Educational Technology International
2015, Vol. 16, No. 2, 141-166

The Effects of Visual Stimulation and Body Gesture on Language Learning Achievement and Course Interest

Dongyeon CHOI* Minjeong KIM

Dankook University

Korea

*

The purpose of this study was to examine the effects of using visual stimulation and gesture, namely embodied language learning, on learning achievement and learner's course interest in the EFL classroom. To investigate the effectiveness of the proposed purpose, thirty two third-grade elementary school students participated and were assigned into four English learning class conditions (i.e., using animated graphic and gestures condition, using only animated graphic condition, using still pictures and gesture condition, and control condition). The research questions for this study are addressed below: (1) What differences are there in post and delayed learning achievement between imitating gesture group and non-imitating one and between animated graphic group and still picture one? (2) What differences are there in course interest between imitating gesture group and non-imitating one and between animated graphic group and still picture one? The Embodiment-based English learning system for this study was designed by using Microsoft's Kinect sensing devices. The results of this study revealed that students of imitating gesture group memorized and retained better words and sentence structure than those of the other groups. As for learner's course interest measurement, imitating gesture group showed a highly positive response to attention, relevance, and satisfaction for curriculum and using animated graphic influenced satisfaction as well. This finding can be attributed to the embodied cognition, which proposes that the body and the mind are inseparable in the constitution of cognition and thus students using visual simulation and imitating related gesture regard the embodied language learning approach more satisfactory and acceptable than the conventional ones.

Keywords : Embodied cognition, Technology-enhanced English learning, Body gesture

* Dankook University
airmania73@gmail.com

Introduction

We use language as a tool for interacting with environment various way, which is why we human are called 'Homo loquens'. When we speak, we spontaneously gesture, through which we illustrate or emphasize what we are saying (Hostetter, 2011). Moreover, in the process of babies' language acquisition, they imitate and use gesture as a precursor of spoken language. Furthermore foreign language teachers use body gestures as an educational tool which enhances the process of language acquisition (Gallese, 2007). One of the theories that provide a clue for this approach is embodied cognition that the characteristics of the human mind is highly composed of the form of the human body (Lakoff & Johnson, 1999). An intrinsic attribute of embodied cognition is an inevitable research subject in social and cognitive psychology, regarding issues like decision-making and social interaction (Bekkering & Neggers, 2002). The central pillar of this theory (embodied cognition) reflects the suggestion that the motor system affects our cognition, just as bodily actions are influenced by the mind (Wilson, 2002). For example, when students bite a pencil in their mouth using the part of muscles for a smile, they can understand delighted sentences better than unpleasant ones, while the reverse effect can be observed in holding a pencil between their upper lip and nose to adopt the muscles of frowning face (Glenberg, 1997; Fargier, Paulignan, Boulenger, & Nazir, 2012).

From a language learning perspective, embodied cognition can suggest that neural resources generally used for perception, action, and emotion are also recruited during language comprehension (Barsalou, 2008). Barsalou also insisted that embodied cognition is all perspective of cognition which is turned into shape by situated action, environment, simulation, and respects of the body. According to this theory, gestures activate images in working memory and can reactivate visuo-spatial information which might facilitate encoding (Richardson, Spivey, Barsalou, & McRae, 2003). In these premise, we can draw a tentative conclusion

that motor simulation which is mentioned previous paragraph is an instant and essential factor of meaning representation and gestures accompanying foreign language items enhance memorability (Allen, 1995; Connell, 2007; Macedonia, 2003; Tellier, 2008) and delay forgetting them. If this is the case, then language and embodiment systems should be mutually constructive and dependent.

There are many researches that have shown positive effects of sensor-motor simulation made from interaction with environment on language learning based on embodied cognition theory. Macedonia, Müller, & Friederici (2011) demonstrated that gestures accompanying speech have a positive influence on memory for verbal information. In other words, meaningful and iconic gestures could enhance learners to retain the verbal learning material. Similarly, recall of verbal material has been shown to improve when adults are cued with self-generated hand gestures compared to when they aren't (Fargier, et al., 2012). These findings suggest that imitation of a gesture during retrieval can facilitate the recall of previously learned words. Given that language and the motor system are closely connected (Zwaan, Madden, Yaxley, & Aveyard, 2004) and that speech and gestures even seem to share the same communication system (Balcetis & Dunning, 2007), theories of embodied cognition will be able to predict that gestures have a significant function in language learning.

The present study

Based on this premise, the purpose of this study was to examine the effects of using visual stimulation and gesture, which is embodied language learning, on English learning achievement and learner's course interest in the EFL classroom. By using embodied cognition theory, experimental environment for embodied language learning system was designed for this study.

When it comes to conventional body-used language learning methods, there have existed some flaws as mentioned before, that is difficulty in handling many students

by teacher alone, boring of repetitive pattern, and being limited to only plain vocabulary learning. Thus technology-enhanced English learning by using Kinect was applied for making up for previous researches. Of course, there have been some researches that used Kinect for language learning. Kuo et al. (2014) testified embodiment-based learning for vocabulary learning. Their study coincided with revised TPR approach to cope with the disadvantage of difficulty in managing students, examining the effect of body gesture as did traditional TPR. However, in this study, we used two independent variables; using visual stimulation (animated graphic vs. still picture) and imitating body gesture (yes vs. no) by technology supported device. An another thing, in terms of embodied cognition, learning environments for language can be made more effective in the context of real exiting situation (Abrahamson & Lindgren, 2014). So we proposed more realistically contextual embodied language learning and examined more broad language learning field such as listening, vocabulary, and language structure with using animated graphic and still picture respectively.

For the purpose of carry out this study, we used two independent variables that is using imitating gesture (yes vs. no) and kind of visual stimulation (animates graphic vs. still picture). So there was four groups and thirty two third-grade elementary school students participated and were assigned into four English learning class conditions (i.e., using animated graphic and gestures condition, using only animated graphic condition, using still pictures and gesture condition, and control condition). The reason why this experiment was composed of four groups is that we verified the effect of embodied cognition in the respect of imitating materials to be learned bodily and watching sentences which were related to human movement task both animated graphic and still one.

In sum, based on the above review of the literature we drew several hypotheses concerning the effect of using different stimulations and gesture on learning achievement and course interest. We expect students to learn more words and language structure in the embodied condition (using images and gestures condition

during learning process) than in the no stimulation and embodied condition (i.e., just watching and repeating condition).

The research questions for this study are addressed below:

(1) What differences are there in post and delayed learning achievement between imitating gesture group and non-imitating one and between animated graphic group and still picture one?

(2) What differences are there in course interest between imitating gesture group and non-imitating one and between animated graphic group and still picture one?

Theoretical Background

Language learning based on embodied cognition

In the literature review concerning embodied cognition and language learning, it has been hypothesized that theory of embodiment has an educational value in that it can facilitate conceptual storage before the information has a linguistic form and facilitates understanding and memory. Language learners acquire abstract (novice) words easily not by labeling of words but by behaving related meaningful motion (Hahn & Gershkoff-Stowe, 2010). Moreover, imitating gestures during words retrieval facilitates manipulation of related sentence meaning (De Nooijer, Van Gog, Paas, & Zwaan, 2013) and intentional actions enhance specific neural motor parts of human system, which are also used as tools for lexical-semantic processing of body related expressions(Rueschemeyer, Lindemann, van Rooij, van Dam, & Bekkering, 2010). In line with this view, movement related sentence (i.e., 'Lift the pen.') has been shown to be better memorized when participants had activated the action themselves (Engelkamp & Zimmer, 1997). In this context, physical interaction with environment gestures will enhance the representation of words or phrases, making it difficult to forget and easy to acquire. Thus, embodied cognition

theory can be used to enforce educational tool that combines body and mind.

The body as an education tool for foreign language instruction

Embodied cognition settled into shape by Lakoff and Johnson in 1999 was known as various names and used in language instruction. The first attempt to integrate the body as a device for foreign language learning was done by Asher in the late 60s. The total physical response (TPR) got learners to respond with physical actions to teacher's commands in the form of imperative sentences (Asher & Price 1967). TPR has helped students understand and memorize linguistic materials. Among language teachers, Krashen & Terrell (1983) were well known for their influential natural approach, supporting TPR as a learning method for novice learners because it can involve learners in realistic language learning activities. In spite of potential advantage, there are at least three reasons for TPR not succeeding in efficient learning tool for second language instruction (Kuo, Hsu, Fang, & Chen, 2014). First, instructor alone are unable to take care of all individual students. Second, students who are not used to such things might find it embarrassing. Third, it is not flexibly used to teach everything, and if used a lot, it would become repetitive. Forth, when a teacher uses TPR in their lesson, they will have trouble teaching abstract vocabulary or expressions.

After the TPR approach, embodiment pervaded in instruction for foreign language which was embedded in a broader framework of lessons such as drama. Carels (1981) also proposed the systematic usage of gestures in language learning. Significantly, he argued that gestures should be performed by the students as well as the teachers, as a memory enhancing strategy. Scott, Harris, & Rothe (2001) adopted a similar stance and described usage of meaningful, iconic and metaphoric gestures in Italian lessons for German speaking students. Particularly, she found the positive effects of embodiment on memory.

Visual stimulation in line with on embodied cognition

When it comes to using visual stimulation, when animated graphics can facilitate to demonstrate human movement, vigorous visualizations like animations or videos are activated (Höffler & Leutner, 2007). Van Gog et al., (2009) stated that the mirror neuron system which is enhanced by watching someone else's action might be an answer for that phenomenon. This premise that we human being could learn through imitation was shaped by Rizzolatti & Craighero (2004). In harmony with this concept of the mirror neuron, embodied cognition theories emphasize the importance of involvement of the motor in learning process as well. These embodied cognition studies showed the relationship between the motor system and semantics, and it is also suggested that animations might be able to be improved by enhancing the motor system by watching and imitating gestures or making students mimic gestures. In terms of learning activity, observation of animating subjects was found to be effective.

Method

Research design & participants

Participants were thirty two Korea primary school children (18 males, 14 females), between ten and eleven years of age (M = 10, SD = 0.6), who were recruited from six primary schools in the same area of the Korea. Children, who were not born in the Korea, were excluded from data analysis. They were divided into four groups and were assigned into four English learning class conditions (using animated graphic and gestures condition; 8, using only animated graphic condition; 8, using still pictures and gesture condition; 8, and control condition; 8) respectively.

We tested primary school children of approximately ten years old because these children are still in the process of acquiring new language with their first language, while being old enough to be able to participate in a study like this one, which requires sustaining attention for the duration of the study, understanding the instructions, and being controlled within a relatively short time.

The independent variables for this study were types of visual stimuli (still picture/ animated graphic) and using gesture (yes/no). In detail, visual stimuli which are related to to-be-learned image were presented to students in two patterns (still picture and animated graphic) and using gesture (embodied simulation) meant imitating gesture in accordance with visual stimuli. As for the dependent variables for this study were learning achievement (listening /vocabulary/language structure) and course interest (attention/ confidence/ relevance/ satisfaction, ARCS) designed by Keller(1987a). Therefore 2 × 2 mixed design was used for this purpose as shown in table 1.

Table 1. Experimental design for embodiment-based learning

		Embodied stimulation(imitating gesture)	
		Yes	**No**
Visual stimulation (animated graphic)	Animated	Animated graphic + Gesture (group A)	Animated graphic + No Gesture (group B)
	Still	still picture + Gesture (group C)	Control group (group D)

* Embodied stimulation (imitating gesture Y/N), Visual stimulation (animated/still picture)

To put explanation of experimental treatment for this study in order, as shown in Fig 1, in the group A, all students would listen and watch with animated graphic and imitate sentence both bodily and verbally. In the group B, all learners would listen and watch animated graphic but imitate sentence only verbally. And group C, all students would listen and watch with still picture and imitate sentence both

bodily and verbally. Finally, group D, learners would listen and watch still picture and imitate sentence only verbally.

	Treatment (Independent variables)			
	Watching visual stimulation		Using imitating sentence	
	Animated graphic	Still picture	Bodily and verbally	Only verbally
Group A				
Group B				
Group C				
Group D				

Figure 1. Learning procedure for embodiment-based learning

Dependent variables (learning achievement and course Interest)

Two English teachers conducted making sentences to be learned. In this context, we used English sentences related to context of real situation (school, home, playground, and physical condition). For each sentence congruent visual stimuli were created. All pictures were depicted as realistically as possible and could be imitated by learners as a form of gesture.

As for the English achievement test which was composed of three parts such as listening, vocabulary, and language structure test, two English teachers put into practice making and revising. After treatment, the test was used as post-test and delayed test with the form of multiple-choice and filling in the blanks questions regarding the sentences to be learned.

As for course interest measurement, CIS called the Course Interest Survey, was used. CIS is not intended to directly measure students' generalized levels of motivation but to measure students' reactions to classroom instruction (Keller, 2006). As an example of usage, Kim (2004) used CIS as a tool for measuring attitude in a technology-related design task. CIS is situational measure of students' motivation to learn with reference to a specific learning condition such as an

instructor-facilitated learning environment. It was designed to be in correspondence with a theoretical foundation represented by a specific model of learner motivation which is called the ARCS model (Keller, 1987a, 1987b). The total reliability of CIS is Cronbach's α .95 and all of the correlations are significant at or beyond the .05 level (Keller, 2006). The measurements adopted a 5-point Likert-type response scale (1= strongly disagree, 5 = strongly agree).

Independent variables (learning system)

The embodied language learning system for this study was designed by using Microsoft's wireless sensing Kinect. Kinect is a wireless motion sensing devices that is developed by Microsoft for Xbox 360 and console for Xbox video game consoles and windows computers. Grounded around an added webcam, it makes users interact and control with their computer or console without game controller's need. The windows presentation foundation by using C# language was applied for composing learning system for both command and feedback as a form of body skeleton.

The procedure for this study was designed to help students enhance their language skills through listening, watching, mimicking to-be-learned learning materials, and repeating (see Fig 2). At first, learners were introduced to the learning activity. Then, by clicking sentence number in the window presentation foundation, an animated clip instructing sentence will be played. Students would listen and watch the educational material and enact the gesture demonstrated in the screen. When finishing the learning sentence, student will proceed to the next sentence by clicking next number. Learners can get feedback from the screen by means of seeing themselves both in reflection and body skeleton for feedback. The system accommodate two learners at a time as shown on see Fig 3.

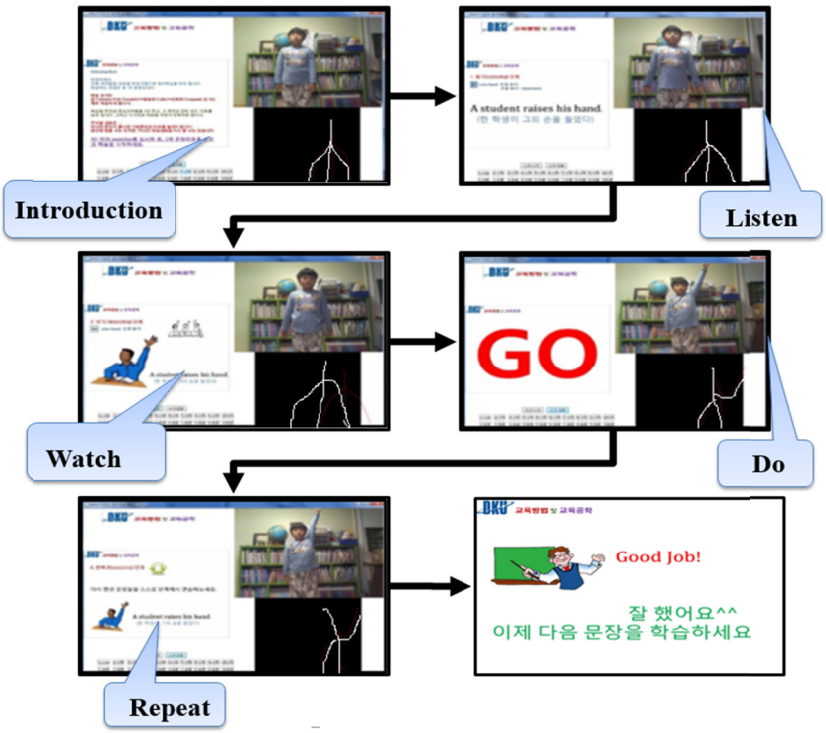


Figure 2. Learning procedure for embodiment-based learning

Figure 3. Construction of embodied language learning

Experimental procedure and data analysis

Whole experimental procedure was performed as below. Listening, vocabulary, and language structure test were given as a pretest. After finishing the pretest, all students would be instructed whole procedure of experiment and some precautions of experiment. In the group A condition, all students would listen and watch animated graphic and imitate gesture and sentence verbally. In the group B condition, all learners would listen and watch animated graphic but imitate sentence only verbally. The procedure of group C was identical with group A except for using still picture instead of animated graphic. Finally, in the control group, all students would listen and watch still picture and imitate sentence only verbally. Throughout whole procedure, all students would be treated same learning steps, which were listen-watch-do-repeat sequence. After finishing all experimental treatment, posttest for learning achievement and course interest survey were given to all participants. After two weeks, delayed test was performed for measuring learners' retention.

The experiment design of this study applied Kinect as a method for treatment, which led to limitation of gathering enough sample. So as a testifying normal distribution and normality of data, shapiro-wilk test was performed. The result of shapiro-wilk test showed that we couldn't concludes normal distribution in post vocabulary test ($p=.030$), delayed listening test ($p=.023$), and delayed vocabulary test ($p=.002$). As a result, nonparametric statistics (i.e., Mann-Whitney U test for main effect and Kruskal-Whallis test for group difference) was used to analyze data for this study.

Result

The descriptive statistics for all dependent variables of learning achievement are

presented in Table 2. This table is organized according to using animated graphic and imitating gesture (i.e., main effect) and, also according to the four participant conditions (both gesture and animated graphic, animated graphic only, gesture, and control group). Mean scores and standard deviations for both tests are given in Table 2.

Table 2. Descriptive statistics for the dependent variables of learning achievement

Independent variables			Dependent variables					
			Listening		Vocabulary		Language structure	
			Post	Delayed	Post	Delayed	Post	Delayed
Effect	Imitating gesture	Yes	7.69 (1.25)	7.81 (1.17)	8.06 (.85)	8.19 (.54)	3.25 (.76)	4.31 (.60)
		No	7.31 (1.40)	7.63 (.89)	7.00 (.97)	7.56 (.51)	2.75 (.68)	3.56 (.81)
	Animated graphic	Yes	7.94 (.93)	8.13 (.62)	7.06 (1.53)	7.75 (.58)	3.06 (.68)	3.94 (.77)
		No	7.06 (1.53)	7.31 (1.12)	7.88 (1.03)	8.00 (.63)	2.94 (.85)	3.94 (.85)
Group	A	G+A	8.25 (.71)	8.38 (.52)	8.25 (.89)	8.00 (.54)	3.50 (.54)	4.25 (.71)
	B	M	7.63 (1.06)	7.88 (.64)	7.50 (1.07)	7.50 (.54)	2.63 (.52)	3.63 (.74)
	C	G+A	7.13 (1.46)	7.25 (1.39)	7.88 (.83)	8.38 (.52)	3.00 (.93)	4.38 (.52)
	D	X	7.00 (1.69)	7.38 (1.06)	6.50 (.54)	7.63 (.60)	2.88 (.84)	3.50 (.93)

* Notes: Possible range for listening/vocabulary (0-10), for structure (0-5).
* For the group, G: Using gesture, A: Animated graphic, S: Still picture.
* For the effect, Yes: Using, No: Not using

As shown in Table 2, using imitating gesture marked high score in vocabulary test. The mean of post vocabulary test was 8.06 (SD=.85) and delayed test was 8.19 (SD=.54). As for the listening test, the mean for the post test in watching animated

graphic was 7.94 (SD=.93) and delayed test was 8.14 (SD=.62). And in terms of language structure, using imitating gesture showed high score for both post (M=3.25, SD=.76) and delayed test (M=4.31, SD=.60). As for the group, using gesture and animated graphic group showed the highest mean and standard deviation of all the groups.

Analysis of learning achievement

Mann-Whitney U test was performed to investigate main effects of visual stimulation and body gesture on English learning achievement. Three dependent variables were used: listening comprehension, vocabulary, and language structure for both posttest and delayed test each. The independent variables were using animated graphic and imitating gesture for the intended learning materials. And additional Kruskal-Wallis test was carried out to investigate difference of four participant group conditions as shown in Table 3.

Table 3. Overview of main effects for learning achievement

	Post test	**Delayed test**
Listening		
Animated graphic(Y/N)	U=79.00, Z=-1.89, *p*=.058	U=69.00, Z=-2.37, *p*=.018*
Imitating gesture(Y/N)	U=140.00, Z=-.908, *p*=.364	U=114.00, Z=-0.56, *p*=.575
Vocabulary		
Animated graphic (Y/N)	U=81.50, Z=-1.84, *p*=.066	U=102.00, Z=-1.14, *p*=.254
Imitating gesture(Y/N)	U=53.50, Z=-2.947, *p*=.003*	U=62.00, Z=-2.28, *p*=.004*
Structure		
Animated graphic (Y/N)	U=116.50, Z=-.464, *p*=.643	U=124.50, Z=-0.14, *p*=.887
Imitating gesture(Y/N)	U=82.00, Z=-1.856, *p*=.063	U=62.50, Z=-2.65, *p*=.008*

* $p < .05$
* For the Y or N, Y: Using, N: Not using

Before mentioning post and delayed achievement test, there was no significant difference in the pretest, so in this chapter comparison among pre, post and delayed test was left out. Considering the result of two independent variables(using gesture and visual stimulation), we conducted Mann-Whitney U test. As for posttest, the result of Mann-Whitney U test indicated that significant difference occurred in using gesture on vocabulary (Z=-2.947, p<.05). However there were no significant differences in independent variables on the other dependent variables. When it comes to delayed test, Mann-Whitney U test analysis indicated that significant differences occurred in three dependent measures: gesture on vocabulary (Z=-2.37, p<.05), animated graphic on listening (Z=-2.28, p<.05), and vocabulary on language structure(Z=-2.65, p<.05). On the other hand, there were no significant differences in independent variables on rest of dependent variables.

Table 4. Overview of group effects for learning achievement

Dependent variables	Independent variables		Post	Delayed
Listening	**A**	**G+A**	χ^2=4.68, df=3, p=.197	χ^2=7.08, df=3, p=.069
	B	**A**		
	C	**G+S**		
	D	**X**		
Vocabulary	**A**	**G+A**	χ^2=12.90, df=3, p=.005*	χ^2=9.95, df=3, p=.019*
	B	**A**		
	C	**G+S**		
	D	**X**		
Language structure	**A**	**G+A**	χ^2=5.60, df=3, p=.133	χ^2=7.16, df=3, p=.067
	B	**A**		
	C	**G+S**		
	D	**X**		

* p <.05
* For the group, G: Using gesture, A: Animated graphic, S: Still picture.

As for the aspect of group condition variables(group A, B, C, and D), we conducted Kruskal-Wallis test. Kruskal-Wallis test analysis indicated that there was an overall effect of four participant group conditions on vocabulary ($\chi 2=12.90$, df=3, $p<.05$) for the posttest(see Table 4). However there were no significant differences in four participant group conditions on the listening ($\chi 2=4.68$, df=3, $p>.05$) and language structure ($\chi 2=5.60$, df=3, $p>.05$). Regarding delayed test, the result of Kruskal-Wallis test suggested that significant difference occurred in four participant group conditions on vocabulary ($\chi 2=9.95$, df=3, $p<.05$). However, there were no significant differences in four participant group conditions on the other dependent variables. Kruskal-Wallis test results indicated that the students who studied with gesture and animated graphic related to learning material might enhance the ability of vocabulary higher than that of listening and language structure.

Analysis of course interest measurements

The descriptive statistics for all dependent variables of course interest (attention, relevance, confidence, satisfaction) are presented in Table 2. This table is organized according to using animated graphic and imitating gesture (i.e., main effect) and, also according to the four participant conditions (both gesture and animated graphic, animated graphic only, gesture, and control group).

As shown in Table 5, using imitating gesture showed high score in attention (M=31.69, SD=2.92), relevance (M=42.00, SD=2.72), and satisfaction (M=37.88, SD=2.73) except for confidence (M=32.94, SD=4.22). And also the mean and standard deviation were high in the watching animated graphic condition; attention (M=30.19, SD=3.35), relevance (M=30.19, SD=3.35), and confidence (M=41.50, SD=2.71). In terms of group condition, using gesture and animated graphic group showed the highest mean and standard deviation in confidence (M=33.25, SD=5.42) and satisfaction (M=38.50, SD=2.93).

Table 5. Descriptive statistics for the dependent variables of academic interest

Independent variables			Dependent variables			
			Attention	Relevance	Confidence	Satisfaction
Effect	Imitating gesture	Yes	31.69 (2.92)	42.00 (2.71)	32.94 (4.22)	37.88 (2.73)
		No	29.31 (2.82)	40.25 (2.05)	31.31 (3.57)	35.94 (1.73)
	Animated graphic	Yes	30.19 (3.35)	30.19 (3.35)	41.50 (2.71)	31.94 (2.11)
		No	28.81 (3.35)	28.79 (3.14)	40.75 (2.35)	32.31 (2.41)
Group	A	G+A	31.38 (3.82)	41.88 (3.31)	33.25 (5.42)	38.50 (2.93)
	B	A	29.00 (2.51)	41.13 (2.10)	30.63 (4.75)	37.13 (1.13)
	C	G+S	32.00 (1.85)	42.13 (2.17)	32.63 (2.93)	37.25 (2.55)
	D	X	27.63 (3.11)	39.38 (1.69)	32.00 (1.93)	34.75 (1.39)

* Notes: Possible range for A & C (1-40), for R & S (1-45).
* For the group, G: Using gesture, A: Animated graphic, S: Still picture
* For the effect, Yes: Using, No: Not using

To examine the effects of visual stimulation and body gesture on students' course interest, a two-way Mann-Whitney U test was conducted, with four sub-measures including attention, relevance, confidence, and satisfaction. The Mann-Whitney U test result showed that there were significant differences in four dependent measures: gesture on attention ($Z=-3.37$, $p<.05$), gesture on relevance ($Z=-2.62$, $p<.05$), gesture on satisfaction ($Z=-2.17$, $p<.05$), and animated graphic on satisfaction ($Z=-2.25$, $p<.05$). On the other hand, there were no significant differences in independent variables on rest of dependent variables. And additional Kruskal-Wallis test was carried out for investigating difference of four participant group conditions. The result of Kruskal-Wallis test had it that significant difference occurred in four participant group conditions on attention ($\chi 2=11.63$, $df=3$, $p<.05$),

on relevance ($\chi 2=9.09$, df=3, $p<.05$), and on satisfaction ($\chi 2=10.48$, df=3 $p<.05$). However, there were no significant differences in four participant group conditions on the other dependent variables (see Table 6).

Table 6. Overview of main and group effects for course interest

Dependent variables	Main effect				Group effect			
	Mann-Whitney U test				Kruskal-Whallis test			
	Imitating gesture		Animated graphic		A	B	C	D
	Y	N	A	S	G+A	a	G+S	X
Attention	U=124, Z=-.15, *p*=.879		U=39.5, Z=-3.37, *p*=.001*		χ^2=11.63, df=3, *p*=.009*			
Relevance	U=95, Z=-1.27, *p*=.203		U=60, Z=-2.62, *p*=.009*		χ^2=9.09, df=3, *p*=.028*			
Confidence	U=107, Z=-.80, *p*=.426		U=89.5, Z=-1.46, *p*=.144		χ^2=2.96, df=3, p=.398			
Satisfaction	U=69, Z=-2.25, *p*=.025*		U=71, Z=-2.17, *p*=.030*		χ^2=10.48, df=3, p=.015*			

* p <.05
* For the group, G: Using gesture, A: Animated graphic, S: Still picture.
* For the Y or N, Y: Using, N: Not using

Discussion and Conclusion

The purpose of this study was to investigate whether using visual stimulation and gesture, namely embodiment-based learning could affect English learning achievement and course interest immediately after studying and after two week delay. The embodiment-based English learning system for this study was designed by using Microsoft's Kinect sensing devices. The results of this study are summarized as follows:

First, visual stimulation had a positive influence on the delayed listening test. However, there were no significant differences on the post achievement test and curriculum interest. This is because the types of visual stimulation for learning materials had positive effects on learning performance whether they were animated graphic or still one (Shintel & Nusbaum, 2007). This results were coincident with previous findings that cognition and thinking happen in experiencing particular

stimulation which links to the nerve of related area (Barsalou, 1999; Skipper, Goldin-Meadow, Nusbaum, & Small, 2007). On the contrary, our results are inconsistent with the results of previous research studies that color affects words memory (Yaxley & Zwaan, 2007) and definition of picture affects sentence understanding (Taylor, 2006; Tversky, 2009; Yu & Smith, 2012) in that delicate attributes of pictures have more significant impacts than plain pictures.

Second, imitating gesture for related studying materials has positive effects on the post vocabulary test and delayed language structure test. Previous research findings that the impact of gestures enhance memory for verbal information in a foreign language (Allen, 1995) and learning through visualized gesture helps significantly better retrieval in the short and long-term vocabulary memory (Macedonia, 2003) have supported our results. And another thing, as for the course interest, there were significant difference in imitating gesture for related studying materials on attention, relevance, and satisfaction. This results match up with the notion that for the purpose of performing behaviors or willingly accepting stimulation, the process of concentration and cognitive ability can facilitate attention and satisfaction (Bäckman, Nilsson, & Chalom, 1986).

Third, when it comes to the effect of four participant group conditions on learning achievement, significant difference occurs on post and delayed vocabulary test. Of four participant groups, students who studied with gesture and animated graphic related to learning material might enhance the ability of vocabulary higher than those of the other groups. This is because words enacted by bodily gesture are better remembered than words visualized by picture (Teller, 2008). Concerning course interest, the fields of attention, relevance, and satisfaction are enhanced by using animated graphic and imitating gesture simultaneously. Krashen (1983) said that affective filter and feeling of anxiety should be overcome for improving confidence in language learning. The reason that confidence is not enhanced by imitating gesture might be attributed to the notion of Krashen's the input hypothesis (Knudsen, 2007).

Overall the results of this study suggest that imitating gesture in learning new words in a foreign language or in an artificial chunk significantly improves the words' memorization and delays forgetting them compared to conventional language learning methods. Based on these results, several implications have been derived, which will be discussed as follows.

First, this study shows possibility of the embodied language learning system which takes into consideration embodied cognition theory. The embodiment-based English learning system for this study is designed by using Microsoft's Kinect wireless sensing devices which can interact with learners by feedback and have already proved to be positive in rehabilitation and treatment for the disabled. This could be helpful for the further researches in terms of triggering learners' interests and motivation.

Second, findings of this study show that individual difference should be taken into account when preparing instructional design. Even though learners who are not interested in novelty experience such as embodiment-based learning, they performed better in learning achievement than those who show interest in embodiment-based learning.

Third, this study suggests the importance of searching multisensory physical experience matching each subject matter. And the results of this study open a new way to overcoming the limitations that physical experience will be suitable only for the field of art, music and physical education. It has a meaningful significance to emphasize physical experience in learning and expand embodied cognition in terms of sensible perspective as well.

This study also includes several limitations, the most important of which is the small size and scope of the sample due to experimental condition that used Kinect. A follow-up study, if participating a larger number of samples, will provide a better understanding for generalization. Especially as for the listening test, it will take a long time to get through improvement. However, in this study, only limited short term was considered for learning achievement. Therefore relatively short period of

observation could be also pointed to as a weakness in this study.

For future study, additional study had better be carried out for not so much short term as long term. And also additional qualitative data related to learner's behavior should be collected in performing tasks. Behavior analysis, which extracts data much larger, by applying factor analysis taken into treatment conditions can help estimate parameter. Lastly, research that could expand the field of its application through various teaching methods and instructional designs for individual embodied experience may need to be made.

References

Abrahamson, D., & Lindgren, R. (2014). Embodiment and embodied design. In R. K. Sawyer (Eds.), *The Cambridge handbook of the learning sciences* (pp. 358-376). Cambridge, UK: Cambridge University Press.

Allen, L. Q. (1995). The effects of emblematic gestures on the development and access of mental representations of French expressions. *The Modern Language Journal, 79*(4), 521-529.

Asher, J. J., & Price, B. S. (1967). The learning strategy of the total physical response: Some age differences. *Child Development*, 1219-1227.

Asher, J. J. (1997). *Learning Another Language Through Actions: The Complete Teacher's Guidebook*. San Jose, SJ: Pajaro Press.

Bäckman, L., Nilsson, L. G., & Chalom, D. (1986). New evidence on the nature of the encoding of action events. *Memory* & *Cognition, 14*(4), 339-346.

Balcetis, E., & Dunning, D. (2007). Cognitive dissonance and the perception of natural environments. *Psychological Science, 18*(10), 917-921.

Barsalou, L. W. (1999). Perceptual symbol systems. *Behavioral and brain sciences, 22*(4), 577-660.

Barsalou, L. W. (2008). Grounded cognition. *Annual Review of Psychology, 59*, 617-645.

Bekkering, H., & Neggers, S. F. (2002). Visual search is modulated by action intentions. *Psychological Science, 13*(4), 370-374.

Carels, P. E. (1981). Pantomime in the foreign language classroom. *Foreign Language annals, 14*(5), 407-411.

Connell, L. (2007). Representing object colour in language comprehension. *Cognition, 102*(3), 476-485.

De Nooijer, J. A., Van Gog, T., Paas, F., & Zwaan, R. A. (2013). Effects of imitating gestures during encoding or during retrieval of novel verbs on children's test performance. *Acta Psychologica, 144*(1), 173-179.

Engelkamp, J., & Zimmer, H. D. (1997). Sensory factors in memory for subject-performed tasks. *Acta Psychologica*, 96(1), 43-60.

Fargier, R., Paulignan, Y., Boulenger, V., & Nazir, T. A. (2012). Learning to associate novel words with motor actions: language-induced motor activity following short training. *Cortex, 48*(7), 888-899.

Gallese, V. (2007). Before and below 'theory of mind': embodied simulation and the neural correlates of social cognition. Philosophical Transactions of the Royal Society B: *Biological Sciences, 362*(1480), 659-669.

Glenberg, A. M. (1997). What memory is for: Creating meaning in the service of action. *Behavioral and Brain Sciences, 20*(01), 41-50.

Hahn, E. R., & Gershkoff-Stowe, L. (2010). Children and adults learn actions for objects more readily than labels. *Language Learning and Development, 6*(4), 283-308.

Hostetter, A. B. (2011). When do gestures communicate? A meta-analysis. *Psychological Bulletin, 137*, 297-315.

Höffler, T. N., & Leutner, D. (2007). Instructional animation versus static pictures: A meta-analysis. *Learning and Instruction*, *17*(6), 722-738.

Keller, J. M. (1987a). Development and use of the ARCS model of instructional design. *Journal of instructional development, 10*(3), 2-10.

Keller, J. M. (1987b). Strategies for stimulating the motivation to learn. *Performance and Instruction, 26*(8), 1-7.

Keller, J. M. (2006). Development of two measures of learner motivation. Unpublished Manuscript in progress. Florida State University.

Kelly, S. D., McDevitt, T., & Esch, M. (2009). Brief training with co-speech gesture lends a hand to word learning in a foreign language. *Language and Cognitive Processes, 24*(2), 313-334.

Kim, M. (2005). *The effects of the assessor and assessee's roles on preservice teachers' metacognitive awareness, performance, and attitude in a technology-related design task* (PhD Thesis), The Florida State University.

Knudsen, E. I. (2007). Fundamental components of attention. *Annual Review of Neuroscience, 30*, 57-78.

Krashen, S. T., Stephen, D., Terrell, D., & Tracy, D. (1983). *The Natural Approach: Language Acquisition in the Classroom*. San Francisco, CA: The Alemany Press.

Kuo, F. R., Hsu, C. C., Fang, W. C., & Chen, N. S. (2014). The effects of Embodiment-based TPR approach on student English vocabulary learning achievement, retention and acceptance. *Journal of King Saud University-Computer and Information Sciences, 26*(1), 63-70.

Lakoff, G. & Johnson. M. (1999). *Philosophy in The Flesh: the Embodied Mind and its Challenge to Western Thought*: Basic Books.

Macedonia, M. (2003). *Sensorimotor enhancing of verbal memory through 'Voice Movement Icons' during encoding of foreign* (PhD Thesis), University of Salzburg.

Macedonia, M., Müller, K., & Friederici, A. D. (2011). The impact of iconic gestures on foreign language word learning and its neural substrate. *Human brain mapping, 32*(6), 982-998.

Richardson, D. C., Spivey, M. J., Barsalou, L. W., & McRae, K. (2003). Spatial representations activated during real-time comprehension of verbs. *Cognitive science*, *27*(5), 767-780.

Rizzolatti, G., & Craighero, L. (2004). The mirror-neuron system. Annu. Rev. Neurosci., 27, 169-192.

Rueschemeyer, S. A., Lindemann, O., van Rooij, D., van Dam, W., & Bekkering, H. (2010). Effects of Intentional Motor Actions on Embodied Language Processing. *Experimental Psychology, 57*(4), 260-266.

Scott, C. L., Harris, R. J., & Rothe, A. R. (2001). Embodied cognition through improvisation improves memory for a dramatic monologue. *Discourse Processes, 31*(3), 293-305.

Shintel, H., & Nusbaum, H. C. (2007). The sound of motion in spoken language: Visual information conveyed by acoustic properties of speech. *Cognition, 105*(3), 681-690.

Skipper, J. I., Goldin-Meadow, S., Nusbaum, H. C., & Small, S. L. (2007). Speech-associated gestures, Broca's area, and the human mirror system. *Brain and language, 101*(3), 260-277.

Taylor, R. A. (2006). Seeing, Acting, Understanding : Motor Resonance in Language Comprehension. *Journal of Experimental Psychology: General, 135*(1), 1-11.

Tellier, M. (2008). The effect of gestures on second language memorisation by young children. *Gesture, 8*(2), 219-235.

Tversky, B. H. (2009). Embodied and disembodied cognition: Spatial perspective-taking. *Cognition, 110*(1), 124-129.

Van Gog, T., Paas, F., Marcus, N., Ayres, P., & Sweller, J. (2009). The mirror neuron system and observational learning: Implications for the effectiveness of dynamic visualizations. *Educational Psychology Review, 21*(1), 21-30.

Wilson, M. (2002). Six views of embodied cognition. *Psychonomic Bulletin & Review, 9*(4), 625-636.

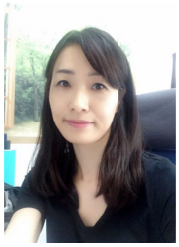
Yaxley, R. H., & Zwaan, R. A. (2007). Simulating visibility during language comprehension. *Cognition, 105*(1), 229-236.

Yu, C., & Smith, L. B. (2012). Embodied attention and word learning by toddlers. *Cognition, 125*(2), 244-262.

Zwaan, R. A., Madden, C. J., Yaxley, R. H., & Aveyard, M. E. (2004). Moving words: Dynamic representations in language comprehension. *Cognitive Science, 28*(4), 611-619.

Dongyeon CHOI

Doctoral Course Student, Dept. of Education Technology,
College of Education, Dankook University.
Interests: Educational Technology, Instructional Design, Embodied Cognition in Language Learning, Virtual Reality.
E-mail: airmania73@gmail.com



Minjeong KIM

Associate Professor, Dept. of Teaching Education, College of Education, Dankook University.
Interests: Peer Assisted Learning, Learning System Development, Cognitive Study on Media Learning
E-mail: minjeong69@dankook.ac.kr http://cafe.naver.com/danedutech#

Received: August 28, 2015 / Peer review completed: October 12, 2015 / Accepted: October 15, 2015