

〔原 著〕

コンピュータ援用学習システム：Flash, PHP, MySQL 使用によるエクササイズの実管理と結果分析

A CALL exercise system with tracking and access control, using Flash, PHP, and MySQL

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Abstract:

A system of multimedia CALL exercises for English study, related to the contents of a popular course book, was developed using Flash. After use in class, it was decided that a system for tracking students' performance and controlling their access was desirable, so such a system was developed using PHP and MySQL. The integrated system has been in use successfully at 2 universities for the past few years. The details of the system are described, and the results of a survey among students concerning the system are reported.

Keywords: CALL; Flash; student tracking

1. Introduction

The history of Computer Assisted Language Learning (CALL) may be said to have begun in 1960, with the text-based PLATO I system.¹ By 1971, prototype multimedia CALL was embodied in the TICCIT system, which linked a computer and television.² But these systems required mainframe computers, and were available at only a few prestigious universities. The spread of personal computers in the 1980s made CALL available to far greater numbers of people, though it remained very much a minority interest, and was not yet widely recognized as a separate discipline. As in so many other areas, the spread of the Internet in the 1990s brought a real revolution to CALL. One aspect of this revolution was much easier distribution of CALL information and materials, but at the same time, new Web technologies facilitated the development of CALL itself, including totally new forms employing human-human interaction and collaboration, rather than being limited to human-computer interaction as in traditional CALL. Some technologies which have been adapted for CALL, such as wikis, podcasting, or an LMS system like Moodle

(<http://moodle.org/>) were unthinkable before the advent of the Internet, or even in the Internet's first few years in the early 1990s. But Web technology advanced rapidly, and CALL followed closely behind, taking advantage of newly introduced features such as JavaScript and Flash to make more interactive and stimulating multimedia CALL material available directly in a browser window. This paper describes a CALL system created by the author employing some of the newer Web technologies. It is currently in use for first-year students at Mie Prefectural College of Nursing and at Tezukayama University. The results of a survey at MCN of the students' opinions of the system are also reported.

2. Design and construction of the exercises

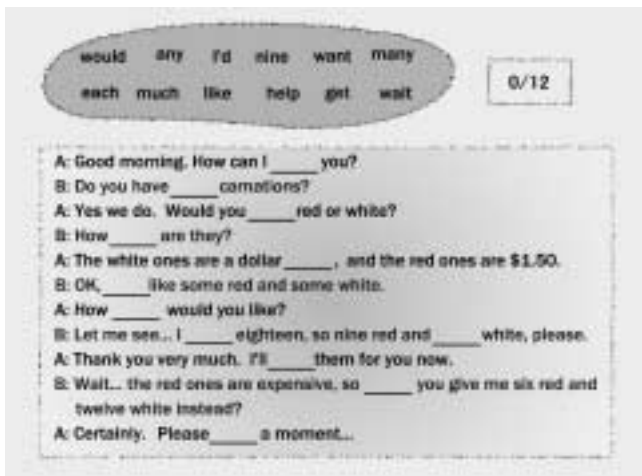
This project began as an experiment in making interactive CALL material which would work directly in a browser window, using Flash. Version 5 of Flash, released in 2000, provided for the first time a true programming language capable of producing real interactive programs that could be delivered to a browser over a network, and function there without any need for server-

side intervention. This, coupled with the innate ability of Flash to handle animation, offered an exciting platform on which to develop stimulating CALL material. The only other platform which could be considered for the same purpose, Java, had a far more difficult development environment compared to Flash's GUI, and it had no innate capabilities for handling animation.

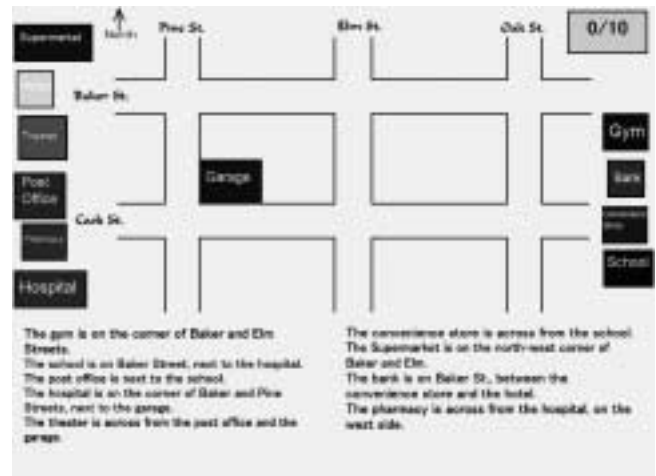
To give the project a practical focus, it was decided to give it the form of practice and expansion exercises linked to the content of a course book, "Get Real 1" (Macmillan), which would be used with first-year English classes at Tezukayama University, Nara. These exercises were to be used in class to provide revision, practice, and expansion of points covered in each lesson. This constraint gave shape to the contents of the exer-

cises, making the overall design in part syllabus-driven, as in the case of Weinberg³ and Rogerson-Revell,⁴ for example. Another shaping constraint was the type of exercises which could be implemented in Flash. Several templates were developed to provide a variety of exercise types, with the aim of heightening student interest and facilitating practice of reading, writing, and listening. The fourth skill, speaking, was beyond the scope of the exercises, but is practiced in class by other means. There are a few distinct types of exercise, and some variations of similar types. The most common type is drag-and-drop, where the object to be dragged is text. This text can be, e.g., words to fill gaps (figure 1a shows an example of this type), half sentences to match up with their complementary halves, or complete sentences to arrange in order to make a conversation. In

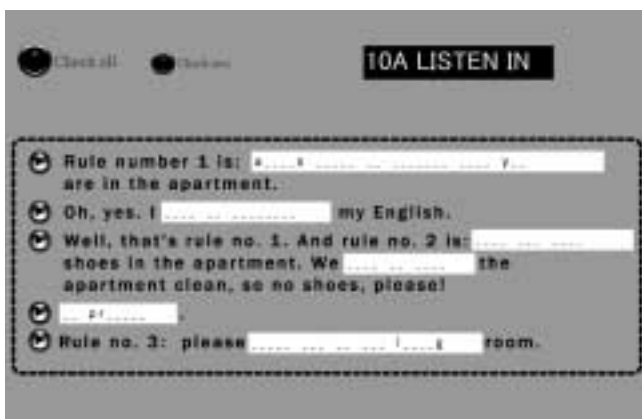
Figure 1. A few examples of the exercises in the system: (a) Drag and drop words; (b) Drag and drop buildings; (c) Guided type-in with listening; (d) Unguided type-in



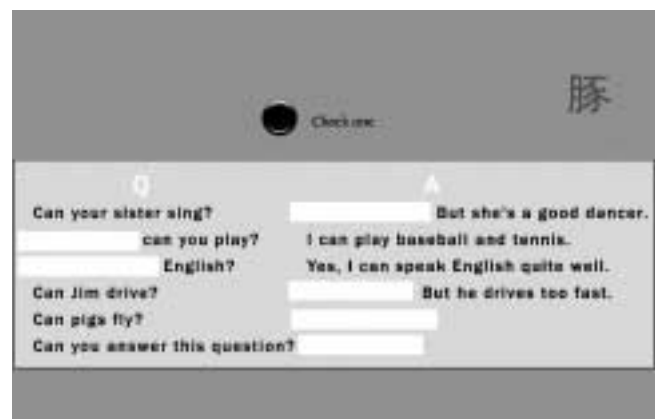
(a)



(b)



(c)



(d)

one exercise, the objects to be dragged are buildings to arrange on a street diagram in order to correspond to a written description of their positions relative to other buildings (figure 1b). After drag-and-drop, the next most common type is type-in. There are two basic types: guided and unguided. In guided type-in exercises, an underscore for each missing character is shown, and after the user has typed in an answer, clicking the Check button changes correct characters to green and incorrect ones to red, and the user can redo only the mistaken parts. Some of the guided type-in exercises include sound and are used as listening exercises. The users can hear the sounds as often as they wish, by clicking a button beside each sentence, and try to type in what they hear (figure 1c). The unguided type-in exercises do not show underscores for each character or correct on a letter-by-letter basis (figure 1d). Other exercise types include listening where the objective is to click on correct items rather than type in, and multiple-choice. In all, there are 108 exercises, 9 each for the 12 lessons in the textbook. Many exercises award a score reflecting the number of errors made, while in others the object is just to complete the exercise. There is no time constraint in any of them. Interactive examples of all the types used can be accessed at

<http://www.mcn.ac.jp/fa/m.obrien/priv/flash1>.

Some of the sounds used in the exercises were taken from the CD which accompanies the course book, and so were copyrighted by the publisher. Permission was obtained from the publisher to include this material in the exercises provided that they were not made available openly on the Internet and that the students bought the course book. The exercises were made available on a server accessible only through the university's internal network.

3. Trial of the exercises in class

Initially the exercises were used in conjunction with the course book for one semester by three teachers with classes of about 40 students. It was agreed by all three that they had been very useful, and popular with

students, but the lack of any tracking system to record some reflection of each student's efforts was felt to be a big drawback. They were used with large classes, so it was difficult to properly monitor who was or wasn't working diligently or scoring well. The nine exercises for one day's lesson (180 minutes) were all made available through a simple HTML menu. Several diverse problems that might be addressable by a tracking system were apparent. Three outstanding ones were as follows:

Probably the easiest to envisage was the slow, reluctant pace of the less enthusiastic students who knew their efforts were not being recorded. But a contrasting problem also existed - students who could not resist jumping ahead to later exercises before the background material had been covered in class. Some students liked computer exercises too much, and would even do things such as doing a computer listening exercise while a paper-based listening exercise for the whole class was going on. There were others who seemed to just like getting a high score for its own sake - in scoring exercises they would try various answers without appearing to consider very carefully. This would depress their score, whereupon they would reload the exercise to start from zero again, feeding in the correct answers they had discovered. This might be termed discovery-based learning, but it is very far from what is envisaged ideally by the concept.

4. The tracking and control system

To attempt to address the above problems, a system was designed in which a master Flash movie would require students to log on, and would then read in and display the exercises as sub-movies, and record the students' performances to a database. The scripting language PHP was chosen as the intermediary between the Flash movies and the database, as Flash has the built-in capability to communicate with server-side PHP scripts, which in turn can interact with the popular and reliable database management system MySQL, which was also adopted for use in the system. One more important feature required of the system was teacher control over students'

access to the exercises, so that they would be available only at appropriate times, mainly in order to eliminate the problem mentioned above of over-enthusiastic students doing exercises prematurely. Of course it would also be possible to use such a control system to encourage tardy students not to take too long on particular exercises by making the exercises unavailable after a limited time. This system was also implemented using the MySQL database. Through a simple GUI, the teacher can set a control for each individual exercise designating whether or not it is available for loading by the students, and also whether or not the students' scores will be recorded, thus facilitating the setting of strict time limits for finishing an exercise as well as for starting it (though in practice it is usually not necessary to use the finishing control). A final refinement in teacher control was the facility to designate individual exercises as non-reloadable, i.e., no score will be recorded unless it is done from start to finish without interruption. This was to counter the other major problem mentioned above, reloading of partially completed exercises in order to gain an increased score. Figure 2 shows a partially-completed exercise as it would appear on a student's screen. The student's number and name are shown on the screen, which is confirmation to the student of being properly logged in, and can be a convenient reference for the teacher.

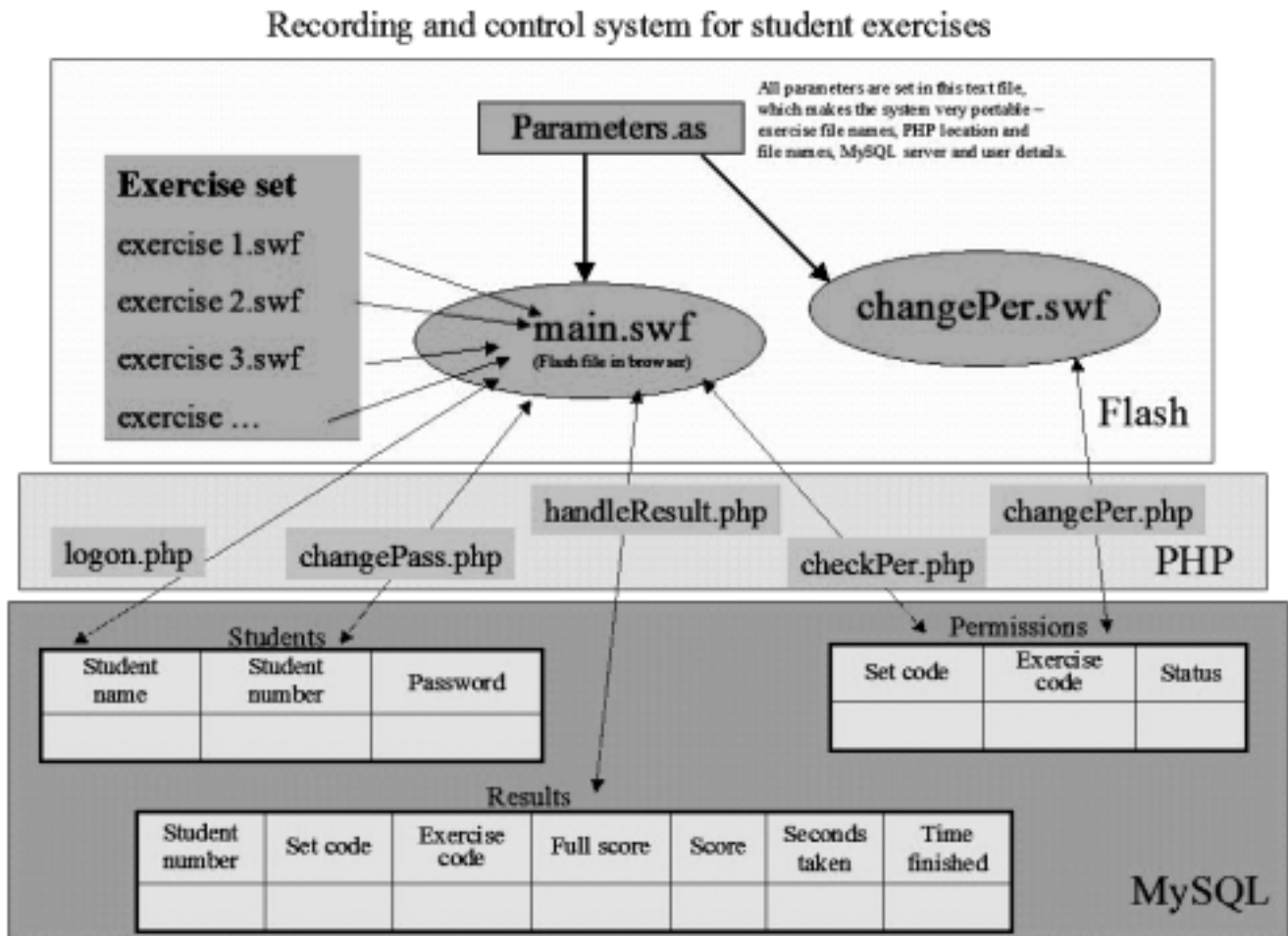
Figure 2. The browser window of a student working on exercise 1 of lesson 6.



Figure 3 shows the recording and control system schematically. The three components, Flash, PHP, and MySQL are shown in layers from top to bottom. There are 2 basic Flash movies, main.swf which is the student interface, and changePer.swf, available only to the teacher, which allows real-time control over exercise permissions. There are 5 PHP scripts to interface between Flash and the database. The database has 3 tables, for student details, exercise permissions, and results. The results can be downloaded as an Excel-compatible file by the teacher at any time. Each record has seven fields: "Student number" is self-explanatory. "Set code" identifies which of the 12 sets of exercises (one for each lesson in the book) the exercise is from, and "Exercise code" identifies the individual exercise itself. "Full score" is the maximum possible score for the exercise, and "Score" is the student's obtained score. For exercises which do not have a score, these fields will show that fact. "Seconds taken" is the number of seconds the student took to complete the exercise, and "Time finished" is the date and time (down to the second) when it was completed.

The eight teachers at Tezukayama University who have used this system over the past four years have reported that they find it useful. This is borne out by the fact that all who were eligible have decided to use it, and none have stopped using it, although they are free to opt out and conduct their classes in other ways if they wish. Two years ago, in 2006, the system was introduced for the author's first-year classes at Mie Prefectural College of Nursing. It was deployed on a dedicated server PC with a 3.0 GHz Pentium 4 processor and 2 GB of RAM, running Ubuntu Linux. Response time is generally very fast, but when many students access within a short period, as happens when a new exercise has just been made available, some students can experience delays of several seconds. A delay of more than about 10 seconds is rare, so this is not a major problem.

Figure 3.



5. Survey of student reaction

Informal reaction from the students to use of the system in class was favorable in the first year, and in the second year it was decided that their reaction should be assessed in a more formal way, to serve as a more reliable guide and better identify advantages and shortcomings of the system. So at the end of the second year a short survey was carried out, on broadly similar lines to those of Hemard and Cushion⁵ or Iskold,⁶ though considerably scaled down. The survey was written in Japanese, and asked the students to indicate their degree of agreement with each of three statements from 1 to 5 -

1 : 全くそう思わない 2 : あまりそう思わない
 3 : どちらとも言えない 4 : ややそう思う
 5 : 強くそう思う

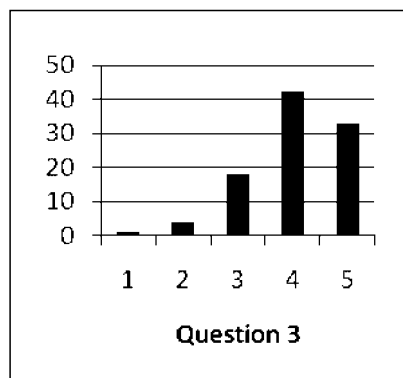
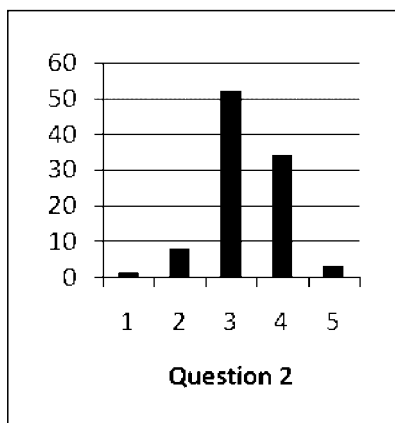
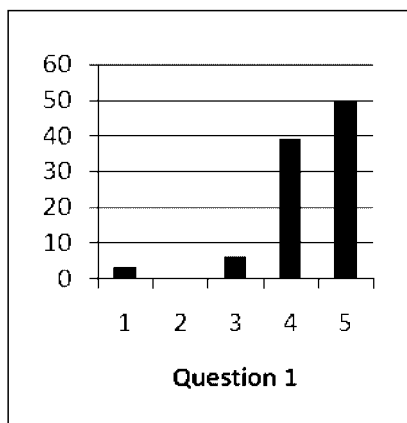
(1: Don't think so at all 2: Don't think so very much
 3: Can't say either way 4: Think so to some extent
 5: Think so strongly).

The three statements were:

- 1 . この授業は楽しかった (The classes were enjoyable)
 - 2 . この授業で自分の英語力が上がった (My English ability improved because of these classes)
 - 3 . この授業はコンピュータを使ったからよかった (It was good that computers were used in the classes)
- 98 students completed the survey form, and all of them responded to each of the three questions above. Figure 4 shows their responses. The response to Question 1 was overwhelmingly positive, 89 of the 98 choosing either 4 or 5, so the students would seem to have found the classes enjoyable. However, they were less positive in concluding that their English abilities had improved as a result. The majority response (52) was 3, and while 34 felt it was true to some extent, only 3 reported that they thought so strongly. As for Question 3, a three-fourths majority (75) reported positive feelings about the use of computers in the classes.

Figure 4. The number of responses under each category to Questions 1, 2, and 3.

	1	2	3	4	5
Question 1	3	0	6	39	50
Question 2	1	8	52	34	3
Question 3	1	4	18	42	33



The students were also encouraged to write comments if (weak points of the classes) その他 (other). The comments they liked any under any or all of three categories: 授業の長所 (strong points of the classes) 授業の短所 (weak points of the classes) shown in Tables 1 and 2.

Table 1. Comments of students who wrote both strong and weak points. Comments in the same row were written by the same student.

Strong points	Weak points
リラックスして、学べた感じで、楽に勉強ができて、よかったです	内容が難しかった
自分の解答があっているのかまちがっているのかすぐにわかる所がよい	1回の授業で解く問題の量が多いので問題を解くことに必死になり、クラス全員で授業をうけているというより、1人でパソコンにむかって英語を勉強している感じがかった。
いろいろな問題ができて楽しかった。	進むのが早いと思う時があった。
コンピューターの授業は楽しいし、ちゃんとスベルの練習にもなったからよかった。	目が疲れた。(うさぎがかわいかった。)
他の授業は寝てる人が多いけど、PCを使うと寝る人少なくなる！！楽しく授業できる	授業休むとスゴク困ってしまうのでは…と思います。(PC使わないとできないことが他の教科に比べてたくさんあるのでは?)
ゲーム感覚で楽しくできた。	テスト前が資料が少なく大変。
楽しめる	答え合わせができない…(時間が短い)ので、次に進めなくて焦りました。
コンピュータでゲーム形式だし、絵もかわいかったしおもしろかったので、勉強するという気がしなかったのでよかったです。	目が少し疲れました。
楽しくすることができるので、あまり眠たくならなかった。	することが同じでボーッとしてしまう。
楽しい、わかりやすい	ヒマな時間が多かった。
たのしかった。	なし
発音練習をするところ、例文を挙げてくれるところ	自分が当たることが少ないところ(発音練習する機会をもっと設けてほしい)
アニメーションがでてきて面白かった。	ねむくなる時がある…
楽しくできた。自分のペースでやれた。	あつてるのにずれて間違になるとくやしかった。
テストが自分のスピードで行われてよかった。	キーボードが上手く使えなかった。
アットホームな感じで楽しい。	長く感じる。
授業って感じがなくて楽しかった。うさぎがかわいかった。	英語力は上がらないかも。
コンピューターを使うので、普通の授業より楽しい	少し理解しにくいかも
おもしろく工夫してあるので楽しく学習できる	とくになし
楽しい	目が疲れる。タイピングが遅いと不利。
リスニングが自分のペースで何回も聴ける	インターネットで遊べる
コンピュータを使うから普通に授業するより楽しかった。	リスニングが聞きとりづらかった。
ゲーム感覚で英語が楽しめ、興味をもつことができた。	コンピューターが苦手な人にとっては、最初は苦勞した。
面白かった。	たまにつながらない時があった。
ゲーム感覚でできるところ	解答の修正がきかないところ
楽しかった。英語の能力が上がったかは分からないけど、基礎を見直すことができました。	特になし(絵がかわいかった。)
自分のペースでできた。	テスト前のテスト勉強ができなかった
リスニングを自分で調整しながら何度も聞けるので自分のペースでできる。	個々のペースが異なるため、個人差が大きく、待ってる時間が長い。
単語も覚えられるし、リスニングもできるしよかった。	パソコンを普段あまり使わないので打つのが大変だった。(うさぎがかわいかったです。)

Table 2. Comments of students who wrote only strong points or only weak points.

Strong points only
<ul style="list-style-type: none"> ■ 授業がパソコンだったから楽しく出来た ■ 何度も問題を解けるところが良かった ■ 習って、その場で問題を解けたし、楽しかったから、よかった。 ■ かわいいキャラクターがかわいくて、やりがいがあった。 ■ 先生が丁寧に教えてくれて楽しかった。(ありがとうございます。) ■ パソコンを使う授業は見やすいと思う。 ■ 楽しく勉強できる。 ■ 新しい形態で楽しめた ■ 練習問題の種類も教科書より多彩であり、勉強になった。 ■ テストも楽しんでできたし、よかった。 ■ 飽きずに英語を楽しく学ぶことができました。 ■ コンピュータを使った方が興味をもって学べた。ゲーム的な問題で楽しかった。 ■ 画面の隅々まで手がこんであってヨカッタ。 ■ キーボードを打つのが速くなった ■ 楽しくできる。 ■ コンピューターは面白い。眠くならない。 ■ 楽しかった 雰囲気がよかった ■ パソコンを使うから楽しい。 眠くならない。 ■ コンピューターを使っでの授業だったのでたのしく取り組めた。 ■ ゲーム形式みたいな感じで問題が解けるから楽しく授業ができる。 ■ 隣の人と会話の練習ができた。 ■ パソコンを使っでの授業は英語では初めてだったので新鮮でした。 ■ 先生がおもしろいです This class is very interesting ■ 英語が苦手で嫌いな方なのですが、楽しい授業ですごくよかったです！ ■ コンピューターを使うのは楽しかった。 ■ たのしかったです。 ■ 英語の授業は基本的にあまり好きじゃないけど、この授業はおもしろかったです。 ■ 楽しみながら勉強ができたところ ■ リスニングが何回でも聞ける ■ パソコンだと楽しかった。 絵がかわいかった。リスニングが何度もできてよかった。 ■ クイズに答えるみたいに楽しみながら授業を受けることができた。何回もできるところもよかった。 ■ 英語をリスニングで何度も聞けるところ ゲーム感覚でできる ■ 単元ごとの、先生手づくりの確認テストがとても楽しかった。特に道案内のあゆみちゃんは、聞き取りにくくて難しかったが楽しかった ■ 楽しく授業できました。 ■ おもしろかったです。
Weak points only
<ul style="list-style-type: none"> ■ 答えが一つに限られていた。同じ意味でもたくさんの表現方法があると思うので、もっとそこを勉強したかった。 ■ 計画性のないところ ■ テストの時、どこをまちがえたかわからない ■ コンピュータ室だけでしか、勉強ができないから、復習しにくいと思った。

The overall balance of the comments was favorable, with many mentioning that the classes were enjoyable. One of the points that some of the negative comments reflected was a problem that had been clearly apparent during the classes: some students could finish the exercises very quickly, and were left with too much idle time, while others were much slower and had to struggle to keep up. This is a difficult problem to avoid in classes such as these, where there is a large difference in English ability among the strongest and weakest students. There was also some dissatisfaction about the online tests, as the students are not shown where they have made mistakes. However, the tests have been deliberately set up in this way to gain the advantage of added security. Because of the way the computer room is set up, it is unavoidable that students can fairly easily see the screens of their neighbors, and in the usual practice exercises during class this has not been regarded as a big problem. It has been apparent from watching them that the great majority of students, if not all, mostly try conscientiously to do the exercises by

themselves, and take pride in completing them by their own efforts. They consult their neighbors or ask the teacher only when they are having trouble completing some points, and this is a perfectly acceptable method of learning, when necessary. But more formal online tests are held a few times during the semester, a short test after each group of 4 lessons from the total of 12, and a longer one in the final class. These are in addition to the paper test during the examination period. The online tests are multiple-choice, and test points from the lessons. They are arranged so that the questions come up on each student's screen in random order, with the order of the alternatives also random. When a student clicks the chosen alternative, the next question immediately appears, without any indication of whether the previous answer was correct, though when the last question is answered the student's total score is shown. It was felt that this system would minimize the danger of students learning anything helpful by looking at neighbors' screens, though it is a regrettable consequence that they are not told where they made their mistakes. The ability

to report this to each student later in a secure way could be a useful addition to the system.

6. Conclusions

The survey has provided clear confirmation of the popularity of the system with the students, which is undoubtedly a point in its favor. However, even though over one-third of the students reported that they felt it had improved their English ability, this is a subjective opinion, and an objective measure to demonstrate its educational effectiveness would require subtle experimental investigation on the lines of, for instance, that described by Nutta.⁷ The popularity of the system may be partly due to the variety of exercise types available, and the variety of visual forms even among exercises made from the same basic Flash template (e.g., Figure 1a and b). However, this comes at the price of longer preparation time, and the necessity to use the Flash authoring program to make new exercises from all of the templates except the multiple-choice one. They are a step even further away from the “dynamic” exercises advocated by Galloway and Peterson-Bidoshi⁸ than are Authorware (<http://www.adobe.com/products/authorware>) and Hot Potatoes (<http://hotpot.uvic.ca>).

The tracking and control system has been very effective in increasing the efforts which many students expend in doing the exercises, as well as in its more direct function of recording performance to help the teacher with assessment. The system is quite flexible and could be used with Flash exercises of many types, not confined to language learning, where real-time control over student access is desired. This simply requires a small piece of ActionScript code to be incorporated into each exercise to allow it to interact with the parent Flash movie. So, overall it has proven to be a very useful system, and in day-to-day operation is easy for a teacher without special computer knowledge to use, due to user-friendly graphical interfaces. However, setting it up initially on a server, and preparing it for a new term with a new group of students, remain specialized tasks requiring expert intervention. Wider distribution would require

these issues to be addressed.

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