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Learning English Words via Visual Media using Tablet PCs

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Abstract: A tablet PC system using an etymological memorization method with animations can enable Japanese children to memorize English words. The system specifically helps with memorization of compound nouns, which are combination of two simple nouns, for animals. For each noun it shows an animation with a narration produced by a voice synthesizer, followed by an animation showing the compound noun, again with narration. The system was experimentally evaluated by comparing the effectiveness of using animation, pictures, and text.

Keywords: Learning English Words, Etymological memorization method, Tablet PCs.

1. Introduction

We have developed a system of iPad applications that is effective in enabling children to memorize English words yet enjoy themselves while learning English. The system specifically helps with memorization of compound nouns, which are combination of two simple nouns.
A compound noun is a combination of two or more simple nouns such that the meaning can be derived from the meanings of the simple nouns. We think that this concept is important for training English learners at an early age, because children come to understand the meanings of various words by considering etymology. For example, Japanese students have difficulty predicting the meaning of a new English word, because Japanese and English are so different. In particular, it is difficult to cope with a complex English word at first sight. The meaning can be made predictable, however, by dividing the word and thinking about the etymology of each part. Using this approach, students can learn many English words that they do not already know. In Japan, full-scale English education starts from junior high school. We want to encourage children to maintain this applied word learning skill for future English learning, and that is why we developed this system of iPad applications before entering junior high school.
Therefore, in our system we apply an etymological memorization method (Zhang and Han 2004), which entails learning compound words by being conscious of the origin of each constituent word. For example, “centipede” consists of “centi” (hundred) and “pede” (foot). The idea is that the learning effect should be increased by learning words via animations for understanding both compound nouns and their constituent simple nouns.
Our group has extensively researched content understanding through animation and shown that animations are effective for understanding content and vocabulary (Sumi and Tanaka 2005) , (Sumi and Nagata 2011), (Sumi and Nagata 2012). In general, animations have been shown to improve understanding and recall of text, making them an effective tool for promoting learning (Levie and Lentz 1982). Research has also shown that animations increase motivation to learn (Rieber 1991). This paper introduces our system and presents a comparative evaluation with elementary school students as subjects using the system with animations, pictures, and Japanese characters.
In addition, we think that after a student learns compound nouns, improvement in long-term memory is possible through the opportunity to use those nouns several times. For example, consider the case of building a simple sentence by combining a noun and a verb. Therefore, our system also has a function for sentence construction, in which the student combines memorized compound nouns and verbs and views corresponding animations.
As for the effect of the etymological memorization method, research has verified its learning effect and indicated the advantage of being able to imagine the meaning of an unknown word by being conscious of etymology (Kikuchi 2011). Another study (Suzuki 2011) examined etymology learning by showing

English words corresponding to Japanese words. This study involved changing the colors of the constituents of a compound noun and showing the whole noun, with a beneficial learning effect for some subjects. We thus adopt the technique in our system of separating English words by color according to etymology.
The field of second language acquisition attaches importance to conveying a message through the meaning of the language rather than focusing on the form of the language. The etymological memorization method corresponds to such basic learning for conveying a message, since learners understand the meaning of the language. This system is also related to the classic flash card systems of computer-assisted language learning (CALL).
This paper investigates the additional effects of animations, pictures, and characters. The sentence construction application entices children to generate an animation by choosing a noun and verb intuitively. It aims to imprint English words on students' memories via learning in an enjoyable way.

2. English Vocabulary Learning Applications

The system consists of four applications: "English Vocabulary," "Sentence Construction," "Vocabulary Quiz," and "Word Meaning Deduction Quiz." The "English Vocabulary" application operates in three different ways, using animations, pictures, or Japanese characters, to compare the effects of these three approaches. The picture and Japanese character approaches respectively show a freeze frame of a picture or Japanese characters representing a noun. In contrast, the animation approach expresses an explanatory state in which, for each noun, an animated animal appears and coalesces from a smoke screen, so that the application finally shows the animal corresponding to a compound noun.
We chose animal nouns as the target words because they are familiar to children. The field of second language acquisition considers background knowledge important for understanding input (Krashen 1985). To make learning more effective by exploiting the learner's field of interest (Shirai 2004), we thus chose animal words.
After learning compound animal nouns, students can use the Sentence Construction application to build sentences using the compound nouns while seeing animations of the corresponding animals. Students then use the Vocabulary Quiz application to confirm how many words they have memorized. We also developed the Word Meaning Detection Quiz application to see if children could deduce the meanings of unlearned compound nouns merely from hints in the form of simple nouns. The system keeps track of the current time, the class, the student number, the application, and the student's numbers of correct and incorrect answers.
All applications were developed using Adobe Flash Professional CS6, Adobe AIR for iOS, and ActionScript 3.0. All icons and pictures were created using Adobe Illustrator CS5. Sound for words in English was obtained from Google's speech synthesis system with words recorded beforehand in MP3 format. The system was designed to clearly express English words through pictures and animations and to support intuitive operation leveraging the benefits of the iPad.

2.1 English Vocabulary application

As noted above, the English Vocabulary application operates in one of three ways, using animations, pictures, or Japanese characters. We chose compound nouns for ten kinds of animals. In a preparatory experiment, we confirmed that ten English compound nouns in our system were not familiar to Japanese fifth and sixth graders, although they knew the Japanese words for these animals. We concluded that memorization of ten words was a sufficient challenge for these students.
The starting screen displays icons for these ten compound nouns. Touching one of the ten icons switches the screen to the corresponding learning screen for the compound noun. Touching the "?" button causes the animation (or picture, or Japanese character) corresponding to the word to be shown on the screen, with the sound of the word in English played at the same time. Similarly, touching the "=" button causes the application to show the animation (picture, character) and play the sound corresponding to the whole compound noun. Furthermore, the animation shows the process of joining the two English words forming the compound together. The sound can be replayed by touching the icon.

2.2 Sentence Construction Application

The Sentence Construction application is designed to promote long-term word memorization through sentence construction. The student chooses a compound noun, which has already been learned, and a simple verb. The starting screen displays icons for the ten compound nouns and ten suitable verbs. The compound nouns, listed on the left side, and the verbs, listed on the right side, can be selected by dragging each into the respective left or right part of the center area. The animation for the resulting sentence then appears in the lower part of the screen.

2.3 Vocabulary Quiz Application

The Vocabulary Quiz application is used to confirm whether the student was able to memorize the compound nouns. The application provides two kinds of quizzes, called Test 1 and Test 2. In both tests, upon seeing the corresponding characters and hearing the corresponding sound, the student chooses an answer by selecting one of four icons to represent the compound noun. In Test 1, the four answer choices consist of two of the compound nouns, including the correct answer, and two simple nouns. In Test 2, the four choices consist of three compound nouns and one simple noun. For the word test in our experiment we adopted Test 2, which is more difficult than Test 1, according to the results of a pre-test experiment with children.
The spoken compound noun can be replayed by touching the button next to the word. If the student selects the right answer, the application switches to a "correct answer" screen with a corresponding sound. Likewise, if the student selects a wrong answer, the application switches to an "incorrect answer" screen with a corresponding sound. One of six different screens is finally shown according to the number of correct answers.
Note here that our system keeps track of the current time, the class, the student number, the application, and the student's numbers of correct and incorrect answers.

2.4 Word Meaning Deduction Quiz Application

This application is used to confirm whether the student can deduce the meaning of an unlearned compound noun from the etymology of English words. As in the Vocabulary Quiz application, this etymology quiz lets the student choose an answer by selecting one of four icons expressing a compound noun, upon seeing the corresponding character and hearing the corresponding sound. Because this test has a high difficulty level, the system shows hints in the form of pictures and characters for words with helpful etymology.

3. Experiment

We held an English learning workshop using our system with 111 children: 34 sixth graders (20 boys, 14 girls), and 77 fifth graders (38 boys, 39 girls). We analyzed the following issues: (1) comparison among media, in terms of which media are effective for memorizing nouns; (2) whether sentence construction is effective for memorizing English words; (3) whether the system differs in effectiveness depending on experience in learning English; (4) whether the system differs in effectiveness depending on cognitive style; (5) and whether, after learning nouns, students find sentence construction by combining a noun with a simple verb effective for memorization.
We used the Vocabulary Quiz application as a word test, and the Word Meaning Deduction Quiz application as an etymology test.
To compare effectiveness, we also developed English vocabulary applications using pictures and Japanese characters, in addition to the application using animations.
We pretested and distributed the subjects into five groups, without differentiation according to gender, English learning experience, or cognitive style. A chi-square test showed no significant difference in bias in the number of subjects for any cross tabulations. The allotment to each group was thus non-biased.
Group 1 used the English Vocabulary application with animations and the Sentence Construction application. Group 2 used the English Vocabulary application with pictures and the Sentence

Construction application. Groups 3, 4, and 5 used only the English Vocabulary application, with animations, pictures, and Japanese characters, respectively. We used the Group Embedded Figures Test (GEFT) to screen cognitive styles. The GEFT involves looking for a specified figure from among various provided figures. It consists of seven practice questions as the first section (two minutes), and 18 real questions as the second and third sections (five minutes each). We measured how many figures children could identify before running out of time. Then, we classified children with zero to nine correct answers as having a field-dependent cognitive style, and those with 10 to 18 correct answers as having a field-independent cognitive style. We translated the GEFT into Japanese because the original GEFT is in English.

Note here that the cognitive style (either field-dependent or field-independent) refers to how people classify personal characteristics, according to differences in the methods used to receive, constitute, analyze, and remember information and experiences (Hojo 1991). People with a field-dependent cognitive style receive the structure of an image as shown, without revising it, and they interact with it. They fuse all elements in the field of vision, without dividing what they see into visual components. On the other hand, people with a field-independent cognitive style consider an image to be a visual stimulus. They can either decompose the image when it is organized or add an original structure when it is not organized. As a result, these people can precisely distinguish specific information in a complicated picture (Moore and Dwyer 1991). For junior high students with a field-independent cognitive style, Hojo (Hojo 1991) found a strong learning effect when they used pictures in English learning. He concluded that because the analysis and estimation abilities of field-independent learners are superior for coping with this problem, they can use information from a picture more effectively.

Before this main experiment, we conducted a preparatory experiment using our system with 18 children at a different elementary school. The subjects used the English Vocabulary application with animations (or pictures). Through this experiment we (1) determined the number of repeated times using the system required to learn an English word, and we confirmed (2) the adequacy of the difficulty of the words and quiz and (3) the system's user-friendliness. We found that there was a difference in the number of times required when the students used the system freely within a limited time. Therefore, we revised the system to maintain a consistent number of times for learning, and we also decided to develop an application using Japanese characters, because there was little difference in results between the animation and picture cases.

As comparison among media, analysis of variance showed no significant difference in scores after using the three different media ($F(2,43) = 0.17$, $p < .05$).

As effectiveness of sentence construction, there was no significant difference in word test scores between Groups 1 and 2 ($t = -0.75$, $df = 63$, n.s.). On the other hand, there was a significant difference in etymology test scores between these groups ($t = -2.56$, $df = 63$, $p < 0.05$). This suggests that deducing new English words was easier using the application with pictures than using the application with animations.

As effectiveness depending on differences in English learning experience, There was a significant difference in scores between Groups 1(experienced) and 2(experienced) ($t = -2.35$, $df = 63$, $p < 0.05$). That is, among the subjects with English learning experience, the application using pictures was more effective than that using animations, before sentence construction. There was also a significant difference in scores between Groups 2(non-experienced) and 2(experienced) ($t = -2.96$, $df = 32$, $p < 0.05$). This means that in the case of learning using the application with pictures, the subjects with English learning experienced performed better than did the non-experienced subjects.

The average etymology test scores were also categorized by English learning experience. There was a significant difference in scores between Groups 1(experienced) and 2(experienced) ($t = -2.22$, $df = 63$, $p > 0.05$). That is, among the subjects with English learning experience, the application using pictures was more effective than that using animations. There was also a significant difference in scores between Groups 1-1 and 2-1 ($t = -1.81$, $df = 17$, $p > 0.05$). This means that among the non-experienced subjects, as well, the application using pictures was more effective than that using animations for deducing new English words. Lastly, there was a significant difference in scores between Groups 2(experienced) and 4(experienced) ($t = 2.28$, $df = 47$, $p > 0.05$). In other words, among the subjects with English learning experience, the application using pictures was more effective than that using animations for deducing new English words.

4. Discussion

Our analysis showed that the English Vocabulary application using pictures, rather than animations or Japanese characters, was the most effective for memorization. In particular, the system was effective for subjects with experience learning English. Moreover, the application using pictures was more effective for children with a field-independent cognitive style than for those with a field-dependent style. Another interesting result was that, for recalling memorized English words one week later, learning with both the English Vocabulary application (using pictures or animations) and the Sentence Construction application was better than learning only with the vocabulary application (using pictures or animations). This demonstrates the effectiveness of sentence construction for learning English vocabulary, thus confirming our hypothesis that building sentences with the Sentence Construction application after learning English words should have a learning effect, specifically for long-term learning.

After the experiment we administered questionnaires to the subjects, offering the chance for free response, and we gleaned the following opinions. For the question, "Were the positions and colors of screen icons easy to recognize?", there were many favorable comments. Examples include "The application was very colorful and characters were easy to recognize," "The icons for '? + ? =' were easy to comprehend," and "It was easy because of the sounds played with the words."

For the question, "Was learning English fun?" there were also many favorable comments. In this case responses include "It was very fun, unlike learning from a textbook," " I have come to like English so far, though it was hard," "It was fun because of the Sentence Construction application,", "I thought it was very good that I could learn English while playing a game, and it was fun," "I could learn English like a game and it was fun," "The Sentence Construction application was very fun," and "It was good to learn even with a quiz."

For the question, "Was learning English easy?", as well, there were many favorable comments. Examples for this question include "It was easy, because the system spoke the words," and "It was easy, because the words were made up of other words." Other comments include "Though it was difficult, it was fun," and "It was sometimes difficult and sometimes easy."

Finally, for the question, "Was it easy to learn English with this method?", there were also many favorable comments. In this case responses include "Because I understood the pronunciation by hearing it and the English was written, it was easy to learn," "Because I could hear the sound, it was easy,", "I could learn English with this system rather than by having someone explain it," "It was easy to understand, because of the audio pronunciation," "It attracted everyone's interest that we could use an iPad system with sound," and "It was easy to learn more than usual, because we always learn English only by hearing."

The field of image psychology postulates that learning effects are determined by such factors as "variables in the image," "characteristic differences in the actor," and "the kind of problem." Here, "variables in the image" refers to media, such as animation. The phrase "characteristic differences in the actor" means the subject's ability. Finally, "the kind of problem" means the problem to be solved, such as learning English words. In this case, we investigated the problem of learning English words by using animations, pictures, and Japanese characters, for children who either do or do not have English learning experience and have either a field-dependent or field-independent cognitive style.

Our hypothesis was that the learning effect would be enhanced by using animations for learning English words, and we thus expected that animations would have a higher effect on learning than would pictures or characters. The learning effectiveness of showing a picture or animation with text was demonstrated in studies by (Cowen 1984) and (Peeck 1974). Additionally, because animation can express the process of combining two English words to create a compound noun, we thought that animation should produce better results than with pictures or characters. For example, the system can present an explanatory animation of an animal noun appearing and coalescing beyond a smoke screen. We found, however, that such explanatory presentations through animation had little or no value and no relation to memorizing English words. It might be that unnecessary movement disrupts memory, or there might be a more suitable speed for presenting images to promote memorization. According to (Levie and Lentz 1982), visual representations have both a cognitive function that facilitates learning from text by improving understanding and retention, and an attentional function that attracts attention to the content. Visual representations could obstruct learning, however, when they capture the learner's attention, because visual representations themselves contain mixed information (Levie and Lentz 1982). Thus, we

conclude that our experimental result for the animation condition was caused by the explanatory animations attracting the learner's attention and obstructing learning.
As a result, the child subjects could gain interest in English learning and learn in an enjoyable way via our iPad-based system. By using the system's applications to repeat the cycle of learning through memorizing, building sentences, watching animations, and taking a quiz, the elementary school children became more familiar with English, more aware of etymology, and more prepared for further English learning in junior high school.

5. Conclusion

In this paper, we have introduced an iPad-based system to help Japanese students learn English compound nouns while having fun. The system consists of four applications: "English Vocabulary," "Sentence Construction," "Vocabulary Quiz," and "Word Meaning Deduction Quiz." We conducted an experiment with our system and analyzed the results in terms of various subjects and conditions.
As a result, the English Vocabulary application using pictures, rather than animations or Japanese characters, was the most effective for memorization. In particular, the system was effective for subjects with experience learning English. Moreover, the application using pictures was more effective for children with a field-independent cognitive style than for those with a field-dependent style. For recalling memorized English words one week later, learning with both the English Vocabulary application (using pictures or animations) and the Sentence Construction application was better than learning only with the vocabulary application (using pictures or animations).

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