Autonomous and Collaborative Learning Environment for Vocabulary Acquisition

Keiichi Kaneko, Kazunori Hasegawa, Xin Jin, Masatoshi Ishikawa
Norihide Shinagawa, Haruko Miyakoda
Graduate School of Engineering, Tokyo University of Agriculture and Technology
Nakacho 2-2-16, Koganei-shi, Tokyo 184-8588, Japan
E-mail: kikaneko@ce.tuat.ac.jp

Abstract.
We have implemented the PHI system that can be used to acquire vocabularies by using iPods. In addition, we have developed the PSI system that can be used to create learning materials for PHI. In this study, we investigate the possibility of autonomous and collaborative vocabulary acquisition of the learners by using these systems and give the design principle of an environment that promotes autonomous and collaborative learning.

Keywords. Computer-Assisted Language Learning, Mobile Learning, Ubiquitous Learning, Learning Material Creation, Vocabulary Learning

1. Introduction

In acquiring foreign vocabularies, it is effective to memorize words with corresponding images or sounds and to repeat the memorization activities [10], [13]. We have developed the vocabulary-learning system PHI (Personal Handy Instructor) and verified its effectiveness [2]. The PHI system enables the learners acquire a vocabulary anytime and anywhere by using iPods. In addition, we have developed the PSI (Personal SuperImposer) system to support creation of learning materials for the PHI system [3]. The novel feature of our work is that we made PSI open to the learners and made them participate in the creation activities of learning materials. Hence, the instructors are released from the burden to prepare a large amount of learning materials. In this study, we investigate the possibility of autonomous and collaborative vocabulary acquisition of the learners by using these systems and give the design principle of an environment that promotes autonomous and collaborative learning.

To recognize the necessary conditions in case of the learning environment design, we have surveyed studies related to the mobile learning and the vocabulary acquisition based on information technology. This field includes many previous or related works.

As researches on the learning materials for vocabulary acquisition, there are various reports that indicate the effects based on the factors of subtitles, animations, and images [1], [14], [15]. However, these reports sometimes bring incompatible results since they are based on different experimental environments. This fact shows that the problems are not so simple since the experimental results depend on the selections of subjects and vocabularies, and it is necessary to conduct further experiments and discussions. Knapp et al. reported a method to reuse the illustrating sentences to resolve the difficulties of learning material creation in their web-based language learning system ELDIT [6]. Verdejo et al. proposed a method to share the learning materials created by the learners by adding metadata to the materials in their project ENLACE [12]. However, in these papers, there is no discussion with respect to the creation of materials. In addition, there is a study on PhotoStudy. By sending the images created by the learners by e-mail, PhotoStudy automatically creates the learning materials and makes them sharable among the learners [4], [5]. Though PhotoStudy is similar to our system, it has a drawback that it cannot handle the materials based on movies.

Thornton and Houser have investigated consciousness of Japanese university students
on the mobile phones, and reported that they use the mobile phones frequently, and they are affirmative to use the mobile phones in vocabulary learning activities [11]. In addition, they conducted an experiment in which the subjects create movies or animations to acquire the idioms, and obtained affirmative opinions from the subjects. However, in their study, they do not provide any special tools to create movies nor animations, and the learners cannot create the learning materials easily.

There are two papers related to reviewing and sharing of the reports submitted by the learners through the web environment [7], [8]. The former paper reports the results that the qualities of the comments strongly depend on the motivations of the learners caused by the reflection to their scores and so on. On the other hand, the latter paper concluded that the learners are motivated to learn more by reviewing their reports among others.

From the above researches, we concluded that we should provide an autonomous and collaborative learning environment that satisfies the following conditions:

1. The learners can create the learning materials easily. From this condition, we can collect and accumulate a large amount of learning materials, and the burden of the instructors can be reduced.

2. The learners can register their materials to the database to share them among other learners. This mechanism allows the learners to browse good materials and good examples to create better materials.

3. The learners can assess the materials created by others. This peer-assessment facility motivates the learners to create a lot of better materials.

The rest of this paper is constructed as follows. First, in Section 2, we introduce the PSI system that supports the creation of learning materials for vocabulary acquirement. Next, in Section 3, we discuss the design of the SIGMA (Special-Interested-Group Material Accumulator) system that provides an autonomous and collaborative learning environment. In addition, we describe the evaluation experiment to verify the adequateness of the direction of our study in Section 4. In Section 5, we give the conclusion and the future works of this study.

2. Learning Material Creation Supporting System PSI

2.1 Structure of Learning Materials

Figure 1 shows the structure of a learning material based on a movie used in the PHI system. A learning material for a word consists of a 5-second movie related to the word, the spelling and meaning subtitles of the word, and the pronunciation sound of the word.

We have fixed the length of the movies to be five seconds based on a preliminary experiment. Moreover, we hide the meaning of the word for two seconds from the beginning of the movie so that the learners can judge if they have acquired the word or not.

2.2 PSI System

PSI works on the Windows operating system. In addition, it has an e-mail receiving mechanism so that the learners can create learning materials automatically by sending movies or still images to the PSI system by e-mail. The overview of PSI is shown in Figure 2.

The learners input the spelling and meaning of the word, and the path of a movie or still image file corresponding to the word. By clicking the convert button, PSI creates a learning material. The pronunciation of the word is extracted from the database which is prepared in advance, and then it is embedded into the material. PSI can create six
materials at a time. In addition, we adopted Unicode as the character code in PSI. Hence, with pronunciation database, we can create the learning materials for vocabulary acquisition between various languages. Figure 3 shows an example of learning materials created by the PSI system.

3. Autonomous Collaborative Learning Environment SIGMA

We have designed and implemented the SIGMA system so that it satisfies the conditions introduced in Section 1. Figure 4 shows the outline of the learning environment by SIGMA. SIGMA is a web application that supports sharing of the learning materials for vocabulary acquisition. SIGMA uses Apache HTTP Server and MySQL to communicate with clients and to manage its database, respectively. SIGMA is implemented by using PHP.

When a learning material is registered to SIGMA, it is automatically released to other learners. Learners can use the registered learning materials by downloading them from SIGMA to PHI and then transferring them to iPods. The SIGMA system also manages the assessment scores and the comments by learners. The assessment scores and the comments are opened to the learners anonymously. The learners can select the effective learning materials by taking the assessment scores and the comments into consideration. Moreover, the SIGMA system has the function to provide the vocabulary tests. It allows the learners to create their own vocabulary tests. The tests created by the learners are also assessed and the results are shared among the learners as well as the learning materials. It is widely known to be effective for the learners to create tests by themselves. However, it is necessary to establish reliance from the learners by protecting the learning materials and the tests from illegal assessment in SIGMA, which is an open and sharing system [9]. Hence, SIGMA enforces the access control on the learners. The anonymous learners can just download the learning materials, take the tests, and browse the assessment scores and the comments. On the other hand, the identified learners can also assess the learning materials and the tests, register their own learning materials and tests, and browse their histories of the test scores. In addition, the SIGMA system provides the instructors the tools for logging management and the score management.

4. Evaluation Experiment

To verify the adequateness of the direction of our study, we conducted three experiments based on English words with Japanese learners. In this section, we give the results and discuss about it.
4.1 Learning Effect of Materials

First, to verify if the learning materials created by the PSI system have enough learning effect indeed, we conducted an experiment with ten students in our university as the subjects. This section describes the procedure and result of the experiment, and discusses about it. The formats of the tests are all common where we showed a list of English words and asked the subjects to answer their meaning in Japanese. The memory retention rate represents the ratio of the number of words that the subjects could remember their meanings in comparison to the number of words that they tried to memorize. Note that the results may be biased since the subjects are university students and their knowledge and intelligence are usually above the average.

This experiment is conducted by following procedure: (1) We conducted a pre-test with respect to English words, and divided the ten subjects into two groups A and B so that each group has five subjects and the same average scores of the pre-test. We also asked each subject to declare more than twenty words that are totally unfamiliar to the subject. (2) For each subject, we prepared learning materials for twenty words selected in (1). The subjects in Group A learned the ten of twenty words by the learning materials by PSI for ten minutes. On the other hand, the subjects in Group B learned the ten words by the traditional pen-and-paper method for ten minutes. (3) We conducted a test just after the learning activity to measure the memory retention rates of the words. (4) By exchanging the methods, Groups A and B learned the remaining ten words by the pen-and-paper method and by the PSI materials, respectively, for ten minutes. (5) Just after the learning activity, a test is conducted. (6) After two weeks and two months, tests are conducted.

The result is shown in Table 1. Since there were no difference between the Groups A and B, the results are joined and processed together. To verify the significant difference of the results between two methods, we conducted t-test. The p value for the retention rates of 2 weeks and 2 months after the learning activities are 0.051 and 0.022, respectively. Hence, the significant difference between the retention rates after two months is observed with 95% probability.

| Table 1: Comparison of Retention Rates between PSI Materials and Pen-and-Paper Method |
|---------------------------------|--------|---------|---------|
|                                 | Just aft | 2 weeks | 2 months|
| PSI Mat.                        | 1.00    | 0.25    | 0.23    |
| Pen&Paper                       | 0.91    | 0.14    | 0.11    |

4.2 Effect of Materials by Learners

Next, we conducted an experiment to verify that the learning materials created by the learners by using the PSI system include effective ones. Thirty students in our university participated in the experiment as the subjects. In this section, we describe the procedure and result of the experiment, and discuss about it.

The experiment is conducted as follows: (1) According to the convenience of subjects, they are divided into three Groups A, B, and C. Group A consists of three subjects and they create the learning materials only. Group B consists of 23 subjects and they create the learning materials and participate in the learning activities. Group C consists of four subjects and they participate in the learning activities only. We showed a list of English words and asked the 27 subjects in Groups B and C to answer totally unfamiliar words. As a result, the following twelve words are all unfamiliar to all of the subjects: ‘allot’, ‘clog’, ‘congenital’, ‘crumble’, ‘futile’, ‘meddle’, ‘mediocre’, ‘proficiency’, ‘surmise’, ‘taint’, ‘trait’, and ‘wither’. (2) The 26 subjects in Groups A and B created the learning materials by using PSI for the twelve words listed in (1). Group A created 26 materials while each subject in Group B created two materials except for one subject in Group B who created only one. Therefore, 71 materials were created by Groups A and B in total, and at least four materials were selected randomly for each of the twelve words. (3) Each subject in Groups B and C used the learning materials for ten minutes to learn the ten of the twelve words for which he/she did not cre-
We conducted an experiment to verify that the learners can find the effective learning materials autonomously by using 23 students in our university as the experimental subjects. In this section, we describe the procedure and result of the experiment and the discussion about the result.

We consider that the memory retention rates attained by the learning materials indicate one of the indices of the learning effects of the materials, and we conducted an experiment to check the correlation between the average assessment scores by the learners and the average memory retention rates as follows by using 23 students in our university as the subjects: (1) The subjects are divided into two Groups A (13 subjects) and B (10 subjects). (2) The subjects in Group A browsed 62 materials that we prepared, and they gave the assessment scores from −3 to +3. (3) We asked each of the subjects in Group B to select unfamiliar words from 62 words. (4) We selected 13 materials for the unfamiliar words so that the assessment scores by Group A are distributed evenly. (5) Each subject in Group B learned the unfamiliar ten words by learning materials for ten minutes. (6) We conducted two tests just after and two weeks after the learning activity to measure the average retention rates.

Figure 7 shows the experimental result. The correlation coefficient between the average assessment scores and the average memory retention rates is 0.41, which indicates weak positive correlation. The result shows that the average values of the assessment scores by the learners have confidence to some degree. However, we can observe that the learners may give high assessment scores to relatively ineffective materials. Therefore, it would be practical to provide adequate support by the instructors for the time being.

5. Conclusion

In this study, we investigated the possibility of autonomous and collaborative vocabulary acquisition of the learners by using our system SIGMA that is based on the PHI and PSI systems. Consequently, we have con-
cluded that (1) it is possible to produce effective learning materials by using the PSI system; (2) the materials created by the learners have sufficient learning effects; and (3) the learners can find effective materials by themselves to some degree. As a conclusion, we have verified the possibility of SIGMA.

To see the memory retention rates for different gender, different age, and different social groups is included in the future works. To check the superiority of the mobility of our system to a desk top system is also included in the future works.

References


