THE EFFECTS OF COMPUTER-ASSISTED INSTRUCTION ON VOCABULARY LEARNING

Hui-Yi Liang¹,², Chih-Chien Yang²

¹Department of Applied Foreign Language, Chienkuo Technology University, Changhua, Taiwan
²Graduate Institute of Educational Measurement and Statistics, National Taichung University of Education, Taichung, Taiwan

¹isis@ctu.edu.tw, ²noahyang@mail.ntcu.edu.tw

ABSTRACT

The purpose of this paper was to study the effects of applying computer assisted instruction (CAI), in this case, LIVE ABC on college freshmen’s English vocabulary development. Two groups (high-proficiency and low-proficiency) of college freshmen from Chienkuo Technology University were used in the study. Each group comprised 50 students (totally 52 male and 48 female). This study was conducted in the fall semester of 2012-2013 and lasted for 18 weeks. A pre-test was administrated at the beginning of the study and a post-test immediately after its completion. The study evaluated student performance using scores on individual semester tests (pre-test and post-test). In addition, a questionnaire was developed to assist the study. The research method applied Grey Relational Model to analyze the assembled data and decide on an effectiveness rating. The major findings of the study were: Where students used computer-assisted learning in vocabulary building their test results were generally better. Low-proficiency students benefit more from CAI than high-proficiency students. All students develop greater fluency, more precise pronunciation and better word understanding. Looking at gender, female students benefitted more than male students. The study also came up with some suggestions for further research in the future.

KEY WORDS

CAI, Educational Software, Vocabulary Learning, Grey Relational Grade

1. Introduction

The purpose of this paper was to examine the effects of using the computer instruction package LIVE ABC as a learning aid to build vocabulary among college freshmen. The use of multimedia technology in the education field, especially in language learning, has become very common in the past few decades. Overseas Chinese Language and Culture Education Online organization proposed that multimedia instruction should be three-dimensional [1]. Instruction in 3-D format applies technology in a way that makes the learning process interactive and true to life. Computer assisted learning invites initiative and contributes motivation to both the teacher and students. Teachers can save time in class and in preparing teaching materials. Students learn naturally and interactively. The most important element in learning any foreign language is to build a vocabulary. A good vocabulary leads to successful reading, oral and writing ability [2]. College students in Taiwan often have weak vocabulary recall and, worse still, a lack of vocabulary to begin with. Learning difficulty and lack of motivation are usually caused by an inadequate vocabulary [3]. Another local researcher found that most Taiwanese college students possess a vocabulary of at least three to four thousand English words while at high school [4]. However, they require at least 10,000 English words in order to understand the academic content of the average university course.

Accordingly, this study focuses on how on-line interactive language learning can be applied to augment vocabulary in the learning process. It aims to answer the following questions.

• Is there a way of measuring how applying computer-assisted learning packages in teaching helps to build vocabulary?.
• At what point in the language learning process does computer-assisted learning contribute most?
• To which element of language learning – vocabulary, pronunciation, fluency, understanding – does computer assisted learning contribute most?
• Is there a measurable difference that computer assisted language learning packages contribute related to gender, that is, do males or females benefit more or less from them?
• Are there any or suggestions that can be made to improve the quality of the Live ABC software package?

2. Computer-Assisted Instruction

Computer-Assisted Instruction (CAI) began in the 1950’s in America. PLATO (Programmed Logic for Automatic Teaching Operation) was the first major research carried out on the topic lead by Donald Bitter of the University of Illinois [5]. CAI places students in a planned computer interaction course. Language learners are placed on an appropriate module according to what stage there are at in
learning process. Students may adjust the pace in line with their own need and ability [6].

To enhance teaching quality and learning efficiency, various audio-visual media have been applied to assist teaching and learning. As technology improved, it has been possible to increasingly use CAI in all aspects of language learning. The purpose of this study was to apply CAI in the critical aspect of vocabulary building and to analysis its effectiveness for that purpose.

CAI (an inclusive term of CALL: computer-assisted language learning) enables the learner to customize his/her environment and determine the pace of instruction. This benefits the learner and increases motivation [7]. The curriculum is pre-planned and installed for students to simulate imitation in the course of training [8]. Another researcher also indicated that CAI is very effective for professional skills training and actually improves the rate at which certification can be achieved [9]. Using CAI as an assisted teaching tool, teachers can simulate in the curriculum true to life situations which are interactive thereby enabling the student to correct mistakes as he/she goes along. By supervising individual students in the process the teacher can get hints on adapting materials to make the instruction more effective for others later on.

2.1 Modes of CAI

There are five main modes in which CAI can be applied in language teaching: tutorial mode, drill mode, simulation mode, games and tests [10]. Tutorial mode in computer assisted learning is also called supervised mode. Computers simulate the role of the teacher. However, unlike in a classroom setting, when using CAI, the student himself/herself can set the pace of instruction in line with their own stage of advancement. In the normal classroom the pace will often be set by the best students with the weaker ones being left behind. Drill mode mainly offers repeated practice in a specific pattern to reinforce the learning. A good CAI will highlight mistakes and suggest what is correct channeling the student into repetition of what is correct so that he/she will learn in the process of correction. Simulation mode, as its name implies, simulates real life situations such as getting through an airport, doing the grocery shopping, participating in a discussion on football. Instructional game mode introduces the student to the language through participation in challenging and fun style games. In the carefree atmosphere it creates the instructional game mode generates enthusiasm with a knock-on beneficial effect [11]. Students are competing to beat their best previous score or time. Test mode mainly encourages language students to practice answering questions stored in a computer data bank. Students can choose questions commensurate with their ability to test their own language proficiency. The computer response is swift offering prompt answers to the questions and even scoring the tests. The test results are then filed and saved as a record of the student’s achievements and for the teacher’s reference.

2.2 Roles of CAI

The computer in CAI not only facilitates the tutor’s role but also acts as a tool for word processing, data management and problem solving. CAI not only accepts comment from the users but also can replicate the actions of the students. CAI creates the learning environment for and becomes the conduit or tool for learning. Other research endorses the fact that computers not alone play a pivotal role in teaching through guidance and instruction but reinforce what is learnt through drills and tests [9,12]. Students select the appropriate learning level which results in virtually customized instruction. CAI not only evaluates how effectively the student is learning but also quantifies the outcomes.

2.3 Strength and Weakness of CAI

The biggest strength of using CAI is in the opportunity it provides for interaction between the learner and the computer. In conventional instruction, only one-on-one scenarios can truly lead to effective interaction. An interactive language learning curriculum becomes a very effective teaching assisted method. Soo and Ngeow (proposed CAI programs offer true to life content and stimulate interest in the student [13]. Other strengths of CAI are: increasing interactive opportunities, meeting the needs of the individual for customized instruction, obtaining immediate feedback, generating enthusiasm and acting as a monitoring tool for both the teacher and student.

In the negative CAI has some weaknesses such as, for example, the expense of the hardware and software which comprise CAI packages, they depend on the student having an element of computer skills, they can be time consuming and, most importantly, they never amount to anything but secondary learning providing little opportunity for interpersonal communication[14].

2.4 Computer-Assisted Language Learning Software

Computer-assisted language learning (CALL) has been around for decades. Barson and Debski indicated that the developing process can be divided into three major periods: behaviorist, communicative and integrative [15]. Behaviorist CALL is a teacher-centered language learning style. The teacher prepares teaching materials for each module. Computers used in language learning act as a kind of materials delivery tool providing good opportunity for practice through repetition. Through this students receive knowledge passively. Communicative CALL is a learner-centered language learning style. It is based on a mutual relationship where not only the computer is active but also the student in interacting with it. In this way the computer becomes a tool that allows students to express their thoughts and emotions [9,10]. Integrative CALL provides language learning activities in a way that stimulate the way the student thinks. It developed at the pace of computer technology and multi-media and is task-based enabling the latest in educational training to be directed at
language learning. According to a recent investigation on 275 college students currently learning English, through the internet, most were positive about its role as a language learning tool. They especially stressed that the more interesting and less stressful environment it provides improves their learning motivation and effectiveness [16].

3. Research Methods

3.1 Research Subjects

Two freshmen classes of Chien-Kuo Technology University were chosen as subjects (one with high English language proficiency and one with low). The high-proficiency class comprises 50 students (28 males and 22 females). The low-proficiency class also comprises 50 students (24 males and 26 females). This program lasted for 12 weeks (36 hours) and students were required to practice on-line after class using the LIVE ABC vocabulary package. The amount of practice time availed of by students was automatically recorded for further reference.

3.2 Research Instruments

This study integrated Live ABC Interactive software into the vocabulary learning element of the English course in Chien-Kuo Technology University. Live ABC Vocabulary Network contains 10 modules. Each module comprises 25 lessons and each lesson introduces 8 new words. Accordingly 2000 new words were introduced to students throughout the course. Practice modes covered phonetic symbols, pronunciation, plural forms, tense, sample sentences and games. A pre-test and a post-test were conducted during the first and last week. Forty multiple-choice questions were designed from the Live ABC Vocabulary Network Word Bank. In addition, to facilitate this study, a questionnaire to evaluate the learning software quality [10]. The questions were as follows.

- Does the teaching content meet the student’s needs?
- Is the course content ample and well-designed?
- Is the pronunciation clear?
- Is the interface function easy to use?
- Does the software work smoothly?
- Is the instruction detailed and user friendly?
- Has care been taken in the design?

3.3 Mathematic Model

The mathematic model of the paper is Grey Relational Grade, and can be described as follows [17]. In grey relational grade, the sequences and are inspected sequences, then, it called “localization grey relational grade”, if each sequence can be the reference sequence, then, it called “globalization grey relational grade”. In our research, we focus on Nagai’s grey relational grade, and the equation is shown in equation (2)

\[
\Gamma_{0i} = \Gamma (x_0(k), x_i(k)) = \frac{\Delta_{0i} - \Delta_{mi}}{\Delta_{max} - \Delta_{min}}
\]

in which

\[
\Delta_{0i} = \left\| x_0(k) - x_i(k) \right\|
\]

where

\[
i. \quad x_0: \text{Reference sequence, } x_i: \text{Inspected sequences}
\]

ii. \(\Delta_{0i}(k) = \left\| x_0(k) - x_i(k) \right\|\): The difference between \(x_0\) and \(x_i\) norm).

iii. \(\Delta_{\min} = \min_{j \in I} \min_{x_{0}, x_{1}} \forall k \left\| x_0(k) - x_j(k) \right\|
\]

iv. \(\Delta_{\max} = \max_{j \in I} \max_{x_{0}, x_{1}} \forall k \left\| x_0(k) - x_j(k) \right\|
\]

After the grey relational grade is calculated, according the value, we can rank the sequence, and this procedure is called grey relational rank. For reference sequences \(x_0\), and inspected sequences are \(x_i\), if \(\Gamma(x_0,x_j) \geq \Gamma(x_0,x_j)\), then we found that under the reference sequence \(x_0\), the grey relational rank of \(x_i\) is greater than grey relational rank of \(x_j\). The definition of globalization grey relational grade, each sequence can be the reference sequence. In this section, we still use Nagai’s grey relational grade as our mathematics model.

\[
\Gamma_{y} = \Gamma (x_i, x_j) = 1 - \frac{\bar{\Delta}_{yi}}{\Delta_{y}}
\]

where

\[
\bar{\Delta}_{yi} = \left( \sum_{k=1}^{n} [\Delta_{0i}(k)]^2 \right)^{1/2}
\]

when the results are found, we can use the eigenvector method to rank the sequence, and then chose
the optimal one. The whole steps are illustrated below.

- Constructing the relative weighting matrix \([R]_{mxe} \), which is called “grey relational matrix”.

\[
[R]_{mxe} = \begin{bmatrix}
\Gamma_{11} & \Gamma_{12} & \ldots & \Gamma_{1n} \\
\Gamma_{21} & \Gamma_{22} & \ldots & \Gamma_{2n} \\
\vdots & \vdots & \ddots & \vdots \\
\Gamma_{m1} & \Gamma_{m2} & \ldots & \Gamma_{mn}
\end{bmatrix}
\]  

(4)

- Finding the eigenvalue for the relative weighting matrix \(AR = \lambda R\).
- Using eigenvector method to find the weighting for each target \(P^{-1}RP = \text{diag}\{\lambda_1, \lambda_2, \ldots, \lambda_n\}\).
- The maximum \(\lambda_{\text{max}}\) corresponding eigenvector are the weighting value for whole sequence.

4. Results and Discussion

The purpose of this study was to examine the effects of CAI software, LIVE ABC, in developing the English vocabulary of a group of college freshmen. For the purpose of the study, a Matlab toolbox was used to analyze the data gleaned through the aforementioned questionnaire, the results are set out in Table 1. The salient findings are reflected in the following statements (in italics): Live ABC Vocabulary Network practice helps me understand meaning. Table 1 also reveals that while the ABC package delivered on all the key aspects of language learning, (fluency, pronunciation and meaning/understanding) they were ranked first, sixth and ninth as aids in the student feedback.

There are some nuances directly related to proficiency levels (Table 2): Live ABC Vocabulary Network practice can improve their English fluency received the highest ranking from those in the high-proficiency group. It means that higher-proficiency students can improve their sentence fluency by integrating web-based learning into the course. I think Live ABC Vocabulary Network practice can improve my English pronunciation and Live ABC Vocabulary Network practice helps me to learn at my own pace also received high weighting values. In essence high proficiency students have benefitted across all the key areas of language learning through use of the ABC package. Being able to work at their own pace and adapt the course according to needs seemed to particularly suit those with ability.

Meanwhile, in the low-proficiency group: I think Live ABC Vocabulary Network practice helps me to increase my vocabulary received the highest weighting value. This was followed by I think Live ABC Vocabulary Network practice improves my motivation” (item 6) and I think Live ABC Vocabulary Network practice helps my vocabulary application (item 5) Again these conclusions demonstrate a very viable role for the ABC Package in vocabulary building, motivation and application among the less endowed students. When these components are combined they deliver a homogenous recipe for success. There is also a variance in results depending on gender. For male students, item 6: I think Live ABC Vocabulary Network practice improves my motivation achieved the highest ranking.

This was followed by vocabulary building reflecting a norm throughout the world where those elements in any scholarship which require motivation and diligence are less likely to need encouragement in the female. Data on different English proficiency groups and genders are shown in Table 2 as follows, and Feedbacks on the Quality of the Software are shown in Table 3.

<table>
<thead>
<tr>
<th>Item</th>
<th>Contents</th>
<th>Weighting</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>I think Live ABC Vocabulary Network practice can improve my English pronunciation.</td>
<td>0.514</td>
<td>6</td>
</tr>
<tr>
<td>2.</td>
<td>I think Live ABC Vocabulary Network practice can improve my English sentence fluency.</td>
<td>0.8328</td>
<td>1</td>
</tr>
<tr>
<td>3.</td>
<td>I think Live ABC Vocabulary Network practice helps me to add up vocabulary volume.</td>
<td>0.7096</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>I think Live ABC Vocabulary Network practice helps me to understand vocabulary meaning.</td>
<td>0.3043</td>
<td>9</td>
</tr>
<tr>
<td>5.</td>
<td>I think Live ABC Vocabulary Network practice helps my vocabulary application.</td>
<td>0.3107</td>
<td>8</td>
</tr>
<tr>
<td>6.</td>
<td>I think Live ABC Vocabulary Network practice improves my motivation.</td>
<td>0.5958</td>
<td>5</td>
</tr>
<tr>
<td>7.</td>
<td>Live ABC Vocabulary Network practice helps me to learn by my own pace and needs.</td>
<td>0.7179</td>
<td>2</td>
</tr>
<tr>
<td>8.</td>
<td>Live ABC Vocabulary Network practice helps me make lesser mistake and feel more carefree.</td>
<td>0.5871</td>
<td>4</td>
</tr>
<tr>
<td>9.</td>
<td>Live ABC Vocabulary Network practice helps me make lesser mistake and feel more relaxed.</td>
<td>0.4866</td>
<td>7</td>
</tr>
</tbody>
</table>
Table 2 Weighting values relating English proficiency and gender

<table>
<thead>
<tr>
<th>Weighting Rank</th>
<th>Weighting Rank</th>
<th>Weighting Rank</th>
<th>Weighting Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-P</td>
<td>Low-P</td>
<td>M</td>
<td>F</td>
</tr>
<tr>
<td>1</td>
<td>0.481</td>
<td>2</td>
<td>0.033</td>
</tr>
<tr>
<td>2</td>
<td>0.5654</td>
<td>1</td>
<td>0.2674</td>
</tr>
<tr>
<td>3</td>
<td>0.0296</td>
<td>9</td>
<td>0.6802</td>
</tr>
<tr>
<td>4</td>
<td>0.1325</td>
<td>7</td>
<td>0.1718</td>
</tr>
<tr>
<td>5</td>
<td>0.0432</td>
<td>8</td>
<td>0.2675</td>
</tr>
<tr>
<td>6</td>
<td>0.1575</td>
<td>6</td>
<td>0.4383</td>
</tr>
<tr>
<td>7</td>
<td>0.4595</td>
<td>3</td>
<td>0.2584</td>
</tr>
<tr>
<td>8</td>
<td>0.344</td>
<td>4</td>
<td>0.2431</td>
</tr>
<tr>
<td>9</td>
<td>0.2728</td>
<td>5</td>
<td>0.2138</td>
</tr>
</tbody>
</table>

Note: High-P: High-proficiency group, Low-P: Low-proficiency group; M: Male, F: Female.

Table 3 Numbers of people and percentages with positive response

<table>
<thead>
<tr>
<th>Contents</th>
<th>Number of People</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>The teaching content meets students' needs.</td>
<td>68</td>
<td>68 %</td>
</tr>
<tr>
<td>The course contents are ample and well-designed.</td>
<td>66</td>
<td>66 %</td>
</tr>
<tr>
<td>The pronunciation is clear.</td>
<td>84</td>
<td>84 %</td>
</tr>
<tr>
<td>The interface function is easy to use</td>
<td>57</td>
<td>57 %</td>
</tr>
<tr>
<td>The software works smoothly.</td>
<td>53</td>
<td>53 %</td>
</tr>
<tr>
<td>The instruction manual is detailed and user friendly</td>
<td>49</td>
<td>49 %</td>
</tr>
<tr>
<td>A good care has been taken to the design.</td>
<td>62</td>
<td>62 %</td>
</tr>
</tbody>
</table>

On the whole, students’ satisfaction with the quality of educational software is quite positive. Some students, however, also expressed negative opinions and made suggestions as follows.

‘The textbook layout is poor and its composition is uninteresting.’

‘More sample sentences should be provided in order to demonstrate usage.’

‘The software instruction manual should be more clearly written.’

‘Games are sometimes too fast making responses/interaction difficult in the moment’

‘The game section is inadequate because with only four to choose from they give little variety and have limited scope.’

‘The interface function sometimes can be slow especially if there are many users at the same time.’

‘The curriculum needs to be updated and changed periodically.’

‘I think more variety of speakers should be provided. Currently only a single male and single female voice is used in the practice sessions.’

‘The test error diagnosis should include more explanations and examples.’

‘Only individual modules are provided with post-tests. It would be advantageous if this were extended to groups of three modules thus broadening the scope of the test to make it a better barometer of progress.’

‘I sometimes have to wait for a long time to log in to the software while I try to use it at my home.’

‘Live ABC sometimes gets cut off while I am using it. The multimedia function seems not very stable.’

5. Conclusion and Suggestions

Using computer software to assist teaching or learning allows the students to discover and experience real-life based situations. In addition, it also offers more learning time for students to develop their language skills and particularly fluency and vocabulary at their own pace in a relaxed environment. While the computer packages may be expensive pay back is rapid making them cost effective.

Differing from most language research methods; this paper sets out to measure the effects and satisfaction of vocabulary learning through computer-assisted instruction by applying an advanced mathematical model, which is called Grey Relational Grade.

Moreover, the creators need to be cognizant of deficiencies such as a lack of variety in the teaching tools, inaccessibility at peak times (the times when most students will want to log on), inadequate review mechanisms both in updating and tests and lack of content, particularly in interactive exercises.

Feedback from the customer (the teacher and student) is critical, begging the question as to why a study of this nature is needed at all, when it should be readily available from research carried out by the software providers, and shared for the common good.

The study does clearly demonstrate the value of CAI in language teaching and augurs well for its continued use at all levels of proficiency.
References