Learning English Grammar with WordBricks: Classroom Experience

Moonyoung Park Marina Purgina Maxim Mozgovoy

The University of Aizu
Aizuwakamatsu City, Japan
{mypark, d8172102, mozgovoy}@u-aizu.ac.jp

***Abstract*—We present the content and the results of the first classroom experiments with WordBricks — a virtual lab-like environment for language learning. WordBricks supports open experiments with grammar constructions as well as assistance in solving traditional exercises. We compare performance of the students who used WordBricks in studies with the performance of those used only traditional learning materials. Our findings show that WordBricks indeed helps language learners in acquiring new knowledge, and in overall provides improved study experience.**

Keywords—Computer-assisted language learning, intelligent systems, virtual labs

I. INTRODUCTION

The use of computing technology is widespread in language education. However, a deeper look into the field of computer-assisted language learning (CALL) shows that in actual practice teachers and learners typically rely on general-purpose services, such as electronic dictionaries or video sharing websites. Indeed, common definitions of CALL simply refer to the use of computers in language learning activities [1, 2]. For example, according to Beatty [2], CALL is "*any process in which a learner uses a computer and, as a result, improves his or her language*" (p. 7) — a commonplace scenario in our digital age.

However, the case of *specialized* language learning instruments is far from being clear. The survey conducted by Hubbard in 2002 revealed that even the CALL experts are not convinced about the effectiveness of specialized educational software. Hubbard notes: "*…it is interesting that questions of effectiveness still tend to dominate. In fact, the basic questions of "Is CALL effective?" and "Is it more effective than alternatives?" remain popular even among those who have been centrally involved in the field for an extended period of time.*" [3]. Dedicated software packages for language acquisition are also very rarely mentioned in numerous "language learning tips" found online [4–6].

The reasons for such state of affairs are discussable; for instance, Efimov et al. [7] believe that natural language processing technologies are not mature enough to meet the needs of nontrivial educational scenarios. They also suggest to try a 'technology-driven approach': instead of relying on immature technologies in traditional learning activities, one can design the activities on the basis on available technologies.

We chose this approach for the currently work-in-progress system WordBricks [8]. WordBricks is a step towards 'virtual lab' in langauge learning, allowing the users both solving predefined exercises and experimenting independently with language constructions, thus exploring the rules of natural language. This system follows the model of Open Source Physics [9] or ChemCollective [10] — the instruments that enable users to perform scientific experiments on a computer screen without necessity to setup a real lab.

In brief, WordBricks lets the users to connect individual words and phrases into complex combinations, and guarantees that any pair of bricks can be connected if and only if the result is grammatically correct. Grammatical rules are implicitly encoded in the bricks shapes, so in most cases the admissibility of any brick combination is clear (see Fig. 1).

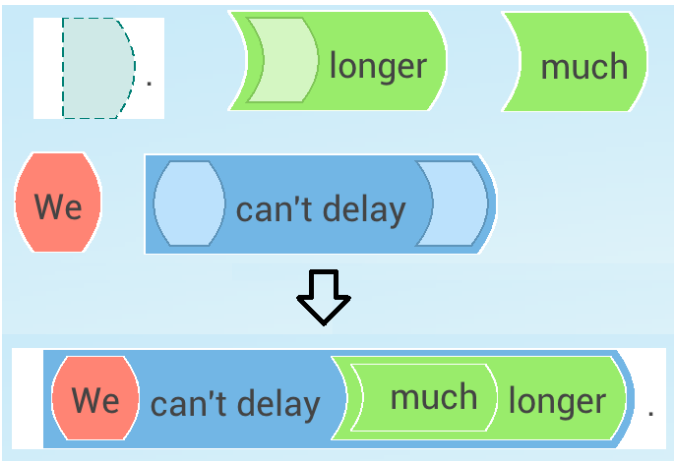

Fig. 1. Connecting bricks into phrases in WordBricks (Android version).

The resulting design of the system is a product of heavy influence of Scratch programming environment [11], numerous debates and tradeoffs, and deserves independent discussion. In the present work, we share the outcome of the first real classroom experiments with WordBricks, aiming at objective evaluation of the system's usability and pedagogical value. We show that the use of WordBricks indeed has a positive impact on students' ability to acquire educational materials, and increase their motivation by introducing game elements into the learning process.

II. GOALS OF THE EXPERIMENTS

The concept of usability has been evolved in the discipline of Human-Computer Interaction (HCI) and applied to the

interaction between the users and computers [12]. Preece et al. [13] highlighted usability as a key concept in HCI to make systems easy to learn and easy to use. To produce computer systems with good usability, it is necessary to understand the psychological, ergonomical, orgainizational, and social factors that affect how users operate.

In this study usability tests are adopted to indicate room for improvement in the design and content of the WordBricks over a semester in an English as a Foreign Language (EFL) classroom at a computer science college in Japan. Thus, the usability should take into consideration of three major characteristics of usability by providing three types of analysis:

1. *Attitude:* observations of users' impression about and satisfaction in WordBricks while they perform the given tasks.
2. *Performance:* measurements of users' performance of the task and quantifying the performance of given tasks.
3. *Suggestion:* observations of users' constructive feedback and suggestion for revision of the system and contents of WordBricks.

This set of three key attributes represented in this usability testing were found for the following two research questions:

1. What are users' attitude of using and suggestions for revising WordBricks?
2. How much did the users score in the English grammar assessment in two different groups — a control group and an experimental group?

A fundamental goal of this study is to demonstrate the utilization of usability testing into the modification and delivery of the instructional application software (WordBricks) in an actual classroom setting, not just post hoc. Thus, the findings from this study should not just be the demonstration of program effectiveness, but an attempt to develop and modify a CALL system as it is put into practice in a real language classroom.

III. METHOD

A. Participants

The research site is a public computer science university in Japan. Two intact groups were randomly assigned from the same EFL class of the sophomore students in the university: a control group (non-WordBricks group, $N = 11$), and an experimental group (WordBricks group, $N = 10$). The students were enrolled in an elective advanced English grammar course, and ranged in age from 19 to 21 years. All of the participants majored in computer science and had a year of previous academic English instruction in the form of required EFL classes at the university level.

On the first day of the semester, a diagnostic English grammar test was implemented for the two groups. The descriptive statistics for the diagnostic test, shown in Table 1, indicate that the mean value of the two groups were very similar.

The teacher participant who taught both groups was a 37-year-old Korean English teacher. He had ten years of ESL/EFL teaching experience.

TABLE I. DESCRIPTIVE STATISTICS FOR TWO GROUPS IN DIAGNOSTIC TEST

Group	***Number of participants (N)***	***Mean (M)***	***Standard deviation (SD)***
Control Group	11	65.25	7.50
Experimental Group	10	65.90	7.99

B. Research Design

To investigate whether WordBricks had any observable effect on students' English grammar learning, a pre-test/post-test design with a control group and experimental group was adopted. In addition, to identity users' constructive feedback, two usability surveys were conducted at the beginning of the semester and at the end of the semester.

In this setup, all 21 participants studied two units from the same English grammar textbook with the same English teacher over the four month periods. Though each group covered the same content and underwent the same English grammar assessment procedures, the control group was taught with an English grammar textbook in a traditional way (teacher-centered, grammar focused), but the experimental group autonomously interacted with WordBricks using an Android-based tablet PC, which was assigned to each experimental group participant.

C. Materials

WordBricks. Each participant in the experimental group was assigned to use one tablet PC to play WordBricks to take their English grammar lessons. Initially, WordBricks contained a number of predesigned exercises, based on the first paragraphs of the Azar and Hagen's grammar book [14]. Later we had to revise the contents according to student feedback.

Usability Survey. An online pre-survey and a post-survey were developed with Google Forms to identify participants' perceptions of and reaction to WordBricks. A pre-survey was conducted to all of the participants before the actual implementation of mobile-based learning, so that the findings from the pre-survey could provide constructive feedback for the WordBricks developers for revision of the system during the semester. After two sets of pre-/post-test experiments, the post-survey was conducted to the experimental group participants to identify the usability of the revised version of WordBricks. The two surveys were composed of nine open-ended questions focusing on users' attitude of and opinion about the contents, functions, and interface of WordBricks.

English Textbook. *English Grammar in Use* (4th edition) was adopted as a course textbook. For this study, Unit 69 and 70 were selected according to the course syllabus order. Both Unit 69 and 70 are about countable and uncountable nouns. However, Unit 70 seems to be more demanding than Unit 69 in that Unit 69 is introductory and Unit 70 is more advanced use of the grammartical points.

Pre-test/Post-test. To compare the two groups, the control group and the experimental group, and to measure the change resulting from experimental treatments (WordBricks-based English grammar learning), a pre-test/post-test design was used

in this study. Based on the course textbook, two sets of paper-based English grammar tests were developed to measure participants' English grammar performance over two course units. For Unit 69 pre-/post-test, participants were asked to correct given sentences focusing on the nouns of the sentences. For Unit 70 pre-/post-test, they were asked to complete sentences using correct noun form.

IV. Results and Discussion

The results of the preliminary usability survey of WordBricks, summarized in Table 2, answer our RQ 1: *What are users' attitude of using and suggestions for revising WordBricks?*

TABLE II. Preliminary Usability Survey Results (Students' Comments)

Interface
The design is very simple. (6)
Menu button and fonts are small. (3)
Color style is bad. (1)
Functionality
It was complicated for me to use the software. (7)
- How to delete bricks (3)
- How to go back (2)
- How to move bricks (2)
Contents
I cannot understand grammatical rules to complete the tasks. (5)
The size of vocabulary used in the software is too small. (3)
Suggestions
Vocabulary (sentence) should be added more from the course textbook. (8)
I want to delete word cards conveniently. (3)
Corrective feedback should be provided for lower level students. (2)
The system should play sounds of English words and sentences. (1)
Font size should be increased. (1)

Note: (*N*) = Number of responses out of 21 participants

Students provided numerous critical comments about the interface, function, and contents of WordBricks at the beginning of the semester. Their main concerns were that the instructional software may need to be more relevant to their English grammar course materials. According to this initial usablity survey findings, a revised version of WordBricks was developed with its contents from the course textbook [15]. This version contains altogether four exercises, spanning over two book units. Each exercise require the users to compose 10-20 sentences using words and phrases from the predefined set. Some exercises follow textbook examples verbatim, while others encourage free experimenting, limiting the users only with grammar rules of the given unit.

After using WordBricks over a semester, post-usability survey was conducted to identify users' (N=10) feedback on the revised version of the system. More than 80% of the survey respondents acknowledged that the interface and the contents of the revised WordBricks were highly satisfactory compared to the previous version of WordBricks.

In addition to their positive feedback, they still pointed out the needs of more explicit corrective feedback and the introduction of grammar point before the actual tasks from the system. This may reveal that the participants are used to teacher-centered deductive English language learning rather than self-driven inductive learning. To better meet the users' needs, especially with different level of English proficienty, it seems to be necessary to integrate such contents and functions in the system in the future.

The answer the RQ 2 (*How much did the users score in the English grammar assessment in two different groups — a control group and an experimental group?*), we implemented the following procedure. Two sets of pre- and post-tests were used to identify any meaningful difference of participants' English grammar test performance. The pre- and post-test were executed before and after each lesson. The data regarding possible effects of WordBricks were analyzed using descriptive statistics due to small number of participants (see Table 3).

TABLE III. Descriptive Statistics of the Pre- and Post-tests

Unit	Test	Group	*N*	*M*	*SD*
Chapter 69	Pre-test	WB	10	15.90	4.43
		Control	11	15.18	5.04
	Post-test	WB	10	24.20	4.02
		Control	11	21.00	5.80
Chapter 70	Pre-test	WB	10	4.20	2.57
		Control	11	6.00	2.72
	Post-test	WB	10	11.60	2.84
		Control	11	9.18	4.17

Note: WB = WordBricks (experimental) group

Descriptive statistics of the pre- and post-tests from the chapter 69 indicate that the experimental (WB) group (M = 15.90, SD = 4.43) and the control group (M = 15.18, SD = 5.04) had similar mean values in the pre-test. In the post-test, the WB group (M = 24.20, SD = 4.02) performed a little better than the control group (M = 21.00, SD = 5.80). Unlike chapter 69, WordBricks users scored lower than the control group in the pre-test of chapter 70. However, they scored higher than the control group in post-test of chapter 70.

The results indicate that the WordBricks group scored relatively higher than the control group in the two tests. Especially in the second unit (chapter 70), WordBricks users performed significantly better than the control group considered their lower score in the pre-test of chapter 70. It is interesting to note that the topic of chapter 70 is more challenging, so it is possible that WordBricks is more efficient in more advanced contexts, where the students might benefit more from an additional support, provided by a software tool.

Our findings may support the positive correlation between using WordBricks and English grammar performance; moreover, it may be a promising sign in that computer-assisted and student-centered English grammar learning through WordBricks does not necessarily sacrifice students' English grammar accuracy. More long-term research on students' English language performance based on WordBricks based learning may be a good indicator to persuade school administrators and English teachers of the practicality of future expansions towards a CALL course or curriculum.

V. Conclusion

WordBricks is an attempt to introduce 'virtual lab-like experience' into language learning. The system can serve both as a supplementary tool in language classes, and as a learner-oriented an instrument for independent exploration of language

constructions. In this paper we analyzed the results of the first classroom experiments with WordBricks. They show that the use of the system in classroom has positive impact on learners' test scores. Furthermore, the students liked the overall user experience of WordBricks, so we believe that the system might improve learners' motivation in studies via increased gamification of the study process.

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