Journal of Universal Computer Science, vol. 7, no. 3 (2001), 240-253
submitted: 27/12/00, accepted: 20/3/01, appeared: 28/3/01 *© Springer Pub. Co.*

A Synchronous EFL Writing Environment for the Internet[1]

Chin-Hwa Kuo
(Computers and Networking (CAN) Laboratory
Department of Computer Science and Information Engineering
Tamkang University, Tamshui, Taiwan ROC
chkuo@mail.tku.edu.tw)

David Wible
(Research in English Acquisition and Pedagogy (REAP) Group
Department of English
Tamkang University, Tamshui, Taiwan ROC
dwible@mail.tku.edu.tw)

Chia-Lin Chou
(Internet & Multimedia Application Tech. Lab
Telecommunication Laboratories, Yang-Mei, Taoyuan, Taiwan ROC
clchio@cht.com.tw)

Abstract: In this paper, we describe the design and implementation of a synchronous EFL computer assisted English writing environment. In addition to supporting the basic writing function requirements, two novel mechanisms, namely, (1) synchronous text co-editing, and (2) voice delivery, have been designed to provide fundamental capabilities over the Internet. As a result, the designed system exploits the integration of computers and networking capabilities with linguistic and pedagogical principles crucial to web-based language learning. The system integrates CMC tools with database technology for the specific purpose of archiving the communications between tutors and students. Since the platform offers a bank of comments that are frequently used in these online tutorials, the system can store and tabulate each token instance when a comment is used. This database then offers instant cumulative profiles into tutor-learner interaction and into the common language errors or difficulties uncovered in the tutorials. Such an archive supports research into language learning difficulties and into patterns of tutor-learner interaction. This data is valuable in the assessment of pedagogical effectiveness and in the development of online tutorial materials that meet the attested needs of learners.

Keywords: Computer assisted language learning (CALL), Learner corpus, Voice transmission, Co-editing
Category: K.3

---

[1] This is an extended version of a paper presented at the ICCE/ICCAI 2000 conference in Taipei, Taiwan. The paper received an Outstanding Paper Award and is published in J.UCS with the permission of ICCE/ICCAI.

1 Introduction

With the popularity of the Internet, in particular the rise of the World Wide Web, there has been a corresponding renewed interest in Computer Assisted Language Learning (CALL). Currently, there are numerous commercially available packages for second language learning ranging in format from CD-ROMs to web-based systems. While CD-ROMs are limited in the resources that can be included and in the level of interactivity and responsiveness to individual users, web-based systems have the advantage of transcending these limitations. More specifically, the Internet offers the potential of integrating content with computer and networking capabilities. Despite this potential, however, current web-based CALL systems are often limited to static systems which store content in relatively easily accessible formats. Among the limitations in these approaches, students are either constrained by restrictive sequencing of materials or fixed content; the learning behavior or performance of students is not recorded or exploited for insights into their needs or difficulties; the experience of previous users (whether students or teachers) is given no role in providing feedback or in evaluating the users or the system.

Among the distance learning systems on the Internet, a fundamental distinction can be drawn between two basic modes of interaction available: *asynchronous* and *synchronous*. In systems using the asynchronous mode, lecture content is provided, typically on web pages. Learners may pose their questions or opinions on discussion boards, and e-mail serves as the main communication channel. These systems lack capabilities for real-time communication between instructors and learners or among peers. In environments that use the synchronous mode, on the other hand, systems are required that support real-time communication modules and interactivity. Many currently available systems have text, audio, and video communication capability. However, these systems do not take the specific needs of language learning and teaching into consideration. The design of the present system has taken the above issues into consideration.

The use of computer mediated communication (CMC) has been examined to some extent. A synchronous CMC platform that encourages more reticent students to use the target language and discuss their writing holds particular promise in teacher-centered traditions where students are often given a more passive role and refrain from voicing their views in class. Further, as far as designing a system with the educators' goals in mind, the design team for the system reported here consists of not only information engineers, but a linguist and language teacher as well.

There is another issue which arises in the design of CALL systems concerning the effectiveness of certain pedagogical practices which is particularly worth some discussion here. Specifically, some researchers in second language acquisition (SLA) argue that corrections from teachers are not effective in helping language learners improve. We have argued elsewhere [Wible], in fact, that such recommendations against correction are premature due to lack of control over the crucial variables in virtually all research on the effectiveness of correction. We argue that only with (1) precise control over the form and content of teacher comments and (2) tracking of the use of those comments and of learner responses to them can the question of the efficacy of L2 corrections by teachers be addressed. We show in that

paper that studies which argue for the ineffectiveness of correction lack such control and tracking.

In this paper, we propose a learning environment designed to overcome the above restrictions. Based on the proposed design philosophy, a synchronous English writing environment, WriteNow, has been designed and implemented on the Internet. The work reported here is the result of collaborative research between Computers and Networking (CAN) and Research in English Acquisition and Pedagogy (REAP) laboratories at Tamkang University.

The system consists of (1) a synchronous English writing clinic and (2) an archive of learner and learner-tutor output. In the first component, the synchronous writing clinic, we make use of a web-based user interface and provide an online essay display board with support for real-time co-editing and dialog, synchronous voice transmission, and an archive of frequently used comments for tutors where commonly used feedback can be easily stored, accessed, and provided to students during the online sessions.

In the following sections, the description of the system is organized as follows. In section 2, an overview of the system is given. We illustrate the design philosophy and building blocks of the system. In section 3, we describe in detail the technical mechanisms, such as session management, the co-editing mechanism, and voice transmission. The system implementation and user interface are described in section 4. Directions for future work are suggested in section 5.

2 System Overview

In this section, we describe the design paradigm of the Intelligent Web-based Interactive Language Learning (IWiLL) in section 2.1 and the functions and tools for the developed synchronous EFL computer assisted learning environment in section 2.2.

2.1 Design paradigm of the interactive language learning environment

WriteNow is one module in a larger web-based English learning environment designed to give learners and teachers access to each other and to online language learning resources [IWiLL Group (01)]. The entire system combines several modules now at various stages of development in an integrated web-based language learning environment combining the study and practice of the four language skills: writing, reading, listening, and speaking.

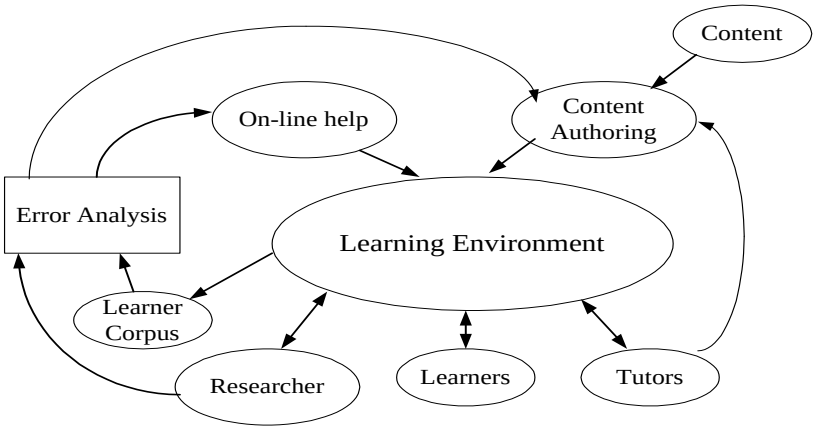

Figure 1: *Design paradigm of the interactive language learning environment*

A representation of the overall system design is shown in Figure 1. The platform takes into account two fundamental sorts of language data.: language input offered to the learner and language output produced by the learner. With respect to input to the learner, the system's design makes it possible for content to be retrieved from a range of sources in various media (text as well as multi-media). These can be edited or annotated by teachers or materials designers and then offered to the learners. Learners access this language input through the learning environment at the center of the system. Here the learner's interface provides interactive access to content and to teachers and tutors. As far as output is concerned, learners are able to write essays and participate in online discussion boards with the help of online dictionaries and writing support. Teachers, in turn, are provided interfaces through which they can comment on the learners' production. Crucially, these interactions are stored as annotated learner data, and learners, teachers, and researchers can access and analyze the relevant performance data and feedback. Researchers have authoring tools to create online help that addresses precisely the errors that they uncover in their investigation of the learner output. In this manner, the expertise of instructors and researchers and the learning experience of learners can be accumulated and shared with all users.

2.2 The Synchronous Online Tutoring Environment

To reproduce a face-to-face writing clinic on the Internet and to exploit the potential of the integration of computers, communication networks, linguistics, and language pedagogy, the proposed writing environment is equipped with the following special tools and functions.

Synchronous text co-editing: Learners copy and paste their essays into a text frame, allowing the text to be displayed to the tutor and learner at the same time.

The users can then communicate synchronously about the content of the essay by text or voice transmission (see below). By marking any portion of the text with the mouse, both learner and tutor are able to work on the same sentence and immediately identify the writing problem. The technical challenge in supporting this function is that when two users can synchronously co-edit the same string in a text, this interaction may result in conflicting data [Kuo (98a)], [Handley (97)]. Hence such a feature requires the support of an adequate co-editing mechanism to avoid the data conflict. To satisfy this requirement, a textual co-editing mechanism has been developed.

Voice transmission: To enhance communication between the participants within this environment, a real-time voice transmission channel has been provided. Typically, current Internet systems deliver only best effort service. In the voice transmission device designed for this platform, we have developed a scheme to overcome jitter [Jha (96)], packet delay [Hsu (98)], [Moon (98)], and packet loss [Podolsky (98)], [Bolot (99)] in order to provide improved quality voice transmission for our purposes.

Comment bank: The heart of this system is the capacity to allow users to mark a specific portion of text and discuss and edit it in cooperation with a second user at a distant location. The main means that tutors are given for providing feedback to the learner is giving comments. To reduce the tedious and repetitive aspects involved in giving this feedback, the tutors' interface includes a bank of easily retrieved frequently used comments. The comment bank includes a set of standard comments and the editing capacity to change or delete any of these and create new ones. The standard set consists of positive comments as well as corrective ones and simple but important session management comments (for example, 'has your teacher already given you any suggestions about this essay?' or 'Please paste your essay in the frame now.') One of the motivating assumptions behind this system design is that the comments provided to learners by tutors contain valuable information for the learner. Traditionally, such comments in tutorial sessions are ephemeral. Fortunately, since the channels of communication for the WriteNow system are computer and networks, this data can be recorded, archived, and indexed to the specific portion of student text that each was aimed at. The data is retreivable by learners, teachers, and researchers, providing rare insights into the learners difficulties and the learning and teaching process.

Online help: The WriteNow interface offers learners and teachers online access to a corpus of standard English and other language resources that can be conveniently consulted during the tutorial session. With these tools, learners can access the needed help at the moment of need. In addition, the overall online environment provides an authoring environment where domain administrators can create online help targeted specifically to the problems uncovered in research on the learners' English output. In the future, these helps will be made available in the WriteNow synchronous environment as well.

Comment tabulations: A record is kept in each session of how frequently a comment has been given. These sorts of data offer a window onto the nature of students' writing difficulties and reflect the sorts of communication that tutors find useful in discussing the essays with students.

3 Design of Synchronous English Writing Clinic

In this section we focus on describing the design of the system's special features: (1) the textual co-editing environment, (2) voice transmission on the Internet, and (3) the comment bank design. The features are intended to support the synchronous interaction of tutor and learner.

3.1 Textual co-editing environment

The co-editing environment is designed to allow a tutor and student to discuss a piece of student writing and permit both participants to focus on the same section of text simultaneously and communicate clearly about it.

Users can make use of two modes, *control* mode and *free* mode. When the tutor would like priority in control over the co-editing procsess, the control mode provides this priority over the learner's editing; the tutor is able to override the learner's output. In contrast, to allow equal control for both parties, in the free mode, the environment allows a two-way override. This provides users with flexibility in revising the essay. The technical difficulty in supporting the free mode lies in the possibility of data conflict. With conventional, floor control mechanisms, such as token control, the data conflict problem is resolved at the cost of some degree of flexibility [Dommel (97)], [Pendergast (98)]. In the approach we have designed, a co-editing mechanism, *Temporal And Spatial Data conflict detection* (TASD) [Kuo (98a)], is provided which takes data consistency and user flexibility into account. The designed algorithm resolves the data conflict by using an *undo* process. Intuitively, data conflict arises when two events occur within the same markup area. By further analysis of the events into relationships such as temporal relations, spatial relations, and event attributes make it possible to avoid many *undo* processes. The version of the co-editing algorithm proposed here is an extension of our previous work [Kuo (98a)].

3.2 Voice transmission on the Internet

Due to the characteristics of the present TCP/IP, the transmission of voice on the Internet is not an easy issue. Currently the Internet offers only a point-to-point *best-effort* service, which may present packet delay, delay variation, and packet loss. We have designed an adaptive policy-based voice tool to overcome this type of transmission difficulty [Kuo (98b)], [Kuo (99)]. In our design [see Figure 2], a data construction mechanism and a QoS adjustment mechanism in the receiving end are used to collect the transmission message in the packet to further probe the network conditions. Then, this message will be sent to the sending end. A sending rate control mechanism is designed to select the suitable sending packet format. There are twenty transmission formats inside the policy selection table, which represents different bandwidth consumption and voice quality requirement to deal with network conditions. Our experimental results indicate the designed policy-based voice transmission scheme is able to deal with the delay, delay jitter, and packet loss problems on the present Internet with voice quality improvement.

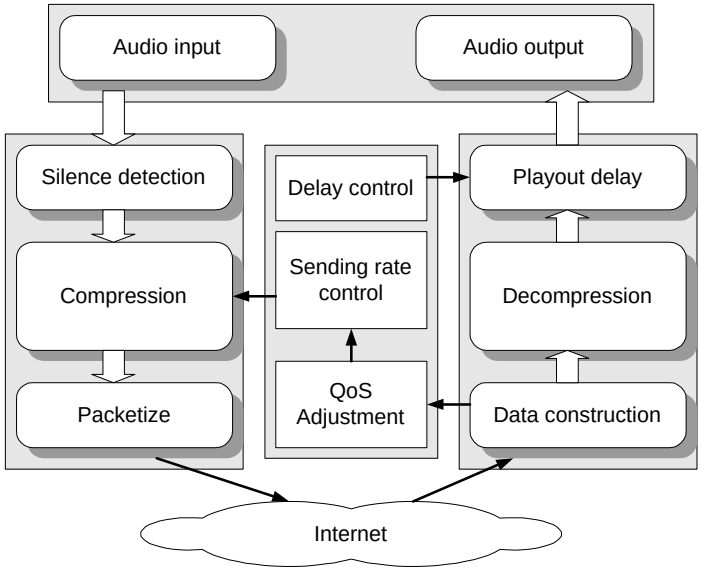

Figure 2: *The designed voice transmission scheme*

3.3 Comment bank design

Experienced writing teachers realize that among the myriad of comments that they offer to student writers on their essays, there exists a core of often repeated advice. The system allows tutors and teachers to store these core, frequently used comments for ease of use. In addition to alleviating the tutors repetitive tasks, the design of comment bank supports the tabulation of online error statistics as well, so that the content of tutor-student interaction can be cumulative and be investigated for learner difficulties and teacher feedback. The comment bank consists of a standard set of comments and an optional set of comments. There are three classes in the standard set of comments: (1) starting comments, which help start the session with initial questions about the assignment, (2) comments about grammar, diction, and mechanics (such as punctuation), and (3) comments about rhetorical elements such as organization and unity. The most frequently used comments are stored in the comment bank so that tutors need not compose them each time from scratch but can simply select them from the bank. The standard set of comments is shared among all tutors while each tutor has an optional set of comments which she or he can edit or modify according to individual preferences.

4 Implementation and Results

A typical session processing subsystem is shown in Figure 3. It consists of: (1) a network agent, (2) a synchronization agent, (3) a floor management control agent, and (4) application agents, for such functions as co-editing, co-drawing, voice, and video tools. With these elements, one is able to integrate many valuable networked multimedia applications. The same system architecture is applied to the implementation of the present work.

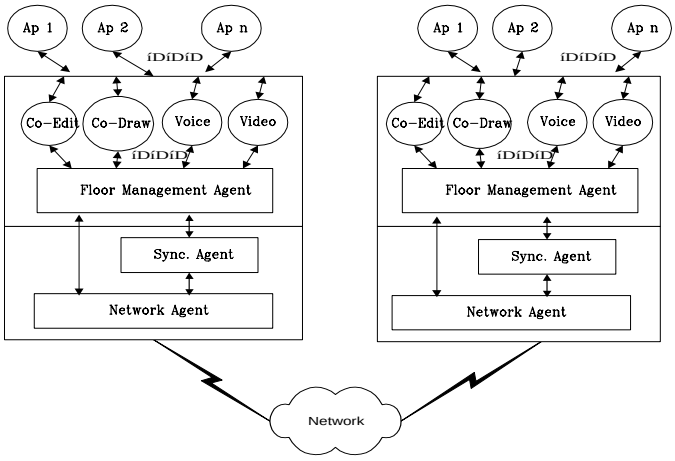

Figure 3: *Networking architecture for CSCW*

4.1 WriteNow graphic user interface

The WriteNow system is implemented with MS Visual C++ 6. Currently, the system runs on Windows 98, Windows 2000 or Windows NT platforms. The graphic user interface of WriteNow is illustrated in Figure 4. After accessing the main page, a user can select the tutor from the online user list. When the connection is made between two users, learner and tutor make use of the co-editing area as editing ground. The markup area will also appear on the screen at the remote site, allowing both users to simultaneously focus on the same portion of text though they are at distant locations. The comment bank and online help also appear during a tutoring session—the comment bank for tutors only and online help for both tutor and learner. The content of comment bank is described in section 3.3. Currently, users can access an online electronic dictionary and a corpus of standard English which can be queried for examples of vocabulary in use. Both learner and tutor may select the corresponding tool from the main page. A voice control panel and a text discussion board are provided as well. Thus, users may choose these communication channels

for their convenience. The implementation of the above functions and tools are described in the following sections.

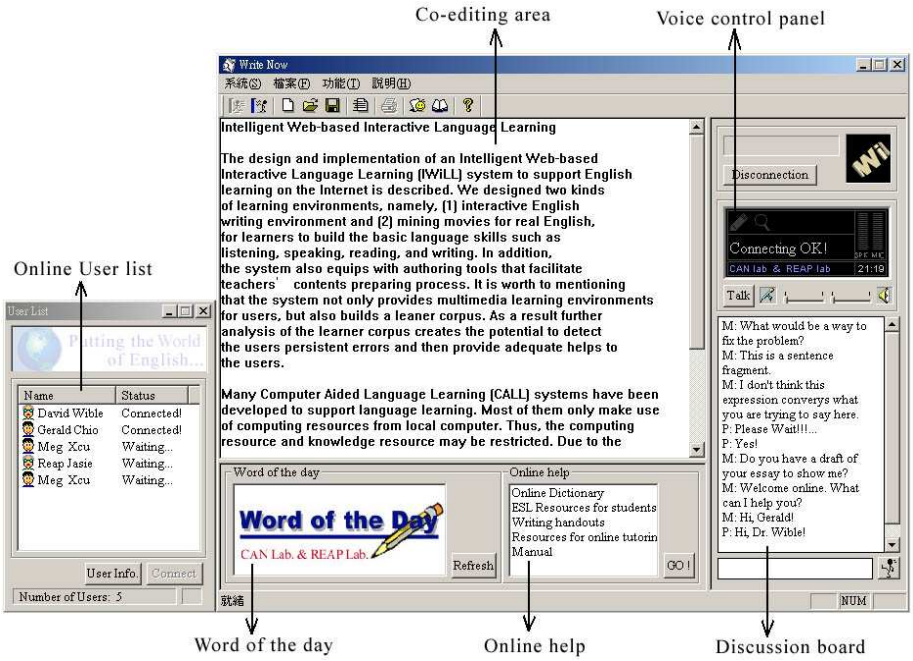

Figure 4: *The WriteNow synchronous virtual writing clinic GUI*

4.2 Implementation of the co-editing module

The possible text co-editing operations can be classified into two categories: (1) General Modification Operations (GMO) and (2) Attribution Modification Operations (AMO). The GMO includes: Insert, Delete, Cut, Paste, Resize, Change_Color, and Copy. The AMO consists of change_font, change_color, change_type, bold, italic, and underline. We assign a unique op-code to each operation. Each event also has a unique data format. The functions of each field is as follows:

Site_ID	Obj_ID	Area	OP	PO	Seq_Num	Data

Site_ID: 8-bit field to identify the participant;
Obj_ID: 4-bit field to identify each active co-editing file;
Area: 8-bit markup area, which includes area start and area length;
OP: 4-bit field to classify the operation;
PO: 8-bit field to include event start_po and operation length;
Seq_Num: 32-bit to identify operation sequence;
Data: modified data field.

These seven fields are arranged into a specially designed data packet for transmission.

Figure 5 shows the co-editing process in WriteNow. When the participants marked up a sentence of interest, the system launches a dialogue box. As the participants modify the sentence, e.g., Insert, Delete, Cut, Copy, and Paste, the co-editing TASD mechanism operates to reduce conflicts in co-editing. Thus, communication efficiency is improved.

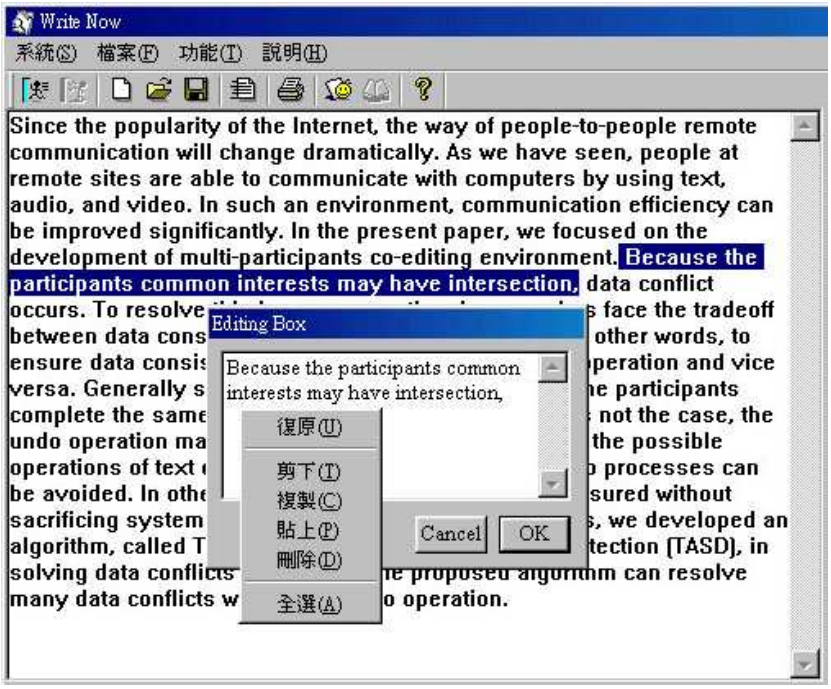

Figure 5: *User interface of Co-editing*

4.3 Implementation of voice transmission module

With the designed real-time voice transmission tool, the WriteNow system provides online conversation support. Users are able to communicate through text as well as voice on the system. As is well known, the transmission based on UDP is an unreliable packet transmission service. Voice quality is degraded when packet delay and packet loss occur. The designed WriteNow system emphasizes the application layer adaptation [Kuo (98b)], [Kuo (99)]. Furthermore, the scheme is transparent to users. Users enjoy the Internet voice presentation quality without noticing the changes in the underlying transmission policy.

The voice transmission scheme consists of silence detection, compression, and transmission, as discussed in section 3.2. We utilize APIs, such as ACM Functions (Audio Compression Manager) and Winsock II, under Windows 98, Windows 2000 and Windows NT in the implementation of voice compression and media transmission, respectively.

4.4 Implementation of the comment bank

WriteNow utilizes the client/server architecture. Microsoft SQL Server 7.0 is used in our implementation of the database. The Operation data flow of WriteNow comment bank is shown in Figure 6. The comment bank consists of two categories: (1) standard set of comments and (2) optional set of comments. The standard set of comments can easily be shared among tutors. Tutors retain their personal comments in the corresponding optional set of comments. A web-based authoring tool is provided in the WriteNow system such that tutors are able to modify their personal comments.

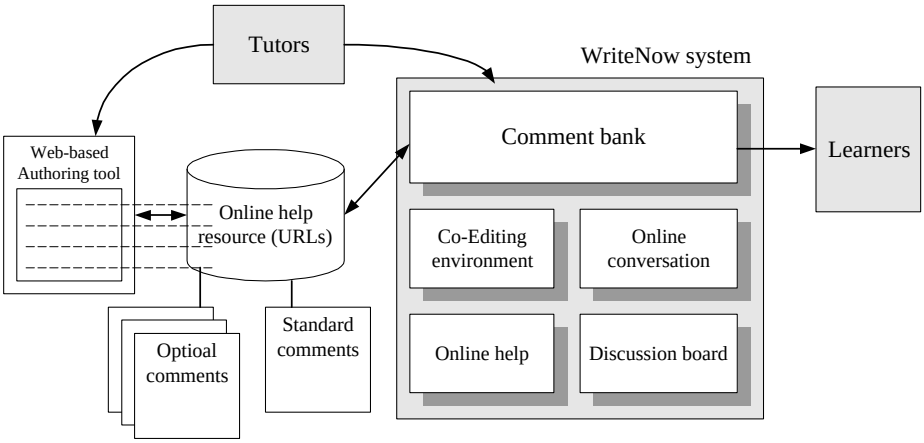

Figure 6: *Operation data flow of WriteNow comment bank*

The portion of the tutors' interface with the comment bank is displayed [see Figure 7]. The upper left panel in the interface displays a simple tree where all comments are accessible. Each comment is represented by a cryptic tag. Once a tutor selects a particular comment from this tree to send to the learner, the full content of that comment appears in the upper right-hand panel. The lower panel tabulates how many times each comment has been used during a tutorial session. This information helps learners, teachers, and researchers reflect on the content of the learner's difficulties profiles the tutorial session.

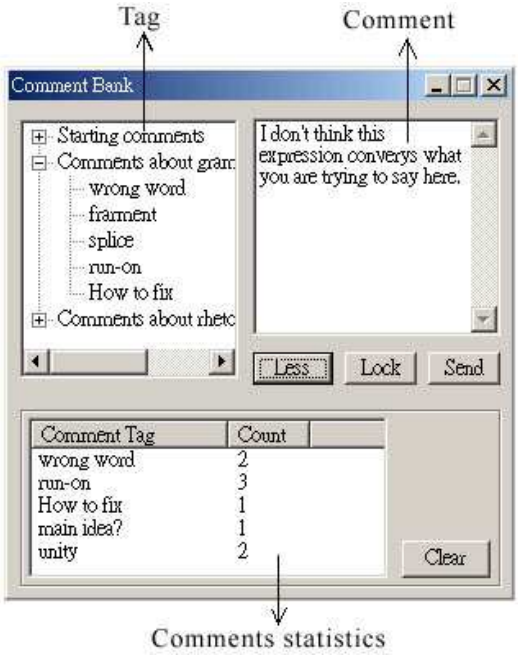

Figure 7: *The comment bank and the comment statistics*

4.5 Implementation of the online help

The online help in WriteNow is designed to provide easy access to resources on the Internet. Users may access the Internet resources such as online electronic dictionary [Cobuild (01)] or grammar help through this environment. A web-based authoring tool is designed to enable the tutor to edit the corresponding URLs. These results are then shown to users in web-based format. Figure 8 illustrates the online help data flow in WriteNow. Under this scenario, the valuable Internet resources are shared and integrated in the WriteNow system and then delivered and presented to users.

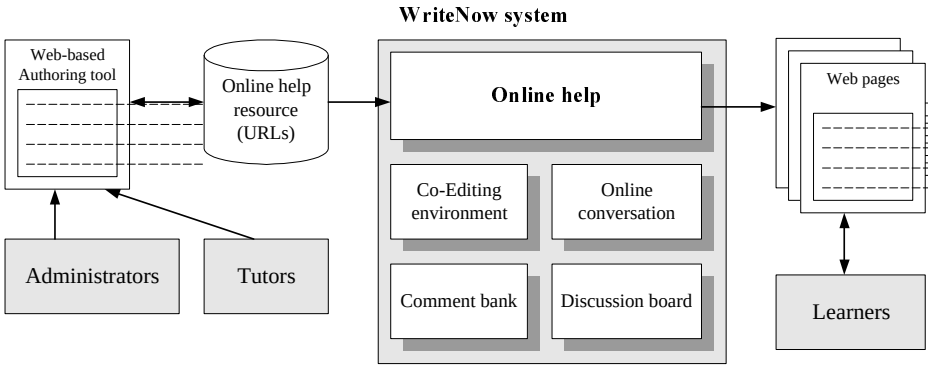

Figure 8: *Operation data flow of WriteNow online help*

5 Conclusions and Future Work

In this paper, we illustrate our design philosophy, premised upon the integration of computer and networking technologies, linguistics, and language pedagogy in the construction of a synchronous EFL virtual writing clinic, *WriteNow*, on the Internet. The proposed system not only breaks down temporal and spatial limitations on distance language learning, but also provides tools for detecting learning difficulties and addressing them in an online environment. Web-based authoring tools are also designed into the system to facilitate tutors in editing their personal comment bank and in collecting useful online help URLs for language learners. Thus, the available Internet resources are shared and integrated.

WriteNow is currently being tested in the Department of English at Tamkang University. The corresponding software works on Windows 98/2000/NT and is available from our web site [IWiLL Group (01)]. The synchronous writing clinic is currently integrated with a complementary *asynchronous* writing environment--an interactive English writing system in IWiLL used by over 200 English majors and six English professors at Tamkang University. The resulting system constitutes a novel multifaceted writing environment for second language learners and teachers.

Acknowledgments

The research reported here was supported in part by a Pursuit of Excellence research grant from the Ministry of Education of the ROC, grant #89-H-FA07-1-4-2. This support is hereby gratefully acknowledged.

References

[Bolot (99)] Bolot, J. C., Fosse-Parisis, S. and Towsley, D.: "Adaptive FEC-Based Error Control for Internet Telephony"; IEEE Infocom'99, March 1999,New York, NY.

[Cobuild (01)] Collins Cobuild Student's Dictionary Online, http://www.linguistics.ruhr-uni-bochum.de/ccsd/, 2001

[Dommel (97)] Dommel, H. P. and Garcia-Luna-Aceves, J.J.: "Floor Control for Multimedia Conferencing and Collaboration"; Multimedia System 5, (1997), 23-38.

[Handley (97)] Handley, M. and Crowcroft, J.: "Network Text Editor (NTE) – A scalable shared text editor for the MBone"; ACM Computer Communication Review, Vol. 27, (1997), 197-208.

[Hsu (98)] Hsu, T. C.: "Adaptive Synchronization Mechanism for Packet Audio Over the Internet"; Master thesis, Tamkang University, Jun 1998.

[IWiLL Group (01)] IWiLL Group, Intelligent Web-based Interactive Language Learning (IWiLL), http://www.iwillnow.org, 2001.

[Jha (96)] Jha, S., and Fry, M.: "Continuous Media Playback and Jitter Control"; Proc. ICMCS'96, 245-252.

[Kuo (98a)] Kuo, C.H., Chio, C. L., Yu, C. H., and Hsia, W. A.: "In Supporting of Distributed Co-Editing Environment"; Proc. ICS, Workshop on Computer Networks, Internet, and Multimedia, (1998), 17-24.

[Kuo (98b)] Kuo, C.H., Hsu,T. C. and Hsi, W. C.: "Adaptive Scheme for Packet Audio over the Internet"; Proc. SPIE, Vol.3561, September (1998), 242-252.

[Kuo (99)] Kuo, C. H., Chio, C. L.; Wei-Hao Chen, Tsung-Chieh Hsu, "Delivering Voice over the Internet"; Proc. NCS, Workshop on Computer Network, (1999), 74-80.

[Moon (98)] Moon, S.B., Kurose, J. and Towsley, D.: "Packet Audio Playout Delay Adjustment: Performance Bounds and Algorithms"; ACM Multimedia, Jan. (1998) 17-28.

[Pendergast (98)] Pendergast, M. O.: " A Comparative Analysis of Groupware Application Protocols "; ACM Computer Communication Review, Vol. 28, (1998), 28-40.

[Podolsky (98)] Podolsky, M., Romer, C., and McCanne, S.: "Simulation of FEC-Based Error Control for Packet Audio on the Internet"; Proc. IEEE Infocom'98.

[Wible] Wible, D., Kuo. C. H., Liu A., Tsao, N. L.: "A Web-based EFL Writing Environment: Integrating Information for Learners, Teachers, and Researchers"; Unpublished manuscript, Tamkang University.