

Exploring the Effectiveness of Using Animation to Learn Chinese Verbs: A Case of Young Preschool Children

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Abstract

The use of animation as instructional multimedia, with its unique dynamic qualities, has certain interesting merits; however, it remains unclear whether its learning effects are truly advantageous. Previous research shows that the effectiveness of animated instructional multimedia depends on how it is used. Therefore, this study aims to explore whether animation is functionally better than other instructional media when it comes to learning Chinese verbs. This study adopts an experimental approach to test three types of instructional modes for Chinese verb character learning: (1) single word, (2) static image, and (3) animation. Sixty preschool students in Taiwan who are Chinese native speakers are included as volunteer participants. Post-test results show the group using animated multimedia to learn Chinese verbs performs better both in reading and comprehension than the single word and static image learning groups. This study suggests that animation can lead to better performance in learning Chinese verbs, and also proves again that animation offers great potential for instructional multimedia designers.

Keywords: animation, Chinese verb characters, instructional media, multimedia

1. Introduction

In recent years, the development of digital technology and the popularity of 3C products (computers, communication devices, and consumer electronics) have provided various kinds of stimulating multimedia products for very young children. As learning contents and methods tend to be digitized, multimedia teaching environments have been generally accepted as useful learning approaches that improve human learning (Sweller 1999; Mayer and Moreno 2002). Even in the stage of early childhood learning, multimedia contents have been widely applied to various areas of early childhood learning (Lin 2012), such as early reading and writing, early cognitive learning, and so on; certain related hardware and software equipment are very common in the classroom. As to the multimedia teaching contents, sound, text, graphics, images, animation, and other elements are included in teaching presentation. Among them, the use of animation in teaching has recently gained considerable attention and has become popular among teachers (Zhu and Grabowski 2006). The main reason is that animation attracts the attention of learners and apparently enhances their learning motivation (Rieber 1991). However, it remains to be confirmed whether using animation as a teaching medium can result in better learning outcomes, as various studies have shown contrasting views of this issue (Park and Hopkins 1993). Many previous studies have focused on the question of which kind of media presentation leads to better learning outcomes (Hung and Higgins 2016); however, some scholars have concluded that such research topics are meaningless and cannot lead to any sound conclusion (Clark 1994; Kozma 1994). This is because the designs of these studies differ very much from one another when it comes to issues of discussion, methods, learning objectives, and so on. These contrasting results have brought about a lot of uncertainty; therefore, it is very difficult to reach a consensus. As Mayer and Moreno (2002) put it, what we really want to explore is not whether animation will improve learning, but rather how it should be used and where it should be used. As such, the discussion of the conditions under which animation can provide the best learning outcomes has become very important. In general, the proportion of preschool teachers who are willing to make multimedia teaching materials is very low (Lin 2012). Many reasons come from not knowing the effect or which multimedia is suitable. The research results of this study may provide a strong proof of whether animation is needed to teach literacy. Therefore, this study takes young children's learning of Chinese verbs as an exemplary

case and explores the learning effects of animation used in such learning. The designs and results of this study are expected to provide suggestions for the use of animation in the teaching of Chinese verbs as well as an effective case for the use of animation in teaching. This present study not only provides a theoretical proof of the use of animation, but also provides suggestions for preschool teachers on the preparation of teaching media.

2. Review of Related Theories

2.1 Characteristics of Animation

Dwyer and Dwyer (2003) defined animation as images that were displayed in dynamic movement. Thalmann and Thalmann (1996) defined animation as a technique for moving visual images by rapidly displaying a series of individual dynamic scenes on the screen. Mayer and Moreno (2002) further clarified that animation included three main parts: pictures, motion, and simulation. In other words, animation is displayed with images, shows action, and is capable of simulating real situations, either by picture-drawing or other simulation methods. This study uses an animation program to edit real motion images and develops simulating animation to carry out instruction.

Due to its unique dynamic nature, when used in teaching, animation functions well in gaining attention and is capable of powerfully presenting content (Rieber 1990; Chen 2011). Lin (2001) argued that in contrast to other media, animation allowed the content to be presented in a double-pipe context, both visual and auditory, and to be embedded and deeply imprinted in the tracks of our long-term memory. In other words, animation media make it easier for learners to set the content in their long-term memory. Rieber, Boyce and Assad (1990) also offered insight into how animation could be used to help students learn more efficiently through encoding in their long-term memory and to search for relevant information. Pinto, Olivers and Theeuwes (2008) also suggested that animations present dynamic stimuli that allow the user to visually focus more on moving or changing content.

2.2 Animation and Learning

In recent years, dynamic visualizations, such as animations or films, have been widely used in multimedia instructional content (Tschirner 2001). Animation provides a clearer and more complete picture of the meaning of presentations, and is particularly useful when displaying dynamic theories and processes (Koning and Tabbers 2011)- for example, the

process of blood flowing through the heart, explanation of gymnastic actions, principle of generating clouds, and so on. Traditional multimedia, such as static images, make it hard to explain dynamic concepts; on the other hand, animation seems to easily express more complex or dynamic concepts and is more functional in giving a clear presentation to learners. The main reason is that animation helps learners directly sense the dynamic characteristics, and it is easier for learners to build up their internal dynamic rendering system. If only static images are used, learners have to devote effort to imagine and to scrutinize the possible dynamic movements (Hegarty et al. 2003). In other words, animation transforms complex concepts into dynamic maps, which are then transformed into more obvious concepts that learners can understand. Thus, learners may require less effort go further and imagine the dynamic simulation of these concepts; this greatly reduces the learners' cognitive load. Furthermore, animation has another very important feature, that is, the "attraction of attention"; it can easily get the attention of learners and ensure that specific emotions and perceptions can be successfully conveyed. As suggested by Lowe (2004), animation can produce both affective and cognitive functions. The so-called affective function lies in the sound, light, and color, as well as the brisk visual movements. This function can attract learners to focus more on the contents they are learning and make such learning more engaging. Researches pointed out that using animation to children's learning can sustain their learning interest and orient to the learning content (Evans, Nowak, Burek and Willoughby 2017). Parette, Hourcade and Blum (2011) declared that visual prompting made with animation can enhance young learners with developmental delay to engage in functional skills and language learning.

2.3 Studies on the Learning Effects of Animation and Static Images

The use of animation as instructional multimedia, with its unique dynamic qualities, may have certain interesting merits, but are its learning effects truly advantageous? Moreover, the cost of animation is far more than other forms of media presentation. If its effectiveness does not surpass other cheaper media, people will not be easily persuaded to use animation as the teaching media. As a result, some studies specifically compared the effectiveness of different media and shown that animation does not provide more effective learning outcomes than do static teaching media (Tversky, Morrison and Betrancourt 2002; Koning and Tabbers 2011). According to Rieber's literature review (1990), only 5 out of

13 case studies showed that animation positively affects learning achievement. Park and Hopkins (1993) also indicated that only 14 out of 25 studies show that dynamic visual media perform better than static images. On the contrary, in recent years, some studies have explored the effectiveness of animation teaching media and static image teaching media, and the results of comparison show that animation is a better teaching media. For example, Lin and Dwyer's (2010) research suggested that using animation as the instructional media help learners at the high school and above levels to achieve better learning outcomes than do static image media. Höffler and Leutner (2007) also suggested in their research that real-life films or animations are more effective than static images and achieve better learning effects. Hald, van den Hurk and Bekkering's (2015) study showed that congruent animations led to better learning outcomes than static pictures among primary school children learning Dutch verbs. Lu et al. (2013) pointed out, in their study, that for beginners who are undergraduate and graduate students, the use of embodied animation as learning media leads to better learning outcomes in Chinese character learning. More recently, Berney and Bétrancourt's (2016) study based on meta-analysis showed that the effect of animation on learning is superior to that of static image media overall. The main reason, as proposed by Lin (2001), is that in the course of learning, animation media functions better than static images in helping learners to code and search in their brain. On the contrary, certain studies have shown that the use of animation is not much better than that of static images (Lewalter 2003). This is partly because the information presented by the animation is temporary and fast, and it is difficult to review repeatedly as with static images (Hegarty 2004).

Although many studies have proved the positive effectiveness of animation for language learning, some studies show the opposite result. No consensus has been reached, possibly because scholars have adopted different research topics and research methods (Mayer and Moreno 2002). Chanlin's (2001) study further indicated whether the learner is experienced or a novice also influences effectiveness of animation learning. For experienced learners or talented learners, the presentation of animation is superfluous and might thus generate negative learning interference (Kalyuga et al. 2003; Moreno 2004; Moreno and Durán 2004). This means specific types of learners may lead to an undesirable outcome. Few of researches targeted at young preschool learners. Broemmel, Moran, and Wooten (2015) suggested that animated books have the potential to positively affect the

literacy development of preschool children. Baharul et al. (2014) demonstrated that using animation to illustrate the concept of solar system to young children can gain better learning outcome than traditional methods do. Therefore, the research object of this study is centered on pre-school children, who are less experienced in the study of Chinese characters.

2.4 Animation for Learning Procedural Motor Knowledge

In Höffler and Leutner (2007), a meta-analysis of 26 studies found that when the learning topic involved human motion, animation media showed better learning outcomes than did static image media with the same content. These studies include folding origami figures (Wong et al. 2009), puzzle construction (Ayres et al. 2009), and tying knots (Garland and Sánchez 2013; Marcus, Cleary, Wong and Ayres 2013). The results of these studies all point to the finding that animation leads to better learning outcomes for learning of procedural motor knowledge. Furthermore, Van Gog et al. (2009) suggested that animation or dynamic visualizations are the most useful for human motion learning, such as surgical procedures or motor learning. They go on to explain that animation learning is like learning by observing the movements of others. The process of observation invokes the learning of imitation in the brain, as in the mirror neuron system proposed by Rizzolatti and Craighero (2004). In other words, by observing the action that animation displays, learners are able to imitate the action in their mind and thus acquire new skills. In brief, according to the above research, animation or dynamic video is very suitable for learning human movements or acquiring procedural motor knowledge.

2.5 Principles of Animation Design and Presentation

The presentation of animation multimedia is not limited to a single mode, but includes several semiotic modes instead. Generally, there are two opposite modes: the verbal mode (e.g., printed words and spoken words) and non-verbal (e.g., static graphs, video, and animation) (Moreno and Mayer 2007). Therefore, the content of animation multimedia teaching may include multiple semiotic modes, such as text, spoken words, and animation. Presenting multimodal materials for teaching not only provides students with diverse modes of learning contents, but also encourages them to develop a more adaptable approach to learning (Vichuda, Ramamurthy and Haseman 2001). Certain studies pointed out that multimodal teaching presentation, as compared with the single

mode of presentation, can make students' learning more effective (Mayer 2001; Fletcher and Tobias 2005). From the perspective of the cognitive theory of multimedia learning, when people diversify their channels of information, they significantly reduce their cognitive loads in learning and thus improve learning effectiveness (Mayer 2001; Moreno and Mayer 2007). The research of Mayer and Chandler (2001) claimed that when animation teaching is supplemented with the verbal presentation of information, that is, with the modalities of both auditory and visual presentation, the learning effect will be better than the animation teaching that has only a single visual presentation. However, the inclusion of multi-media elements in the learning environment does not guarantee a better learning outcome; that is, some forms of presentation or specific types of learners may lead to an undesirable outcome (Ngu and Rethinasamy 2006; Sun and Cheng 2007). Several researchers pointed out that animation has better learning outcomes only for beginners or when the education of concepts and ideas that appear are more complicated (Kalyuga et al. 2003; Moreno 2004; Moreno and Durán 2004). Therefore, the semiotic mode is expected to promote better learning effectiveness in Chinese character learning when the verbal mode is supplemented with the non-verbal mode of animation.

With regard to the use of animation as teaching media, some basic principles must be considered; otherwise, the use of animation might fail to show its advantages and instead evoke negative results. Mayer, Anderson, Moreno, and other scholars put forward certain principles of arrangements and designs for use in teaching media; these principles are founded on conclusions obtained from empirical studies, and are worth referencing when designing experiments (Mayer and Moreno 2002). First is the multimedia principle. The combination of animation and text is more effective than merely text (Mayer and Anderson 1992). The main reason is that animation creates the so-called mental connection between the learners and the narrative text; however, when only text is used to describe the learning content, the learners must undertake further inner linking of related experiences, which increases their cognitive load, and thus reduces learning effectiveness. The second principle is the spatial contiguity principle. The text and dynamic image must be very close on the same screen to function well. The main reason is that when the corresponding text and images on the screen are close enough, the learners can better link up the two in their brain; on the contrary, when the two are far apart, the learners have to expend their limited cognitive ability to search for links between images and text (Moreno and Mayer 1999).

The third principle is temporal contiguity. The so-called temporal contiguity principle suggests that animation and corresponding textual explanations can serve more effectively when the two are presented at the same time as compared to when they are presented at different times. The main reason is that when images and text appear at the same time, the internal links in working memory are better achieved (Mayer, Moreno, Boire and Vagge 1999). Therefore, based on these three principles, the design of multimedia teaching materials can reduce learners' cognitive load and achieve better learning results. As suggested by Mayer and Moreno (2002), when the production and application of animation media are combined with multimedia cognitive theory, learning outcomes can be enhanced. Therefore, in this study, the multimedia teaching materials are designed on the basis of these principles and then applied to explore the effects of animation on the learning of Chinese characters.

2.6 Chinese Character Learning

Among all languages, Chinese is notoriously difficult to learn and teach (DeFrancis 1966; Lu, Wu, Fadjo and Black 2010). Chinese characters are also relatively difficult to read. The main reason is that the morphology of Chinese characters is irregular and the morphophonemics are unsystematic (Everson 1998). The original representation of Chinese characters is more like the description of actual things, for each word is a separate symbol (Shei and Hsieh 2012). Scholars pointed out that three challenges that arise in the study of Chinese characters: shape (graphic form or orthography), sound (phonology), and meaning (semantics) (Xu, Chang, Zhang and Perfetti 2013). In other words, when one begins to learn Chinese characters, one should be able to recognize the form of the word, understand the meaning of the word, and pronounce the word correctly, because each Chinese character corresponds to a syllable and a morpheme. Therefore, for beginners, the study of Chinese characters may have to start from the word, and the learner has to memorize the visual form of each word and the unique pronunciation of each word as well. The first step in learning Chinese characters should, therefore, be to develop the sensitivity to each character's visual-orthographic structure (Wang, Perfetti and Liu 2005). First of all, the learner must recognize the visual form of these words as the foundation of learning, and then enter the well-organized context for sentence learning. As suggested by Nation (2001), it is advisable for one to learn, firstly, each Chinese character in an isolated way

before one moves further to learn sentences in terms of contextual understanding. Therefore, the design of this study focuses on the study of Chinese characters word by word. Moreover, by the method of visual presentation, we develop learning experiments particularly for preschool age children who have just begun learning Chinese characters.

There are very few studies related to animation to learn Chinese characters. Hsiung, Chang, Chen and Sung (2017) used stroke-order animation with pronunciation and pinyin to improve foreign language learners in learning Chinese characters. However, the result showed that no significant impact on the effectiveness of recognizing and writing Chinese characters. It may be the reason that the traditional emphasis on the correct stroke order does not help the recognition and writing of Chinese characters. In addition, Chen (2012) proved that using animation materials to assist grammar learning can really achieve better results. She suggested that the situation created in animation can reduce the anxiety during learning and improve the efficiency of learning grammar. Therefore, the study focuses on whether animation media can provide better learning outcome for pre-school learner in learning Chinese verbs.

2.7 Research Aim and Hypotheses

According to the discussion above, when the use of animation media follows the cognitive theory of multimedia learning, animation media will function effectively in assisting learners to gain more understanding. Moreover, many studies have proved that animation media is very suitable for procedural motor knowledge learning. Since the process of understanding and learning of Chinese verbs, such as words of movement or of behavioral action, shows similar characteristics to that of the dynamic procedures of understanding, and since Chinese verbs are relatively difficult for young children as beginners, clearer and easier teaching tools are needed. Therefore, this study aims to explore the effect of animation media on Chinese verb learning and assumes that animation media is better than other forms of media for learning Chinese verbs. The following two hypotheses serve to indicate the purpose of this study.

Hypothesis 1: Animation instructional materials are superior to verbal presentation for Chinese verb character learning.

Hypothesis 2: Animation instructional materials are superior to static images for Chinese verb character learning.

3. Method

In order to achieve the purpose of this study, we use quantitative empirical research methods. Based on our experimental research design, we undertake pre-test, intervention teaching, and post-test research procedures.

3.1 Participants

The initial participants in this study were 68 children, from three public preschools in Taichung, a city in the middle of Taiwan. They were all in the same grade of preschool, and were 5-6 years old. All participating students were Chinese native speakers and had no problem with Chinese speaking and listening skills. These children had just recently been exposed to reading and writing in Chinese and the amount of characters the children could read was quite limited. This study divided them into three groups randomly, and each group had its own multimedia combination with different arrangements; however, the literacy content was the same. Each group had 20 persons selected under random distribution, with a mix of both males and females. Before the experiment, the participants were checked in the pretest to see how many of the words taught in the experiments were already known to them. According to the pretest, those who could read more than 1/4 of the Chinese words on the experiment list were excluded. This was mainly to control the knowledge gap among the experimental participants so that the differences among their knowledge of words would not be too large; in so doing, we reduced the possibility that this factor might cause some experimental interference and affect the correctness of the experiment. In the end, the actual participants in this study included 60 young pre-school children (32 male, 28 female).

3.2 Research Tools

The teaching instrument used in the experiment was multimedia teaching materials designed by the author. The designs of teaching materials were divided into three kinds. The three kinds of multimedia combinations were not the same, but the learning contents of each of them were the same. Due to the consideration of young children's limitations in attention span, only twelve groups of verbs were included on the list. Many studies showed that students could concentrate in the classroom only about 10 to 15 minutes (Davis 1993; McKeachie 1999; Benjamin 2002; Goss Lucas and Bernstein 2005; Wilson and Korn 2007). Particularly, it is highly difficult for young children to maintain their attention

during classroom learning. Altun, Hazar and Hazar (2016) pointed out that for young children of 5-7 years of age, the attention span in learning may not exceed fifteen minutes, and their concentration will decline after that time. According to this limitation, the proper number of groups for learning Chinese verbs within this attention span is around 12 groups; therefore, the overall teaching time is about 12 to 13 minutes. The choice of 12 verb groups was based on the concept of early childhood learning construction. Their reference point of learning started with their familiar experiences, never too far away from their daily life (Vygotsky 1986). Therefore, verbs selected for young children were drawn from their daily experiences, such as catching a ball, bathing, writing, and so on.

The multimedia combination of the control group contained the visual symbols of characters and the pronunciation of the verbs, as shown in Figure 1. The teaching materials of the first group included image aids in addition to text and pronunciation (Figure 2), and the materials for the second group included text, pronunciation, and animated content (Figure 3).

In the content design of multimedia teaching, the three challenges for learners of Chinese characters were to acquire the shape, the sound, and the meaning of Chinese characters, as mentioned in the previous literature. Therefore, in the design of animation contents, we clearly presented the shape of Chinese characters in each teaching group so as to help young children to visually memorize the shape of Chinese characters. In each group of text-based teaching, the pronunciation of a Chinese verb was uttered three times to help children memorize their pronunciation. Animations, in the continuous visual presentation, help children to understand the meaning of verbs. As to the content design of the teaching media, we followed the three principles of animation design discussed in the literature. For instance, based on the spatial contiguity principle, our design located the text and animation same screen, and based on the temporal contiguity principle, the animation and its corresponding text were presented at the same time.

The multimedia teaching contents of each group were produced with 2D animation software, Adobe Flash CS6. The presentation modes and interactional functions were written in the ActionScript 2.0 programming language. Each group of verb words was taught in about 10 seconds for all three groups. In each intervention group, the content of the verb teaching material (the visual symbols of characters and the pronunciation of the verbs) and the amount of time spent teaching each verb were controlled to be the same.

This means the total amount of time spent looking at text, static images, and animation was the same in the three groups.



Figure 1: A Screenshot of the Instructional Content for the Control Group



Figure 2: A Screenshot of the Instructional Content for the Static Image Group



Figure 3: A Screenshot of the Instructional Content for the Animation Group (Images Taken from the Continuous Time Frames of Animation)

Chinese character learning was divided into two parts: reading and comprehension (Zhao 2008). This is because even if the participant can give the correct pronunciation of a

word, this does not mean that he/she really knows the meaning of the word. On the contrary, when the participant can point out the relevant meaning of the word, it does not necessarily mean that they can pronounce the word. Therefore, the test tool for Chinese words should include reading and comprehension. Because the target students in our study are preschool children, the design of the assessment of learning effectiveness needs to consider the limitations of their writing and reading ability. The assessment tools, consequently, were designed by the researchers according to the teaching content so that the tools could meet the limits of the children's answering abilities. The reading part was selected from 12 groups of Chinese verbs printed on two pieces of A4 size paper with a balanced distribution. Then the teacher indicated the word group and asked the students to read the selected words out loud, as shown on the left side of Figure 4. As for comprehension, the children used their favorite method, i.e., word matching with linking of dots, to carry out the test. The words and images were placed on both sides randomly. With the printed test sheet, the subjects used a pen to link the word with the image that represents its meaning. The contents of the test contained the 12 groups of words from the teaching material; the selected words were divided into two groups for the test (on the right side of Figure 4). The test tool for reading was based on the K-R value (Kuder-Richardson reliability) of .78, and that of comprehension was based on the K-R value of .75.



Figure 4: A Screenshot of the Reading and Comprehension Test

3.3 Procedure

The procedure started with the pre-test in which all children are individually tested one-on-one by the experimenter; then they joined the controlled experimental teaching. After that, the post-test was given. The research procedures were similar for all three groups, only the media used for teaching content differed. Each experiment was conducted with groups of 4-5 people in an undisturbed classroom. First of all, the teaching content was pre-tested with the reading test and comprehension test. When the results of the pre-test showed a student got one-fourth of the answers correct, the participant was excluded, and another participant filled in. Then, the instruction was carried out before the intervention learning. After that, the multimedia teaching of Chinese verbs was carried out, and the mode of teaching media differed for each group. Each time, a complete teaching cycle (about 2 minutes) was carried out followed by a 3-minute break. The whole instruction process included three complete teaching cycles, the total time being around 12-13 minutes. After the instruction was completed, participants had a 5-minute break; then, the post-test was conducted with the same instruments. Participants were individually tested one-on-one by the experimenter. Based on this procedure and various teaching media contents, the researchers conducted experiments on the control group, group 1, and group 2.

3.4 Data Analysis

The research design is comprised of three independent variables, namely three groups of training media. The dependent variables in the study are the reading and comprehension mean scores of Chinese words that provide both the pre-test and post-test measures. Having collected the pre-test and post-test data of the three groups for reading and comprehension, we conducted quantitative data analysis. Using SPSS software tools for our analysis, we first carried out a descriptive analysis. To investigate whether the differences between the pre-test and post-test measurements were significant and also exclude some disturbance variables, we undertook an analysis of covariance (ANCOVA).

4. Results

The Chinese character reading test was recorded in two parts: reading accuracy and comprehension. Prior to the training, the researchers checked the participants' level of

Chinese character understanding. The scores for reading and comprehension of Chinese words were measured based on the number of correct responses. In order to investigate whether the differences between the pre-test and the post-test scores were significant and to exclude certain moderating variables, the researchers conducted a 3 (study groups) by 2 (the pre-test and post-test) two-way mixed design analysis of covariance (ANCOVA) on the scores.

The mean reading scores of the three groups are summarized in Table 1. Before initiating the application of ANCOVA, the researchers had to support the results by testing the assumption for homogeneity of regression, which was non-significant (data of α^*): $F(2,57) = .044$; $p = .957 > .05$. This showed that the slope of the regression line in the three groups remained the same. Therefore, the analysis of covariance could be further conducted. The result of the ANCOVA was significant ($F(2,56) = 14.308$, Eta Squared $\eta^2 = .338$, $p = .00 < .05$), and this indicated certain significant differences probably exist between the experimental groups and the control group on their post-test scores on the reading test.

The adjusted post-test average scores of the three groups' reading tests are shown in Table 1. The mean difference (I-J) of the reading test scores between group 1 and the control group is .578, with the significance level of .114 ($> .05$). This indicated that there is no significant difference between the control group and group 1 (the graphic teaching group) on the reading test. On the contrary, the mean difference (I-J) between group 2 (animation teaching group) and the control group is 1.88, with the significance level of .00 ($< .05$). The mean difference (I-J) between group 2 (animation teaching group) and group 1 (graphic teaching group) is 1.3, with the significance level of .001 ($< .05$). This indicated that group 2 (animation teaching group) scored significantly higher on the reading test than did both the control group (the textual teaching group) and group 1 (the graphic teaching group). In other words, the findings indicated that for teaching of Chinese verb reading, animation teaching resulted in the better learning effectiveness than teaching simply with text or supplemental images.

Table 1: Pre- and Post-tests Scores on the Reading and Comprehension Test

	Group	N	Reading		Comprehension	
			Mean (SD)	Adjusted Mean	Mean (SD)	Adjusted Mean
Pre-test	Control (word)	20	.20		.25	
	Group-1 (picture)	20	.20		.05	
	Group-2 (animation)	20	.23		.20	
Post-test	Control	20	5.05 (1.36)	4.93 (a)	4.40 (.82)	4.37 (a)
	Group-1	20	5.45 (1.32)	5.51 (a)	5.55 (.99)	5.66 (a)
	Group-2	20	6.75 (1.41)	6.81 (a)	6.95 (1.43)	6.87 (a)

Similarly, analyses of the comprehension test are shown below. The mean scores of the comprehension test for the three groups are shown in Table 1. The test of the assumption of homogeneity of regression showed non-significant data (of a x): $F(2,57) = .93$; $p = .40 > .05$. The analysis of covariance of the comprehension test can be further conducted. The result of the analysis of ANCOVA was significant ($F(2,56) = 28.11$, Eta Squared $\eta^2 = .501$, $p = .00 < .05$). This result showed significant differences might exist among the three groups in the post-test scores, which indicated certain significant differences could exist between the experimental groups and the control group in their post-test scores for the comprehension test. The adjusted post-test average scores of comprehension test are shown in Table 1. The mean difference of the comprehension test scores between group 1 and the control group is 1.29, showing significant differences ($P = .00 < .05$). The mean difference between group 2 and the control group is 2.50, also showing significant differences ($P = .00 < .05$). This indicated that there are significant differences in comprehension test scores between the control group and group 1 (graphic teaching group) as well as between the control group and group 2 (animation teaching group). Moreover, the performances of the two experimental groups were better than that of the control group. The mean difference (I-J) between group 2 (animation teaching group) and group 1 (graphic teaching group) is 1.22, with the significance level of .001 ($< .05$).

This result indicated that group 2 (animation teaching group) scored significantly higher on the comprehension test than did group 1. In other words, for the training of Chinese verb comprehension, animation teaching was significantly more effective than teaching with only text or supplemental images.

5. Discussion

In the end, which achieves better learning effects: animation or other media? It is difficult to gain a consensus in such a discussion, and often this is due to varying learning content designs or research methods, which could lead to very different outcomes. Thus, as Mayer and Moreno (2002) argued, the effectiveness of animation learning must be considered in the context of its proper use or the way it is applied. Therefore, in terms of the characteristics of animation, this study aims at apply animation teaching media for the study of Chinese verbs and compares the animation approach with static image and text only teaching media so as to reveal differences in the learning effectiveness of the different approaches. To measure how well the learners have acquired complete knowledge of the Chinese words, we divide the research into two parts: reading and comprehension (Zhao 2008). Here we deal with different media and discuss the effectiveness of diverse approaches to learning Chinese verbs.

According to our two hypotheses, learning of Chinese verbs is more effective when taught by animation when compared to mere text and static image methods. The results of this study showed that the group using animation media is significantly better, as evaluated in the post-test for both reading and comprehension, than the groups using only text and static images. The results are consistent with numerous studies on animation, such as Lin and Dwyer (2010), Höffler and Leutner (2007) and other studies which suggested that animation is a better teaching media than just static pictures. However, as discussed in the above literature, the discussion of the effectiveness of animation media must focus on the method and timing of its use. If the discussion only falls into arguments about pros and cons, then it is not very helpful. Therefore, we further explore why there was a positive effect in the case of Chinese verb learning. We summarize three main reasons.

First, the dynamic concept of Chinese verbs is very suited to the use of animation teaching. A Chinese verb basically indicates an action, or behavioral action, and the meaning tends to involve the concept of continuous dynamics. For example, the verb

“skate” in Chinese is “溜冰” (*liubing*), which describes the dynamic meaning of sliding on ice. This verb describes a continuous dynamic action. Therefore, the presentation of complete action is needed to understand a Chinese verb. For young children just beginning to learn Chinese verbs, animation can help to clearly express the meaning of the Chinese verb and also help them to achieve better learning outcomes. This result was consistent with the findings of Höffler and Leutner (2007). Based on the meta-analyses of 26 studies, they concluded that the learning categories of human movements or procedural motor knowledge were well suited to teaching with animation media. The content and quality of Chinese verbs are very similar to procedural motor knowledge, both of which emphasize dynamical or procedural understanding and cognition. Therefore, in the learning of Chinese verbs, animation media is better than static images and mere text and could thus bring about better learning outcomes.

Second, animation can simulate dynamic realistic situations. This can help learners to understand the teaching content. The results of this study showed that in understanding Chinese verbs, the effect of animation media is better than that of static images, and teaching static images is significantly better than only reading the word. This result was consistent with Glenberg et al. (2004). The dynamic scenario is better than text-only reading, because it enhances children’s understanding of the story content and the contextual meaning. Marley et al. (2007) provided further evidence that when learners see other people represent the text content in a dynamic way, the content is understood better than when learners are exposed to text-only reading. Glenberg et al. (2011) pointed out that the simulation of human-motion teaching by animation media is effectively similar to teaching by real human beings. Furthermore, the dynamic presentation of animation is of great help to stimulating the learner’s attention (Rieber 1990).

Third, when the designs of animation teaching are consistent with the cognitive theory of multimedia learning, the learners can achieve better learning. The designs of animation media in this study follow the principles of multimedia cognitive theory, such as the multimedia, spatial contiguity, and temporal contiguity, all of which are outlined by Mayer, Anderson, Moreno, and others.

Therefore, the results of this study showed that if the animation multimedia is designed based on the principles of multimedia cognitive theory, then it can indeed improve learning outcomes. Such results were in line with what Mayer and Moreno (2002)

have argued, i.e., when animation media is designed according to the principles of multimedia cognition theory, it will reduce the cognitive load of the learners and make the learning effects more efficient.

With the above discussion, we can conclude that animation media is suitable for the learning of Chinese verbs. The results of this study not only prove that animation can help children's comprehension of Chinese verbs, but that it also helps them to remember Chinese verbs. It may be that Chinese verbs represent a dynamic-action concept, which matches the dynamic quality of animation interpretation. Therefore, we recommended that early childhood educators use animation design when teaching children to recognize Chinese verbs, because such an approach is more effective than employing static images or mere text.

There are still a few limitations in this study. First, few participants may have difficulty understanding the meaning of static images. Although we have carefully selected the teaching still images which are suitable for young children to understand and every word is accompanied by pronunciation, it is still possible that some young children have difficulty understanding the images. Therefore, for the future research, the description of the image content to the participants can be performed before the study is conducted. Conversely, this reveals an advantage of animation media, it helps children's comprehension more efficient. Second, this study only focuses on the learning outcomes of Chinese verbs in different media, and does not consider the comparison of different teaching methods. Therefore, the future research can focus on the comparison of the effectiveness of different teaching methods, such as: static image book, animation story, interactive picture book, etc.

6. Conclusion

Few previous studies have explored the use of animation in complex semantics and verb learning in pre-school stage. This study is the first to explore the effect of Chinese verb learning with animation and proves that animation has a better effect than only text and static images. The main contribution of this study is to prove that instruction with animation can lead to better performance for pre-school young children in language learning. The current study makes theoretical and empirical contributions to this general domain and suggests when and how educators can use animation as an instructional tool.

As argued by Mayer and Moreno (2002), animation is a great potential tool for instructional multimedia designers, and when the design of such a tool follows the principles that are suggested by the cognitive theory of multimedia learning, animation can meaningfully promote the learning effect of learners.

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使用動畫學習中文字動詞之成效探討

—以幼兒階段為例

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摘要

雖然動畫的獨特動態特質，作為教學媒體有很多的優點，然而其實際所帶來的學習成效是否真的較優呢？研究顯示，動畫是否能成為有效的多媒體教學工具，主要是取決於動畫被使用在何種內容的學習。因此本研究旨在探討，當動畫媒體用於中文字動詞的教學時是否比其他媒體來得有成效。本研究採用實驗研究設計為研究方法，針對中文動詞的學習內容，測試以三種教學模式，單一文字、靜態圖像、和動畫的學習成效。研究結果顯示，使用動畫媒體的組別，在中文動詞讀字與理解兩個面相的後側評量上，明顯比只有單一文字的組別、及靜態圖像的組別來得佳。本研究建議，動畫在中文動詞的學習上可以帶來更好的成效。本研究再次證明動畫是一個極具潛力的媒體教學工具。

關鍵詞：中文動詞 多媒體 動畫 教學媒體