a significant difference ($t = -4.042$, $p < .05$) between the mean scores of the pretest ($M=45.15$) and the posttest ($M=58.18$). In simple terms, these results revealed that the interactive multimedia program and the printed materials had a significant effect on 8 experimental subjects and 11 control subjects¹⁸ respectively although their mean score of the posttest is not high. This implied that Chinese aspect marker *le* was not easy to learn for CSL learners.

Table 2. Paired T-test Results of 8 Experimental Subjects

Task	N	M	SD	t
pretest	8	49.58	14.52	-3.845*
posttest	8	62.50	7.51	

Note. Maximum score = 100, * $p < .05$

Table 3 Paired T-test Results of 11 Control Subjects

Task	N	M	SD	t
pretest	11	45.15	14.09	-4.042*
posttest	11	58.18	7.80	

Note. Maximum score = 100, * $p < .05$

Next, an Independent T-test was employed to answer Research Question One. There was a detailed descriptive statistics in the following Table 4. The figure indicated that there was no significant difference between the mean scores of the interactive multimedia program ($M = 62.50$) on 8 experimental subjects and the printed materials ($M = 58.18$, $t = -1.218$, $p > .05$) on 11 control subjects. That is to say, the interactive multimedia program didn't outperform the printed materials significantly.¹⁹

Table 4 Independent T-test Results between these Two Groups

Group	N	M	SD	t
Experimental	8	62.50	7.50	-1.218
Control	11	58.18	7.80	

Note. Maximum score = 100, $p > .05$

What is more, a Paired-sample T-test was employed to Research Question Two although the answer to Research Question One is negative. Research Question Two aimed to investigate if the interactive multimedia program is more effective in the learning of the syntactic behavior learning or the semantic. We also attempted to examine the performance of the syntactic behavior and the semantics on the learning of perfective *le* through the printed materials since

¹⁸ The number of the experimental subjects may be too few to prove their effectiveness. Thus, we used the Wilcoxon Test, one type of the nonparametric methods which are most appropriate when the sample sizes are small, to reexamine the result. The results of Wilcoxon Test showed that there was a significant effect within these two groups ($p < .05$).

¹⁹ A Mann-Whitney Test, one type of the nonparametric methods for small sample size, was performed to reassure the result of the Independent T-test. The result of the Mann-Witney Test also showed that there was no significant difference between these two small groups.

the multimedia program didn't show more effectiveness than the materials. The following Table 5 showed the Paired T-test result of the difference between the performance of true/false for the syntactic behavior and multiple-choice for the semantics of 8 experimental subjects. The figure indicated that there was no significant difference between the syntactic behavior and the semantics in terms of the pretest and the posttest in the multimedia group ($t = 1.35, p > .05$).

Table 5 Paired T-test Results of the difference between True/False and multiple-choice of 8 experimental subjects

Task	N	M	SD	t
True/False	8	17.97	11.298	1.35
Multiple-Choice	8	7.14	17.908	

Note. Maximum score = 100, $p > .05$

Table 6 below presented the Paired T-test result of the difference between the performance of the true/false and multiple-choice of 11 control subjects. The figure also indicated that there was no significant difference between true/false for the syntactic behavior and multiple-choice for the semantics in terms of the pretest and the posttest in the control group ($t = -.376, p > .05$). What the findings of the above Paired T-test in Table 5 and Table 6²⁰ implied was that the CSL program designed in the study took account of the learning of both the syntactic behavior and the semantics of the perfective *le*.

Table 6 Paired T-test Results of the difference between True/False and multiple-choice of 11 control subjects

Task	N	M	SD	t
True/False	11	11.93	17.56	-.38
Multiple-Choice	11	14.29	11.07	

Note. Maximum score = 100, $p > .05$

All of these findings above could imply that that the CSL program of the perfective *le* created in the study on the basis of linguistic studies is useful for the CSL learning of the perfective *le* whether it is presented with words and pictures, comprised of the printed materials, or audio-narration and animation, of the computer-based interactive multimedia program. The CSL program designed in the study also considered both the syntactic behavior and the semantics in terms of the learning of the perfective *le*. Meanwhile, the mean scores obtained from the result revealed that the perfective *le* is not easy for CSL learners.

In the following, we assessed the interactive multimedia program by the criteria of a good CALL program for Chinese set by Zhang [34] and reviewed responses from the experimental group who used the interactive multimedia program as a self-learning tool.

3.2 Assessment of interactive multimedia program

²⁰ In order to make the result more reliable, we used a Wilcoxon Test for small size group to examine the difference between performance of the true/false for the syntactic behavior and true/false for the semantics of 8 experimental subjects and 11 control subjects. The results of the Wilcoxon Test showed that there was no significant difference between the performance of True/False and multiple-choice questions.

Zhang [34] argued that success or failure of a CALL program depends on the technology, language knowledge and language pedagogy. We took account of these three aspects while creating the multimedia program in our study. For example, for language knowledge, we adopted some well-established linguistic studies about generalization of the perfective *le* with four situation types for the content. Form-Focused Instruction, a type of language pedagogy known for teaching grammar, was used as our concept of arranging the content. As for technology, the well-known Macromedia Flash for animation design and Authorware integrating the components including sounds and clips.

Furthermore, Zhang [34] pointed out that the creativity and abstractness of grammar requires real ingenuity when designing CALL programs for CSL. Following this argument, we didn't give any grammatical explanation in our program. Instead, we used animation and audio-narration for target sentences. Animation can illustrate the abstractness and creativity of grammar. Audio-narration which comes out with the text is supposed to help beginning learners ease the anxiety when they don't recognize some words in these target sentences shown on the screen. It was said that the learner's emotional state plays an important part in student motivation and receptiveness to learning.

On the other hand, Zhang [34] proposed that some learners, especially those at the beginning level may feel overwhelmed when confronted with many choices. They may feel more comfortable following a teacher-suggested sequence of activities. In our study, we were unlikely to overcome the barrier because the multimedia program in the study was taken as a self-learning tool rather than an assisted-teaching tool. Learning through the interactive multimedia program on their own without teachers' assistance reflected the participants' responses received through questionnaires, as previously mentioned. From their responses in the questionnaires, we found that almost half of them didn't know how to start the multimedia program. For example, they had difficulty in downloading Flash Player required for them to see the animation even though we attached the guide sheet²¹ showing instructions to use it. Thus, half of the experimental group never used it as a self-learning tool because of technical problem. This is the major reason resulting in that the effect of the interactive multimedia program didn't show more significantly than its printed materials.

Secondly, the cause for the failure of the multimedia program is those know how to use the multimedia program were not used to it while reading without any teacher stand-by. In this case, we learn that the tutorial sessions of using the multimedia program can be offered in the future studies as it is better to have a teacher stand-by to provide a sense of security. According to Zhang [34], learner's positive affect is the principle for language teaching, especially for CSL CALL programs.

In addition to the above-mentioned clues for effect of the multimedia program, two specific problems about the multimedia program itself we acquired from participants' responses through the questionnaire and interview are stated as follows. The first is the lack of easy access. The users cannot reach the multimedia program by just one click-on. Instead, they have to download Flash Player first if they haven't installed that in their computer and follow the instruction sheet to do the following three procedures including opening the specific folder as the first step, finding the index.swf file as the second step, and opening that file by Flash Player as the third step. Not until completing these three steps can users get start the multimedia program and skip to the menu page. Judging from the above procedures, starting the multimedia program in some way is not easy and simple, especially for users who don't get used to using computer.

²¹ In the guide sheet, the procedures of using program were listed one by one.

The second cause induced from the participants' responses, is its instructions unfamiliar with the subjects. Take words shown on the button items or icons as example. It is somehow too complicated for users to understand its function. Take the word *HuíZhǔmùlù* 'back to the main menu' of the icon as the example, it is beyond the beginner-level. Even though we stated the functions of the icons on the instruction sheet, it was unlikely to be available for the beginning CSL learners, who simply cannot understand Chinese characters. Another illustration is interactive practices or games. The instructions for practices are too difficult to understand for CSL beginners. We also indicated how to do the exercises on the guide sheet. However, those wordy instructions likely resulted in learners' low motivation of keeping on the program.

So far, it seemed that the multimedia program didn't have a more apparent effect than the printed materials. We have discussed the reasons for less significant effectiveness of the multimedia program. The major reason is that not all of the participants use it as a self-learning tool. To make sure all subjects use the program in the future studies, we should provide tutorial sessions, in which they are asked to use it with teachers' assistance. Two more reasons related to the presentation of multimedia program are the lack of easy access and instructions of unfamiliarity with the experimental subjects, in particular those of the icons and practices. We learn that making access easy is the most important thing for activating users' motivation and reducing their anxiety while learning. The easier the access to the program is, the higher the motivation of learners has. Besides, instructions for the icons and practices are supposed to take students' background into consideration. Also, it is required to understand their real language proficiency. For example, some participants who said that they have learned Mandarin more than half a year do not know all the 800 words for Beginner. Thus, they may not comprehend some words in the program. For this point, we think the experienced TCSL teachers can be good supervisors or advisors for presentation of the interactive multimedia program. With their suggestion, the program can be more comprehensible for users.

3.3 The printed materials as multimedia in presentation modes

In this section, we argued that the printed materials in our study are considered as a kind of multimedia presentation. Based on Mayer [23], there are three views of multimedia - delivery media, presentation modes, and sensory modalities respectively.

In terms of the second view "presentation modes," multimedia means using two or more presentation types to present the materials. The focus is on more than one way to present teaching materials, such as words and pictures. This view is consistent with a cognitive theory of multimedia leaning [23], which assumes humans have separate information processing channels for verbal and pictorial knowledge. For example, a textbook which contains words and pictures is multimedia in this view because materials can be presented verbally as printed text and pictorially as static graphics.

The printed materials in our study are a kind of multimedia based on Mayer [23] presentation mode because words and pictures in the printed materials are more than one way to present them verbally and pictorially respectively. From the result mentioned above, its effectiveness was established by looking at the performance within the control group using it as a self-learning tool.

4 Conclusion

After a quantitative analysis of the data and discussion of the interactive multimedia program

and its printed materials, the findings were concluded as follows. The results of the present study may be summarized by pointing out that both the interactive multimedia program and its printed materials are able to show significant effect within their groups in terms of the learning of the perfective *le* with four situation types. What these findings implied is that the CSL program designed in the study is useful as a self-learning tool for the CSL learning of the perfective *le*. Also, the below 65 points of mean score of the posttest indicated that Chinese Aspect marker *le* is not easy to learn for CSL learners. This is in complete agreement with the studies [5, 13, 18, and 31] we mentioned in Section 1.

However, for Research Question One, the results did not reach our assumption in which the interactive multimedia program was more effective than the printed paper. These results may be explained by the following two causes. Firstly, participants' responses showed that only eight people used the interactive program and 11 people used the printed materials. Secondly, the printed materials composed of words and pictures are considered as multimedia [23]. Regarding Research Question Two, the results indicated that there was no significant difference between the learning of the syntactic behavior and the semantics of the perfective *le*. What these findings implied is that the CSL program of the perfective *le* as a self-learning tool designed in the study considered both the learning of the syntactic behavior and the semantics.

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