

A New Developmental Model for Multimedia-Based EFL Software Creation and Use for Educators and Educator-Programmers

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Abstract

We have developed three application programs and reusable components for English as a Foreign Language (EFL) Education using iterative and incremental methods. English teachers who belong to computer literacy groups are able to use these three application programs in actual English classes, and teachers who are able to program, even they are beginner programmers, are able to make their own English-conversation learning programs using these components. Thus, componentware-based software development methods as adopted here, have the potential of transforming teachers belonging to beginner-programmer groups to a sort of special programmer-group able to develop fully functional and effective EFL software packages. Our goal is to design a new developmental model that allows teachers to produce their own teaching application-programs without having to acquire any specialized programming knowledge. This paper describes a) the benefits of componentware-based development methods, and then b) describes the application programs that we have developed for EFL education, c) the reusable components, d) an ongoing application development program, and finally, e) an English-conversation program which a beginner-programmer has made using reusable components.

1. Background

The Ministry of Education, Culture, Sports, Science, and Technology (MEXT) in Japan has been moving forward with the Millennium project, which, as part of its mandate, is setting up computers in all K1-K9 classrooms in Japan, and future plans are to incorporate computer use into all subjects in all classrooms. MEXT intends to prepare 15sec.-30sec. video clips, which teachers will be able to present in their classes—along

with internet-based materials, as class supplements. While such plans are a step towards IT integration in the classroom, we do not think this plan adequately exploits available computer/IT technology, particularly in terms of problems relating to usage limitations stemming from a centralized approach to pre-prepared/pre-packaged databases. Educational computer usage could become more decentralized if teachers were easily able to produce their own teaching materials, in accord with their students' abilities. To the present, hundreds of thousands of teaching materials have been put on the market; nonetheless many teachers have been producing 'handmade' teaching materials on their own. One reason for this is that often commercially available materials are designed as general-purpose programs, and thus are often unsuited to individual classroom requirements: instructional methods and student-comprehension are highly variable and specific to unique educational environments.

The situation described above is just as valid for computer-based teaching materials. However, ordinary teachers are unable to produce their own computer-based materials—materials preparation requires computer-programming skills. As a solution to this dilemma, we have proposed a 'componentware materials development methodology'[1]. In this revised paper we would like to a) describe the benefits of the componentware-based development method, and b) describe three application programs for EFL education that have been developed, c) describe the reusable components, d) describe an ongoing application program, and finally, describe e) an English conversation program that a beginner-programmer created using reusable components.

2. The Benefits of Componentware- Based Development Methods

Componentware is an object-oriented software

development method which uses and integrates components as essential building blocks [2]~[5]. Componentware methodology allows us to develop software systems in both a top-down and a bottom-up fashion. This is an essential aspect of educational software systems development. The bottom-up approach can allow a teacher to easily develop a new educational software system by assembling pre-existing components. In the case where a teacher wants to develop a new type of teaching material, the top-down fashion can be adopted to break down a teacher's requirements into functionally modular components.

Another advantage of the componentware methodology is in meeting requirements for computer usage in the real educational world: we can categorize teachers into three groups—an advanced group able to develop original software components, an intermediate group able to assemble pre-existing components into educational software, and a beginner group, able to use pre-existing educational software systems in their classes. The advanced group develops components, making full use of their specialized knowledge and provides them to the intermediate group; the intermediate group is able to produce educational software by using given components (i.e. they can produce specialized software systems without specialized knowledge); and the intermediate group is able to provide educational software to the beginner group—the beginner group is then able to make use of the educational software in their classes.

If this flow from the advanced group to the beginner group is made to function smoothly, computer-based education can become more effectively and easily implemented.

Our aim is to create this flow, on an experimental basis. In researching how multimedia computer systems and software could best contribute to education, we focused on the educational field of English as a Foreign Language (EFL). In the EFL field, teachers have not only been using multimedia devices such as tape-recorders, CDs, and videotapes, but also have been using computers since the advent of the institutional computer lab. In order to increase the developmental-efficiency of both EFL education software and reusable components, we divided the ingredients for EFL education into three parts: a) English Skills (listening, speaking reading, and writing), b) Learning Methods (the practice and its ascertainment), and c) Supplemental Tools (tape recorder, video, dictionary, and etc).

3. Three Serviceable Application programs and the Components

We have been developing educational software and

software components for EFL education using an iterative and incremental method. First, we developed a "Hypermedia Pronunciation Power Program (HPP)[6]"(fig. 1,2), which aimed to help EFL students improve their listening and speaking skills. We defined nine reusable components in developing the HPP program. Second, we developed a "Multimedia Authoring System for Teaching EFL (A-MATE)[7]" (fig. 3), which aimed to help a teacher belonging to the "beginner group" make several types of interactive multimedia quizzes for teaching EFL. We reused five out of the nine HPP components, and made two new components in developing the A-MATE program. Third, we developed a "Multimedia Bilingual Dictionary for JFL/EFL Learners (MBD)[8]" (fig. 4). MBD is a multimedia bilingual dictionary for beginning students of either Japanese or English. We reused four components out of eleven pre-existing components, and built four new components.

Currently, we are developing a new educational software application, a "Multimedia Vocabulary Concordance and Academic Lexis (VOCAL)[9]" (fig. 4), for students in the Science, using components which enable students to strengthen reading and writing English Skills. Below, we will describe in more detail these four application programs.

3.1. HPP: Hypermedia Pronunciation Power

HPP aims to help EFL students to improve their listening and speaking skills. HPP includes video clips of a native speaker pronouncing individual sounds, words, and sentences. Students can then imitate mouth positions as well as the sound of a native speaker. In addition, students can record their voice and can compare graphically their intonation with that of a native speaker. Moreover, students are able to practice their listening with environmental noise added intentionally. This feature is useful for EFL advanced-class students who can understand the speech of native speakers relatively well, but have difficulty with variation and environmental interference.

HPP is composed of five sections for EFL practice: the *Explanation Section*, *Listen and Repeat Practice Section*, *Visual-Voice Section*, *Minimal-Pair Practice Section*, and *Quiz/Games Section*.

The Explanation Section. The *Explanation Section* presents a diagram of the organs of speech, the phonetic alphabet, and a consonant and vowel chart in this section.

The Listen and Repeat Practice Section. The *Listen and Repeat Practice Section* allows students to do "listen and repeat" type exercises. Students can select

the vowels/consonants, and then also select those words they wish to practice. As shown in Fig. 1, students can listen to and see a video of the teacher. Thus, students are able to study the tongue position, mouth, and lip movements produced by a native speaker.

The Visual Voice Section. The *Visual-Voice Section* allows students to see both the waveform and the spectrogram of the phonemes of a word which the teacher pronounces (see Fig. 2). HPP also allows students to record their own voice, and shows this waveform and spectrogram as well. Thus, HPP allows students to compare their voice with the teacher's, both visually and aurally.

The Minimal-Pair Practice Section. The *Minimal-Pair Practice Section* allows students to practice listening to minimal-pair words. Typical Japanese people often have great difficulty distinguishing "sink" from "think," and "light" from "right." Minimal-pairs are composed of paired word-sets similar to those above.

The Quiz/Game Section. The *Quiz/Game Section* allows students to test and verify their listening ability. HPP is able to give quizzes of minimal-pair words, and students then answer the quizzes. HPP *randomly* plays either "light" or "right" from that particular (light-right) minimal-pair. Due to this feature, students are unable to predetermine the correct answer.

3.1.1. Components of HPP.

We developed the following components to be reusable: (a) a fundamental utility component group, consisting of (a1)high quality timer, (a2)count up/down timer, (a3)data randomized shuffler, and (a4) text-file operations; (b)voice recording and playing component; (c)video recording and playing component; (d)voice spectrograph component; (e)oscilloscope component; (f)voice mixer component; (g)volume control component; (h)multiple-choice quiz component; (i)and a multimedia database component.

3.2. A-MATE: A Multimedia Authoring System for Teaching EFL

A-MATE aims to help a teacher to create web-based exercises and quizzes for their classes without requiring any programming. An EFL teacher will be able to create various types of exercises by preparing teaching materials, according to a simple format, without the need to use any programming code. A-MATE will be able to automatically create the appropriate HTML/JavaScript forms and pages by extracting necessary information from prepared materials.

After our analysis of TOEFL and TOEIC exercise texts, as well as EFL textbooks, we found that we can abstract typical EFL exercise activities as follows:

1) Present example problems utilizing a (multi-)media type and format.

2) Choose one out of a group of question/answer patterns.

We have plotted our program strategy to produce student exercises based on above two EFL development activities adopted in general:

1) A teacher chooses one exercise pattern from the group of exercise types.

2) The teacher also chooses one question/answer pattern from the question/answer groups.

That is basically all that a teacher has to do to create Web-based exercises and quizzes for their classes.

3.2.2. Components of A-MATE.

In order to develop A-MATE, we reused five out of nine HPP components, which are (a), (b), (c), (g), and (h), added two features to the component(i) of HPP in order to manage the quiz "type" and "difficulty," and developed (j) a "new quiz generation" component which generates "Fill-in blanks" type quizzes, "Connect -n to -n items" type quizzes, and "Arrange items into proper order" type quizzes.

3.3. MBD: Multimedia Bilingual Dictionary for JFL/EFL Learners

There are various types of electronic dictionaries and software on the market, but not many are compiled for beginner language-learners. A beginning-level CAI dictionary can incorporate features important to both EFL and Japanese as a foreign language (JFL) learners. For instance, 1) many EFL beginners have a strong desire to acquire accurate English pronunciation, but it is difficult for these students to pronounce English words correctly (even with aural cues), without demonstrable knowledge of the mechanisms of pronunciation, such as tongue position, lip movements, etc., so, to benefit learners, video clips of a native speaker pronouncing terms can be included in the dictionary software; 2) for JFL learners, dictionary word look-ups often include unknown kanji, which can create frustration and confusion—therefore, rapid kanji-to-kana translation can be provided for all kanji appearing in the dictionary; 3) typical dictionaries do not contain semantic look-up categories, which are beneficial to learners and speed learning. Through software implementation, it is possible to design a variety of look-up methods and particularly, lexical look-ups can be included in the dictionary design; 4) both EFL and JFL learners can benefit by hearing as well as reading all terms and sentences contained in the

dictionary, in both languages—voice-synthesis technology allows for this possibility.

Thus, we began the MBD project in order to effectively eliminate shortcomings and aid learners in their desire to acquire a target language. Essentially, novel voice-synthesis elements have been integrated into the MBD program and pilot-tested. Program software allows the database to be accessed and searched by several methods, including: 1) Word Entry; 2) Partial-Word Entry; 3) Jump Searches & Jump Searches Across Languages; 4) Lexical Category Searches; 5) Lexical Correspondence Searches. Program software also allows for text search-strings to be entered in the Roman, kana, and kanji alphabets.

Figure 5 shows a screen shot of MBD. For JFL learners, a means of converting kanji to kana has been implemented—the learner right-clicks the mouse and selects “KANJI” from the menu that pops open. The kana associated with the kanji then appear in a small window. EFL learners can benefit from associating written English, with its many spelling idiosyncrasies, to the spoken word. Students can practice English by playing multimedia clips that demonstrate a native-speaker’s mouth-movements. For both JFL and EFL learners, all mirror-sentence pairs can be listened-to by utilizing the text-to-speech voice-synthesis feature, which functions in either language. We believe that these design features can make a contribution to foreign language education and provide enjoyable learning opportunities for students.

3.3.1. Components of MBD.

We reused components (a),(b),(c),(g), and (i) of HPP, and made four new components: (k) a full text search component, (l) a dictionary component, (m) a Japanese Kanji to Hiragana converter component, and (n) a Text-to-Speech synthesis (TTS) component. Currently, MBD is accomplished through one associated external software package for the converter component (the Japanese “language pack” freeware support associated with the Microsoft Internet Explorer 4/5 browser (IE-4/5)), and for the TTS component (Microsoft Speech Software Development Kit). Concerning the TTS, MBD allows users to switch to another speech synthesis engine, if users have an available speech synthesis engine that uses Microsoft Foundation Classes.

4. An Application program Under Developing Using Pre-existing Components

4.1. VOCAL: Multimedia Vocabulary Concordance and Academic Lexis

Although computer-based concordance programs are available for the researcher, a multimedia concordance program has not yet been authored that is specifically designed to both meet the needs of academic, learner-centered reading programs, and which seeks to increase student comprehension of scientific texts in ESP (English for specific purposes) settings. The VOCAL program presents a computer assisted language-learning (CALL) software design and rationale for a tripartite concordance and lexis that reflects the three major groupings of English vocabulary deemed particularly relevant for English for academic purposes (EAP) science study, as well as other academic fields. The ultimate goal of the program under development is to enable vocabulary study to be further integrated into EAP reading classes, with the potential of accelerating students’ comprehension of the vocabulary, texts, and contexts in which the vocabulary items are contained (fig. 6).

The VOCAL program consists of several modules. The SRT (Source Reading Text) module is the central module of a projected multi-module, multimedia CALL reading program, designed to provide: a) vocabulary, b) reading materials, c) student assessment, d) test creation, e) data collection/compilation of study and test histories, and f) grading functions for the teacher (or independent student). Teachers and departments will be able to utilize the total program as an educational tool in designing distance learning and student self-study courses, as well as integrating the program into courses which make use of computer labs.

4.2. Components of VOCAL

Concerning the VOCAL program, we are reusing components (a),(b),(c),(g),(i), (k), (l), and (m) without alteration, and are creating an additional component for the concordance function.

5. An Application program Example Made by a Beginner Programmer

Figure 6 shows a screenshot of an "English Conversation Studying Program" made by a beginner programmer. Her education in programming involved a six-month introductory course in C programming. Before starting to design her educational application, a two-hour class provided an explanation of the Delphi programming environment, usage of components, and a demonstration of pre-existing components. Consequently, she was able to create an application for English dialogue-practice in two days using pre-existing components (this does not include the time spent preparing instructional materials such as

scenario-writing, video-taping, and digitizing). One and a half hours after she started programming, she asked us two questions. The first question concerned an error that had occurred when she tried to play a movie clip while a different movie clip was playing, and a second question asked, was how to create an adequate interval time between the playing of the two movie clips. The first question was solved by checking the playing status of the movie clip using an "if-statement", and the second question was solved by inserting a pause routine immediately after a movie clip played. We consequently modified the corresponding components, as our aim was to have a beginner programmer create an application program using our components, without having to know how to program an "if-statement". The student's application program has a very simple structure, composed of three similar pages, nonetheless, it is a worthwhile and practical language-learning program, as our student has demonstrated.

6. Conclusion

The "reuse rate" of existing components in each of the programs is 71% for the A-MATE program, 56% for the MBD program, and 89% for the VOCAL program. Although the reuse rate of the existing components of the MBD program (the second program developed using existing components), is lower than that of A-MATE (the first program), this is because the MBD needed several special components for Japanese language processing and speech synthesis. As shown in the results of the VOCAL program, the reuse rate of existing components of a new program will generally increase as additional programs are developed. Typical EFL learning activities aim at improving three abilities: communication ability, reading ability, and writing ability. All of the programs we described here can be used for improving these abilities. The HPP program can be used for improving communication ability, the A-MATE program can be used for improving all three abilities, the MBD and the VOCAL programs can be used for improving reading and writing abilities. The beginner group (one of three groups we categorized teachers into, in the background section of this paper) is able to use all of the programs as-is. Further, the application program by the beginner programmer that we introduced above (section 5), indicates the possibility that componentware-based software development methods can contribute to educational software development, and can empower students' learning.

Thus, the fifteen components in the overall componentware environment can be used by the beginner and the intermediate group for their own

unique designs to produce additional EFL educational materials. We will report our findings in more detail after documenting further case studies. In the future, the advanced group will be designing and building various additional components and offering them to the intermediate group. In this way, a large number of useful educational programs will become available for teachers interested in utilizing CALL programs specifically tailored to their needs, in diverse educational settings.

We hope that the componentware developmental model for multimedia-based EFL software creation, for use by educators and educator-programmers, may be able to help educational computer-usage shift from uniformity, based upon a centralized approach, to more diverse usage stemming from a decentralized approach.

7. References

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