BRIX: Meeting the Requirements for Online Second Language Learning

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Abstract

This paper describes the design and evaluation of BRIX, an environment for online learning of second languages. A needs analysis identified specific requirements of online language learning. Commercial course management systems were determined to be inadequate with respect to these requirements. BRIX was developed to address the need for a generic language learning environment that fulfills language educators' requirements focusing on reading, writing, and listening activities and can easily be customized for different language courses. The design of BRIX is based on pedagogic approaches and theories of teaching and learning second languages and on the results of analytic and empirical evaluation of test versions of the software. In this paper we describe the needs analysis and the design of BRIX, and present an evaluation that compares the use and usability of a Chinese course in BRIX to a previous handcrafted version of the same course.

1. Introduction

Second Language Acquisition (SLA) is one of many academic fields in which Internet technology has been applied in instruction. Distance education is desirable for SLA, especially for languages that are not commonly taught in a given institution (Fleming and Hiple, 2002). According to a survey conducted by the Chinese Language Teachers Association in 1996, many U.S. institutions did not offer Chinese programs because there were not enough prospective learners at their home institutions. Online language learning provides an opportunity for universities to offer courses in any language by combining scattered groups of learners from diverse locations. Furthermore, online learning also enables global language-partnerships between second language learners and native speakers who can collaborate and serve as peer educators.

However, current commercial software systems for distance education are not adequate for most SLA applications. Distance education for SLA requires a system that supports not only input and output of the character set of the target language but also a range of learning tools such as discussion boards, vocabulary activities, grammar clinics, online dictionaries, and writing draft books, and instructor tools such as feedback and assessment tools, all organized around learning activities and communicative practice in listening, speaking, reading and writing. Although some of these tools are provided by commercial course management systems, they are not tailored for the teaching and learning of second languages and are provided piecemeal rather than being organized in a manner conducive to the desired learning activities Consequently, many language education institutions have built their own courseware for their Web-based distance classes. This work requires intensive web programming experience, which regular language instructors cannot afford the time to pursue. Language educators need a system that can allow them to work independently as course designers, with no need for programming skills. BRIX, a tool for building SLA courses, was developed to meet this need.

In this paper, we first describe specific requirements of SLA and evaluate two major commercial learning management systems currently used in distance education against these requirements. Having motivated BRIX, the conceptual framework of BRIX and its features are treated in the third section of the paper. We then present an evaluation of BRIX based on its use in an Advanced Chinese Reading and Writing course at the University of Hawai`i.

2. Requirements for SLA Environments

Computer Assisted Language Learning (CALL) has existed since the 1960s (Levy, 1997, cited in Glatz, 2000). However, the use of computer technology has increased dramatically with the advent of multimedia and internet based technology, especially the World Wide Web

(WWW), in the 1980s and 1990s. The WWW has changed second language learning by providing rich content and interactive multimedia material that can be integrated into language learning activities, enhancing language learning efficiency (Bush, 1997 cited in Glatz, 2000; LeLoup, Cortland & Ponterio, 1999). Many websites of for-profit and non-profit language education organizations, therefore, provide interactive language exercises for self-study. These materials are built using mainly HTML, various multimedia authoring tools, and JavaScript (LeLoup, Cortland, & Ponterio, 1999; Zhang, 2001). However, language learning based only on self-test computer exercises presents limitations. Zekulin (1993) stated, "in doing computer exercises, some students are primarily interested in right and wrong answers, less in why a particular answer is right or wrong." Moreover, in the field of SLA it is now generally accepted that communicative use of a language with other learners is an essential ingredient in language learning settings (Omaggio Hadley, 2001).

Due to the importance of communicative practice, courseware for language learning should feature more than human-to-computer interactive material or an electronic form of a written textbook; it should facilitate a cooperative learning environment (Nelson, 1999; Slavin, 1980; Zhang 2001). Courseware should provide the means for virtual communication and interaction with other classmates, because students learn and strengthen their comprehension by contribution and sharing information (Fleming, 2001; Glatz, 2000; Johnson & Johnson, 1994). Plass (1998) summarized particular language learning activities and features for which foreign language multimedia software should provide support. For instance, to facilitate the writing process, courseware should be designed to support peer review, editing, and rewriting. Further requirements are adapted from the pedagogic approach used in language classes developed under the National Foreign Language Resource Center (NFLRC) at the University of Hawaii (Fleming 2001). A focus is placed on features that support reading, writing and listening activities.

The following subsections motivate the development of BRIX by evaluating two commercial Learning Management Systems (LMS), Blackboard and WebCT, with respect to requirements adapted from the pedagogic approach used in language classes developed at the National Foreign Language Resource Center (NFLRC) at the University of Hawaii (Fleming, 2001), and guidelines in Plass (1998). The focus is on features that support reading, writing and listening activities. The analysis draws upon on other studies (Bayne & Cook, 1999; Lewis, MacEntee & Maher, 2002; Siekmann, 2000), on specifications provided on the Blackboard and WebCT websites as of December 2002, and on our own experience.

2.1 Language

The LMS should enable the use of character sets for multiple languages. In our case, European and Asian languages are of particular interest. One should be able to select the language for all elements of the course, including the menus and navigation bars as well as course content and help facilities.

Neither WebCT nor Blackboard was developed specifically for language classes, but they can handle some target languages. According to their web sites as of December 2002, WebCT supports 14 European languages, while Blackboard has developed multi-language support including East Asian languages. Blackboard can display menus and navigator bars only in English while WebCT can display menus and navigator bars in 14 different languages but not Asian ones.

2.2 Discussion Boards

Asynchronous collaborative language learning environments require discussion forums as places for sharing and gathering information, strengthening comprehension, and facilitating peer review. Group discussion can be either public (whole-group) or private (restricted groups). However, in the context of language teaching and learning, small group discussions should not necessarily exclude all access by non-members of the group. Rather, language learning goals are better served when students in small groups are able to engage in conversation in their own group, for example to carry out a role play activity, while the messages in their discussion can be shared with other groups. Therefore "private" in this context means that the system should grant read/write privileges for group members, but read-only privileges for non-members.

WebCT and Blackboard both support discussion boards. Instructors can create multiple discussion forums in each course, but basically they can place the forums only within the discussion board frame. Both Blackboard and WebCT support private and public group discussion. However, neither of them allows non-members to view messages of other private groups. Discussion boards in Blackboard seem to be more intuitive than those in WebCT. Messages in WebCT are accessed by clicking on their titles and are displayed one at a time in a single secondary window. Usability testing shows that students suffer from having to click repeatedly in order to view posted messages on WebCT unless a compiling feature is applied. From the instructor's point of view, it is desirable for all messages to be displayed under each topic/ subject. This makes it easier for the student to compare, refer to, and reply to messages.

2.3 Dictionary

Dictionaries are key tools in language classes. For online language classes, the instructor should be given the chance to pick the most suitable online dictionary, and the online dictionary should be integrated in the courseware to allow students to search for unknown vocabulary items.

Neither WebCT nor Blackboard has a dedicated dictionary feature, as they have not been specifically designed for language classes. However, WebCT has a glossary that instructors can create in which they can store words, terms and annotations. Nevertheless, manually entering all vocabulary items and synonyms into the WebCT glossary is a prohibitively laborious task.

2.4 Composition Activities

Writing activities require peer review, editing, and rewriting of essays. Writing can be supported with a composition draft book – a personalized organizing tool, notebook and storage area for student drafts of essays. For composition exercises, the instructor often asks students to hand in two to three drafts of each essay. For each draft, the instructor gives feedback to the student about problems in content, grammar or organization. Students use the feedback and rewrite the essay before handing it in again. Students often need to revise their drafts multiple times. In the ideal online language learning environment, peer feedback would also be facilitated. Therefore, for supporting the writing process, a language courseware system should integrate an essay composition area featuring a discussion board associated with a draft book. This makes it easy for students to compare first and subsequent drafts along with feedback from the instructor.

WebCT and Blackboard both have internal notepads with which a student can take notes. Discussion boards are also available for posting draft versions of essays and getting feedback from instructors and classmates. However, these features are in separate locations and are not organized or integrated in support of the writing process as described above. Like many other online learning activities, SLA requires better integration of discussion tools with the student work to be discussed (Suthers & Xu, 2002). Furthermore, the system should provide thematically related words that have been posted to the class word bank earlier in the unit. A student drafting an essay can then easily incorporate words from the list, strengthening the incorporation of new vocabulary into her productive language use. Nothing like this is available in Blackboard or WebCT.

2.5 Reading Activities

Reading activities should be supported with an area designed specifically to store vocabulary items and their annotations, textual and audio pronunciation, and comprehension exercises. Two principles followed in the NFLRC language reading courses are that an instructional sequence should begin with what students already know, rather than an instructor's assumptions about what they know, and that the reading process should be an interaction between text-based elements and reader-based elements (Fleming, 2001). In line with these principles, a warm-up activity is introduced at the beginning of each lesson. In this activity students post words and sentences they already know in connection with the topic of the lesson. Words and sentences the students contribute, together with their pronunciations and definitions, are stored in a database after being vetted and corrected by the instructor. The daatabase is freely accessible by students throughout the duration of the course.

Commercial courseware has no specifically designed feature facilitating this type of vocabulary activity. Special areas with specific layouts enabling students to post words or sentences to build up vocabulary are not available in either WebCT or BlackBoard. Using a discussion board for this task is difficult and does not provide a usable interface.

2.6 Exercises and Quizzes

Language exercises in SLA range from structured and practice-oriented types, such as true/false or multiple-choice questions, to open-ended and use-oriented types, such as contributing one's opinion in a discussion. In general, structured exercises are used more at the beginning of a lesson in what are often called the input and practice stages, and less later on in the lesson as students gain freer productive use of the language covered in the lesson. Quizzes often incorporate a mix of the two types. The capability of courseware to facilitate a variety of exercise types is of critical importance in assessing its suitability for SLA.

It is of particular importance that courseware be able to accommodate both self-practice exercises and quizzes or tests. When doing self-practice exercises, students should be able to try as many times as they want without negative consequences. Scores should not be reported to instructors, but a history of page visits should be available for purposes of monitoring students' levels of participation. Hints or feedback should be provided as needed. Quizzes designed for assessment, on the other hand, should have scores attached and be constrainable in other ways, such as being accessible only once.

Blackboard and WebCT both provide a quiz function. Self-practice exercises are not available as such in Blackboard. Instead, Blackboard provides quizzes in which grading can be optional. WebCT has a better self-practice feature in which students can work through the exercise as many times as they want without a score being reported to the teacher.

2.7 Navigation

In general, two main types of navigation are used in learning management systems. In the first type, navigator menus are organized by activity type (or the tool that supports each activity), so that in a given course all activities of that type are grouped together — all discussions are listed together, all content pages are listed together, all quizzes are listed together, and so forth. In online courses organized using this type of navigation tool, students navigate by looking at a schedule and then returning to the activity-type menu, where they click on a link and jump to the related activity. Problems may result when students jump into areas in which they are interested regardless of the directions of the instructor. For example, students might want to do an exercise before an assigned reading — the opposite of the assigned order. As a result, the student's comprehension and performance will suffer.

In the second type of navigation, the course menu is hierarchical and presented in chronological order of the course content. Branch, Kim, & Koenecke (1999) recommend this organization for comprehensive course sites. Students can go step by step along the chronologically arranged hierarchy tree menu. Evidence from our own study of the log files of existing courseware systems suggest that chronological navigation works better for online learning. 98% of students could return to the correct activity after logging on to the class without accessing the course schedule page. 90% of students never missed activities and course contents that instructor assigned to them.

WebCT and Blackboard allow instructors to create unlimited content modules. However, their mechanism of organization and customization works differently. WebCT has better customization and organization of content and navigation, but is also more complex (Siekmann, 2000). Blackboard, on the other hand, doesn't allow much for customization unless the user has HTML programming skills. WebCT provides tools for instructors to create course content and activities such as quizzes and HTML pages, and then organize them in different areas within the course. A table of contents in WebCT can be built hierarchically and in chronological order. Blackboard, in contrast, has specific areas for the placement of various types of content and activities. There are three main areas in Blackboard for the placement of material: Course Documents, Course Information, and Assignments. Each area can hold an unlimited number of folders containing hyperlinks to content files. There are certain limitations on customizing the organization of contents in Blackboard and WebCT. Even though WebCT allows tools for releasing course content in chronological order, it does not make this available for all system features. Features such as the discussion board cannot be integrated as a part of the table of contents unless the user is familiar with certain specialized techniques.

A feature by feature summary of this analysis will be provided in Table 2, after we describe BRIX.

3. BRIX — Elements for Language Course Creation

Given the limitations of commercial systems such as those just outlined, it is understandable that language-learning institutes often build custom systems. For example, the National Foreign Language Resource Center (NFLRC) at the University of Hawai`i created advanced (third-year) Web-based courses in Chinese, Korean, and Japanese. Courses are taught in lesson units, each of which consists of a sequence of activities (Table 1). Activities include vocabulary activities, language exercises, small group discussions, grammar clinics, core content, essays, and quizzes. These activities are organized in a progression from vocabulary study at the word/phrase level through conversational use at the sentence level to presentational use at the paragraph level. All related content (including language activities such as discussion) in a given unit are organized into a specific module in the desired order.

Table 1. Instructional activities of online language courses in NFLRC (Adapted from Fleming, 2001)

	Sequence of Activities
I. Preparatory Activities	1. Warm-up (pre-knowledge vocabulary)
	2. Preparation (self-test exercise)
II. Core Activities	3. Pre-activities
	4. Authentic Text
	5. Global, Specific information, Linguistic, and Post Activities
III. Follow-up Activities	6. Trouble shooting (Q&A forum)
	7. Small group discussion
	8. Grammar Clinic
	9. Final Essay
	10. Quiz

The NFLRC courses were all developed and coded by hand. Yet the cost of custom development is too high. The prospect of developing additional courses in new languages using a similar instructional model spurred the development of language course creation software to reduce the need for intensive programming for every course. The result is BRIX, a platform for creating second language online courses. BRIX is designed to support the language learning activities mentioned in the previous section, with a particular focus on the pedagogical requirements of the NFLRC (Fleming 2001).

An alternative approach is to integrate specific additional components, such as a language bank or dictionary, into a commercial learning management system (LMS). However, the commercial tools do not fully support the organization of language activities and contents into units with a progression from vocabulary to conversational use and presentational use. Navigation remains awkward, affecting the learning process of students. Moreover, double-byte character sets were not handled well when we undertook this work.

3.1 System Development and Evaluation

To support asynchronous learning regardless of the location of the learner, BRIX was implemented as a WWW-based system. It uses a three-tier architecture. The ColdFusion web application server was selected as a middleware of the system. The implementation based on FuseBox methodology for ease of development and maintenance.

BRIX was developed by the first author using an iterative cycle of requirements analysis, rapid prototyping and formative evaluation (Hix & Harston 1993) under the direction of the other authors. Requirements analysis was accomplished with interviews of prospective instructors and students and analysis of existing NFLRC web-based courses and commercial course management systems (Blackboard and WebCT). Design and formative evaluations were accomplished through rapid prototyping using web-authoring tools, expert usability reviews, and evaluation and testing by instructors and students as representatives of their respective user populations. The second author conducted the usability reviews. Three language educators (including the third author) iteratively evaluated requirements and prototype designs. One to three students tested each prototype following an informal think-aloud protocol. Summative evaluation will be described later in this paper.

3.2 Conceptual Model and Features

With BRIX, language educators can easily create their own language course without involving a web developer. An instructor can create text contents, self-test exercises,

quizzes, discussion forums, and essay and vocabulary assignments by using instructor tools. Moreover, BRIX also includes student management tools, assessment tools, and a special tool for customizing the navigator menu.

To create a course, an instructor first prepares a course outline by making lessons or content modules along with contents or activities of that module. The instructor can create activities -- vocabulary, grammar, discussion, essay, self-test, and quiz -- using BRIX's authoring tools. Other contents such instructor-authored HTML files or links to external content on the WWW can be also integrated with the course. All information is stored in a database from which it can be retrieved and presented by the system using Dynamic HTML templates. Activities and contents can also be imported from previous courses. The following paragraphs briefly describe the authoring process and the functionality of BRIX's student interfaces.

Building the Course Menu. The instructor can use a menu builder to indicate the location of a lesson and its activities in the course menu (Figure 1, left side). Menu items can be displayed in either English or the target language. Activities and contents can be defined first, and then grouped and organized into specific lessons. If no lesson is specified, the created activities will be placed in a default module. Navigation need not be specified until the last step of the course building processes (but can be specified earlier). BRIX offers only the chronological menu style, as it is the best design for language learning activities.

Creating a language lesson. A lesson unit is a group of content and activities. To create a lesson unit, the instructor indicates the location in the course menu and provides the name of the lesson and other information. The contents and activities associated with the lesson will be displayed under each lesson, even if they were created in other places, as this helps the instructor organize the course.

Creating Language Activities. BRIX has tools for creating five types of language activities – Vocabulary Assignment, Discussion Forum, Quiz, Essay, and Self-Test Exercise. Instructors can organize these activities in a chronological menu. BRIX encourages but does not require instructors to follow the NFLRC progression from vocabulary to conversational (discussion) and presentational (essay) use. Activities can be hidden during the development process and released completed.

Vocabulary Builder. To create a vocabulary builder assignment, an instructor provides a title, instructions, and a due date, and then adds multiple questions. Each question may require a vocabulary response or a sentence response. A vocabulary response consists of the word in its original form, the Romanized pronunciation, and an English gloss (definition). A sentence response elicits a

Figure 1. Essay Composition

sentence expressing background information about the lesson topic. Vocabulary Builder assignments may be placed early or late in a lesson. Placement early in the lesson targets elicitation of students' background knowledge associated with the lesson topic. This background knowledge may be linguistic (vocabulary) or substantive (facts and figures, pre-formed opinions). Placement later in the lesson targets strengthening of knowledge students have acquired from the lesson's core material. Words or sentences that are added by the students will be stored in the Language Bank, which can be accessed by everyone throughout the class.

Discussion Board. The instructor can create discussion forums for specific topics. For example a lesson might have discussion forums for Q&A, Grammar Clinic, and Small group discussion. Each discussion forum can be either public or private. Private in this context means group members have full privileges in posting (read/write) while non-members can only view the posting messages. Creating a discussion forum is simple: the instructor enters the title of discussion either in English or in the target language, along with its type, instructions and due date.

Essay. An essay is an area for students to post compositions. Instructors and classmates can review and comment on the essay (Figure 1). To facilitate the writing process, the essay activity is supported by a draft book where a student can review and rewrite their essay based on instructor feedback and classmate comments. All vocabulary items that have been input during a given lesson using the Vocabulary Builder appear in an auxiliary window when the student uses the Draft Book in that lesson. To create an essay assignment, the instructor specifies the title, instructions, number of drafts and due date of the assignment.

Quiz. There are five types of quiz questions: multiple choice, true/false, fill in the blank, short paragraph, ordering, and matching. Each quiz is organized into parts and sub-parts. A part is an area for related questions, and a sub-part is group of the same type of question. For example, part I might be for reading comprehension consisting of two sections – multiple choice and matching. The instructor can create instant feedback for each question that can be viewed by students after finishing the quiz. Questions can be imported from previous semesters. Any change to the imported question will not affect the original question in the previous semester. Self-test exercises are based on same types of questions as the quizzes but are not graded. Feedback given to the student is not shown to the instructor. However, there are reports showing how many times a user has visited the exercise pages.

Assessment Tools. BRIX also offers assessment tools for tracking students' progress. The instructor can create or customize evaluation criteria for grading students. Each criterion can be associated with any learning activities. The instructor can check how many postings a student started and responded to in each discussion board; what

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pages have were visited and for how long; and the frequency of the student's logins. The instructor can create criteria and grade by lesson, and when grading, give comments on each criterion and overall. Students can also check their progress and grade online.

3.3 Comparison to Commercial LMS

Table 2 provides a comparison of BRIX to WebCT and Blackboard based on features of interest for Second Language Acquisition.

TABLE 2. Feature comparison of course authoring software and BRIX

System feature	WebCT	BB	BRIX
Primary Criteria			
Fully support languages			✓
Support content module	✓	✓	✓
Support vocabulary activity			✓
Support grammar activity (via discussion and textbook)	✓	✓	✓
Support composition activity			✓
Integrated online dictionary of target language			✓
Release content and all activities in chronological order	Partial		✓
Support multiple discussion board areas per course	✓	✓	✓
Support public and private discussion group	✓	✓	✓
System can create groups randomly	✓		
Instructor can create groups manually	✓	✓	✓
Allow non-member access private group discussion *			✓
Support full range of language exercises			✓
Support full range of language quizzes		✓	✓
Support multimedia contents	✓	✓	✓
Integrated online course with CD-Rom	✓	✓	
Secondary criteria			
Create a copy of an existing course	✓	✓	✓
Release feedback within quizzes	✓	✓	✓
Release content to specified group of users	✓		Partial
Instructor can delete messages	✓		✓
User receive announcements on login page	✓		✓
Instructor can view number of hits per page	✓		✓
Instructor can view date and time of each student's first and last login	✓	✓	✓
Instructor can view how many bulletin board articles a student has read	✓		✓
Instructor can view how many bulletin board articles student has post	✓		✓

4. Evaluation

The evaluation was intended to investigate how well BRIX can support language educators in managing their class in the way they desire, the usefulness and effectiveness of BRIX for language learning, and the cost savings of a reusable course system. The evaluation compared the use of an online version of the course Advanced Chinese Reading and Writing (CHN332) that was constructed by hand with the use of the same course constructed in BRIX. Data gathered from students included questionnaires, log files, student-created content, and observations of user behavior in usability testing. For evaluation of the instructor tools, we gathered data from language instructors in NFLRC. This evaluation may be seen as a summative evaluation with respect to the current version of BRIX, although it is formative with respect to our ongoing improvement of the software.

4.1 Evaluation of the Authoring Environment

This portion of the evaluation addressed how well BRIX's course authoring tools support language educators in building and customizing second language learning courses. Evaluation of suitability for SLA focused on a language course, Advanced Chinese Reading and Writing (CHN332), taught using BRIX in the Spring of 2003. Additional (but non-SLA) evaluation of course authoring tools was based on a cultural exchange course, Contemporary Franco-American Views on the World of Work, between University of Hawaii at Manoa and the University of Paris. The ease of use of the system was analyzed based on data collected from teachers who created these classes and 5 additional volunteers in usability testing. The hypothesis was that BRIX was easy to use if the instructors and test users were able to figure out how to setup and manage their class by their own

without help from the expert. A questionnaire was used to collect user opinions using scores ranging from 1 (extremely difficult) to 10 (extremely easy).

From the instructor's point of view, BRIX was easy to use overall: the average score given by actual instructors or course designers was 8.75 out of 10. These instructors had some prior experience creating language courses using WebCT and Blackboard. Based on test users and feedback from instructors, BRIX still needs an improvement for ease of use in some areas, including Quiz Maker, the interface between Course Content and Menu Builder, and the wording in descriptions of some tools. Quiz Maker and Menu builder were problematic for novice users to learn. In order to enable flexible release and presentation of course contents, content-creation tools and menu builder tools were separated. Instructors had to construct the content first and then make the content available on the course menu. This concept was too complicated for novice users to figure out by themselves. However, once they had been told, they could have succeeded the second time without help from an expert. Addition of a wizard-like interface may be used to make a connection between course content and menu builder tools. The Quiz Maker was also difficult to use for some users. The design was based on a complex hierarchy of parts and sections, which users could not figure out. Though the hierarchy and its parts are necessary for creating a SLA quiz that meets NFLRC requirements, we have been redesigning the user interface of Quiz Maker to be less complicated.

Assessment tools were a very successful feature in CHN332. The instructor of the class strongly agreed that the grading tools are effective and efficient. BRIX can provide a summary of all activities and performance of each student for each lesson and overall, helping the instructor to grade students while saving a lot of time.

All of responding instructors agreed that BRIX provided an excellent learning system for SLA, especially in reading and writing, and that it also can be used to support non-language courses. However, BRIX needs some expanded features to support voice interaction, which is necessary for listening and speaking skills.

A cost analysis was undertaken to estimate costs of BRIX-supported versus handcrafted courses. The analysis was done in terms of staff hours, as this is by far the greatest cost factor. (In our case, the staff were graduate students.) The fixed cost (infrastructure development and training) was 255 hours for the handcrafted system and 500 hours for BRIX. The variable cost (course creation and maintenance per course) is about 645 hours for a handcrafted course and 320 hours for BRIX, assuming that the instructor can create his or her own course in BRIX. Based on these estimates, the break-even point is one course, and savings should accrue at the rate of about 325 hours per course thereafter.

4.2   Evaluation of Instructional Effectiveness

This evaluation was based on the premise that BRIX can effectively help students learn languages if the design and features of the tools – The Language Bank, dictionary, discussion board, and DraftBook – encouraged students to use them as often as the instructor wants. BRIX is considered to be a viable replacement for the prior custom built online courses if usage did not decrease as compared to the prior course. Therefore we evaluated the usefulness and effectiveness of the tools by measuring students' usages of these tools. Specifically, BRIX was effective if 1) the student re-visited the Language Bank after completing the pre-activities in order to accumulate and share knowledge with their classmates; 2) students were able to use the dictionary when they encountered a problem in vocabulary; 3) students used the discussion board to share their problems and knowledge with their classmates; 4) students used the DraftBook to revise their composition assignment (essay) at least one time before they handed in their works; 5) students discussed and commented on other students' works, promoting collaborate learning. We compared results on these criteria to the results from the previous system. Our goal would be achieved if the performance of students who used BRIX met the above criteria and also improved over that of students who used the old online system. In this evaluation we assumed that students in an advanced reading and writing course have no problem dealing with Chinese characters. Therefore, lack of usage will not be due to inability to read the instructions or navigational devices. In comparing BRIX with the old system we are assuming that the average behavior and performance of students reflects the actual usefulness and effectiveness of both systems because they are based on the same instructional method and contents and involve similar student populations.

Two data sources were used: an opinion survey of students taking the course, and frequency of tool usage by those students as recorded in server log files. The evaluation is based on use of the previous online course by 54 students over three semesters, and use of the BRIX version by 21 students in one semester (of which 13 responded to the survey).

According to the log files, students using BRIX revisited the language bank about 72% more often than in the previous system. On average, 57% of students using BRIX revisited the language bank without instructions from the teacher. Of those who visited language bank, visits averaged about 2.5 times per lesson. This number was double the number of students who visited the language bank in the previous system. Also, 40% of those visited Language Bank to review other vocabularies from peers, while 60% of them visited Language Bank to check the instructor's feedback on their word/sentence.

Nevertheless, 85.7% of students responded that Language Bank is not very helpful in their opinion and 14.3% of this 85.7% did not use the Language Bank due to lack of understanding of how it works. A redesign of instruction may help students understand the purpose of the Language Bank, and redesign of the user interface of language bank would help the system yield better outcome in future semesters.

The integration of the Language Bank, DraftBook and Discussion Forum improved the writing process. Typically, the language teacher encourages students to revise each essay draft as many as possible before handing it in. This could help students improve their writing skill. According to the log file of the old system, only 7% of the students using that system revised their essay before submitting, and on average, each of those students revised their essays only 1.12 times per essay. BRIX yielded better results: 48% of students used the Draftbook to revise and edit their essays before submission, an increase of 585%. Moreover, the log file indicated that students revised and edited their draft an average about 3 times before submission, which is two times as many as in the old system and beyond the point the teacher expected. A third (33%) of students who did not revise and edit their draft reported that their essays were too short to need revision, and 17% of those who did not revise reported that they usually had no time for revisions. Students agreed that the keyword list was helpful, and the Draftbook was easy to use. More than 75% of students incorporated the words in the keyword list within their essay.

Participation in the discussion forum also increased in the BRIX system. On average, a student contributed about 3 messages per week compared to 2 messages per week in the old system. The online dictionary was the least successful feature: 75% of students did not want to use the online dictionary due to the complexity and incompleteness of the available vocabularies of the given site. (We used an external dictionary developed by others.)

Overall ease of use and navigation of organization of BRIX got good scores from the students: 76% of students agree that BRIX is easy to use, while 23% said they spent some time to figure it out. Note that the 23% of students who had problems at the beginning were novice users – they had never used any online learning system before they were using BRIX. The organization of BRIX's course contents yielded a slightly lower score: 61.5% of students reported that the organization was good, and they were always able to find anything they wanted, while 30.8% of students reported that they needed to spend sometime to figure it out. However, 50% of those who complained reported that the problems mainly come from an unclear schedule rather than from BRIX's design.

Finally, BRIX's effectiveness was reflected in student performance. Using data from lessons 2 through 6, scores for students in the BRIX-supported course (20 students) improved over scores in the hand-crafted course (24 students) in all of the following evaluation categories: participation (+13.3%), content (+10.5%), timeliness (+10.9%), following directions (+7.0%) and quizzes (+3.5%).

5. Conclusion and Discussion

Second language acquisition courseware should support particular features for learning activities such as vocabulary, grammar, essay writing, etc. Collaborative learning as well as self-study should be supported. Ease of use and flexibility are also issues for course authoring tools. BRIX has been built on pedagogical theory for second language learning. Ease of use was important in the design of BRIX, as language educators and students are not necessarily skillful in computing technology. Accordingly, we applied current usability engineering techniques. BRIX can yield great benefits to language institutes by saving the time and cost to develop courseware for each language course.

BRIX was used in the Advanced Reading and Writing in Chinese course of the University of Hawai`i at Manoa in the spring 2003 semester. Comparing usage in this course to usage of a previously developed system, we found that BRIX succeeded in providing a more effective learning environment for supporting second language acquisition, especially in reading and writing process. However, some features need to be improved, such as the Language Bank and Quiz Maker. To make BRIX be completed for SLA courseware, BRIX need further expansion to support speaking activities and to fully integrate audio and video functions.

The principles of SLA described in this paper have some features that are specific to language learning, and some that are general features of learning and cognition. In fact, there is currently a vigorous debate in the SLA field about whether the mechanisms of language acquisition constitute a distinctive cognitive phenomenon – a "black box" for language, as it were – or are merely a particular manifestation of general processes of human cognition. Because of the overlap between language acquisition and learning in general, the design of BRIX was informed by such general principles of learning as "from simple to more complex," "build on learners' existing schemata," and "input before output." However, because BRIX has an open, modular design, while it does facilitate the implementation of these principles, it does not force them. Their effective implementation is still up to the user.

BRIX was designed to accommodate instances of these principles that are particular to language learning.

For example, vis-a-vis the principle "from simple to more complex", in other fields of learning one might begin with axioms and progress to proofs; in language one begins with sounds and words and progresses to sentences, paragraphs, and extended discourse. "Building on learners' existing schemata" in an advanced astronomy course might involve eliciting learners' current understanding of the relationship between time and the speed of light; in a language skills course it is more likely to involve eliciting words and sentences that learners already know in relation to a given topic area. Both of these principles informed the design of the "language bank" in BRIX, but while the "language bank" is an excellent tool for activating students' existing schemata in a language course, if we were to design a course in advanced astronomy using BRIX, a public forum might be a better tool to use for the activation of students' existing schemata, since it can better accommodate the extended discourse required to discuss concepts of cognitively high order.

6.   References

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