Developing Critical Thinking Skills through Web-based Reading Courses

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INTRODUCTION

This paper gives a rationale for using multimedia resources available on CD-ROM and the Web in ESL/EFL reading courses at the university level, especially where the objective is to develop critical thinking skills. The desiderata of courses using this format with this specific skill objective would include a rich set of up-to-date materials, preferably with a selection of difficulty levels on each topic to accommodate individual students; high quality and varied graphic supplementation of topics; some degree of interactive learning mechanisms; and, optimal independent practice with feedback for each student.

The importance of critical thinking is first explained. Then the logic of reading courses as a basis for acquiring thinking skills is introduced, followed by a description of how multimedia materials are thought to affect learning and thinking. This description includes a number of positive learning features in Web-based materials, and also some software designs, such as Intelligent Tutoring Systems. These are becoming more available to teachers as a result of the popularization of the Web and the development of packaged software.

Finally, three Web-based ESL/EFL reading courses designed last year for science (Shizen), technology (Joho), and sports (Taiiku) students are discussed. These courses were the basis of a more complex approach to be used this year. This is also described in some detail.

CRITICAL THINKING SKILLS

Critical thinking involves the ability to evaluate and analyze information and to interpret it, often by inference (Jones & Ratcliff, 1993). Such thinking is an abstract cognitive function that is generally acquired as a skill. We therefore tend to develop it in an educational setting, mostly at the secondary or post-secondary level.

There is increasing concern in many of the advanced technological nations (and particularly the United States, Britain and Japan) that educational institutions are not producing students whose skills in critical thinking are adequate for the requirements of modern professions. Much of this anxiety arises because modern economic, scientific and technological communities are far more dynamic than ever before in history. Even the most

Stapp, Y. (1999). Developing Critical Thinking Skills through Web-based Reading Courses. In *The Web of English Curriculum Development* (pp. 59-68).

advanced nations cannot hope to maintain a permanently competitive position in a global community unless they have highly skilled workers—e.g., engineers, scientists, economists—who can develop technical innovations and solve the problems of complex systems. This type of innovation and system-maintenance involves the processing of huge amounts of information, much of it very challenging. Moreover, the creative and analytical aspects of dealing with this kind of information requires critical thinking.

But the ability to think critically is not just a requirement of one's job. The relationships between the individual and his/her broader community are also dynamic in modern times. As traditional cultures yield to the fact of better-educated populations, the role of the citizen also changes. Traditions, religions and other hierarchical systems once imposed prescribed world-views on people, but such pervasive control is today becoming an anachronism. As governments and employers depend for their well being on highly trained citizens and personnel, it is those citizens and personnel, the people with the actual expertise, who are implicitly in command, simply because they are in demand. The balance of power shifts.

With the implicit power associated with one's relative expertise, there is also a new responsibility. The modern citizen can no longer depend on religious, governmental or workplace authority as the source of his/her world view or opinion. Young people today just out of college find they must become informed, form opinions and prepare to act (or not act) on diverse concerns. Everything from energy policies to pollution to hedge funds can be viewed as everyone's problem—a collective situation requiring serious thought at the individual level. So the modern citizen is in many ways an international citizen by default, and needs to understand much more about the world than his or her parents did even a generation ago. To function as a worker, a citizen, and a parent, the modern individual has to think critically on many matters and a great deal of the time.

Reading skills as the starting point for critical thinking

The development of thinking skills tends to occur in an educational setting since school is the usually the first place where we learn to deal with information. Most of that information is represented in reading materials, so the development of thinking skills logically tends to begin with reading, then extends to writing. In high school and college, students are usually exposed to a variety of genres—journalism, essays, academic texts, fiction, and so forth—which gives them the opportunity to analyze the structure and content of different types of texts.

Given the international culture today, much of the information read all over the world is in English, and will be for the foreseeable future. In that case, it is necessary to incorporate critical thinking skills in ESL/EFL reading courses. At present there is no received standard, but in view of the widespread concern about developing students' critical thinking skills in

educational systems, more attention to such skills will probably also appear in ESL/EFL courses.

Presently, in some ESL/EFL programs, specific texts are assigned with or without the instructor's participation in the decision. In other cases, the choice of subject matter is often left to the individual instructor. Similarly, the amount of reading material, the attention to vocabulary development, and the type of skill assessment all vary across different programs. Whatever the program, however, there is usually some attention to critical thinking skills. For example, many generic texts designed for reading courses include different types of study guides designed to help students with interpretive and analytical skills. Of course, at the university level, it is important to keep in mind that types of critical thinking vary across disciplines (Meyers, 1986). The type of critical thinking needed by science students may differ substantially from the type needed by liberal arts students. The selection of materials for different types of students is therefore important. Nevertheless, the general principles of critical thought—analysis, evaluation and inference—do apply to any field.

Focused skill-training in reading courses

It appears that there is a strong correlation between direct training for critical thinking skills and the development of such skills, and that this approach might be more efficient than instructional methods that are indirect. There may also be a clear learning advantage for skill development where the reader's attention is directed in a methodical way toward different aspects of a text. In ESL readers such as Neufeld & Webb's *25 Strategies* (1984), each of the 25 reading lessons includes exercises meant to develop a particular reading skill. Different foci include lexical distinctions, grammatical structures, punctuation, levels of diction, structuring of a text (main idea, supporting details), and inferences. Working through such a text helps the student to organize the information s/he has read in an objective way, on the one hand, and to respond to it subjectively (develop an opinion), on the other. Indeed, since specific components such as vocabulary development are essential to the development of critical reading skills (Follman et al., 1970; Jones & Ratcliff, 1993), an overt and methodical approach might be the most effective approach for developing critical thought.

The role of Web-based development of critical thinking skills

Internet technology provides teachers and students with several new avenues for developing critical thinking skills. In view of the fact that university students are increasingly required to develop proficient "computer literacy" skills, reading courses can simultaneously develop skills in critical thinking and computer literacy. The use of the World Wide Web (WWW, or "the Web") introduces students to an enormous range of materials, not just in the

form of readings, but also through libraries, indexes, online courses, dictionaries, museums, and almost anything else. Many Websites also provide a means of two-way communication, so that students can interact with other people in particular subject contexts all over the globe.

Because of the importance of up-to-date skills and information in many careers today, more people will be required to continue education in the broad sense, and the Web will probably become a major source of this education, through online courses, tutorials, specialized discussion lists and other resources. Further, because of the importance of English, university students in ESL/EFL programs who get training in Web resources will have a skill advantage when they get their first jobs.

However, there are other reasons for using the Web in ESL/EFL reading (and other) courses. One important reason is that university libraries all over the world are confronted with skyrocketing costs for professional journals and monographs. This trend will soon prohibit subscriptions for many institutions (Dalton, 1999). Science journals are the most expensive at present, partly because of the high cost of producing photographs and other graphics which are necessarily included in articles, and partly because of the very specialized readership. Annual subscriptions for some key professional journals run in the thousands of dollars: *Brain Research* is $15,203, while *Nuclear Physics B* costs $11,267. Professional journals like these are essential for researchers; if they are unavailable because of cost, researchers in many countries will not be able to keep up with their respective fields. For just this reason, an increasing number of scholarly journals are moving to the Web. There are several incidental benefits of this trend. One is that information is completely up-to-date. In paper journals, by contrast, the publication process is so slow that some information is out of date by the time it reaches the reader. Furthermore, paper journals shipped to university libraries in foreign countries are generally delayed because publishers have to opt for cheaper postal rates (and slower delivery). This means that it is often impossible to see the current issue of a journal in a foreign library. If the journal moves to the Web, readers can see articles the day they are published, and they can also access the archives. Another important benefit of online publication is that it makes up-to-date information accessible to a much wider audience. Even better, it provides the option of linking to related information sites on the Web. Students who learn Web mechanisms for locating and linking information are thus acquiring skills that will prove indispensable in their careers.

Journals and magazines are not the only reading source available on the Web. As the technology improves and costs are reduced, it is possible to put whole books, including even rare volumes, on the Web in the form of electronic books (e-books). It is technically possible now to produce whole electronic libraries with the texts linked to related sources, although

present costs and personnel requirements make this impossible at the practical level. However, it is only temporarily impossible. Eventually, any reader in the world with Web access will be able to access any e-book in an e-library, print out parts or whole, and even bind it (Dalton, 1999).

For teachers it is important to understand the implications of these developing Web resources. As Dalton (1999) suggests, the prospect of e-books implies a whole new type of reading. The sheer volume of available information can be overwhelming, so students need to learn how to search and select for their specific purposes. This takes some practice, and is quite different from the usual library search (which also takes practice). Students also need to learn how to locate the important parts of a given text quickly (such as an article)—that is, they need to learn effective reading skills. These types of skills can be handled very well in a Web-based reading course because virtual libraries (that is, cyber-libraries) make it possible to practice in the classroom.

Web-based reading courses also make it possible for teachers to help students locate suitable information at a level appropriate for the individual reader. In ESL courses, for example, university students working with challenging content (e.g., science, technology) that is especially difficult for them in English can work with Web texts written for young adolescents that is easy to read. As vocabulary and reading skills improve, students can access the same content in more advanced sources. For difficult concepts (in science readings, for instance), graphics, video illustrations and animations are available on the Web which greatly assist explanation, and at the same time improve analytical, interpretive and other reading skills.

Computer Assisted Language Learning (CALL) materials offer multimedia input, and often include interactive exercises which give students control over the pace of learning. That is, students are able to focus individually on aspects of material which are difficult, and practice as much as necessary until they master the material. Interactive materials are now widely perceived as important for effective language instruction (Hoffman, 1993; Wheatley, 1991). Many Web-based resources contain interactive features, and they often have, or it is possible to add, a communicative dimension through email, bulletin boards, discussion groups and other devices.

Interactive Web resources, however, are sometimes criticized as still limited. For some, the Web itself is not an optimal learning resource for this and other reasons, such as the problem of accessing delays at certain times (e.g., Bork & Britton, 1998). The effective use of the Web as an instructional resource in the classroom, however, depends very much on the instructor. For ESL/EFL courses in reading, the instructor has to be willing to commit a considerable amount of time, at least initially, to organizing resources, devising effective lessons, and helping students with the technological aspects of the Web. If the objective is

to develop critical thinking skills, the abundance of Web-based materials, the linking mechanisms, the multitude of graphics which help to clarify concepts, the results are well worth the effort. The limitations that some critics suggest for interactive instructional material are readily compensated for by the rich variety, including 3-D graphics, that are available. The problem of time-delays for downloading of material from the Web is already solved through software that allows the instructor to download sites to a server ahead of class time. It is also possible to transfer material from the Web to CD-ROM, now that CD-Write drives are affordable (Bork & Britton, 1998). Teachers can, in this way, create their own multimedia and interactive materials using resources (such as graphics) from the Web.

In many countries, the university ESL/EFL class may be the first—and maybe only—class where up-to-date materials in some content areas are made available, in English, and in a format students can deal with productively. The development of critical thinking skills in such ESL/EFL classes should be sensitive to the kinds of material that students will actually be reading in the university, in addition to some general materials (news, fiction, etc.).

The connective structure of node-and-links in multimedia and Web materials apparently organizes information in a way analogous to and certainly compatible with cognitive frameworks (Jonassen, 1988). This feature, combined with interactive components in multimedia has been shown to be more effective than traditional materials (Fletcher, 1990). However, there are still questions to be resolved as to the source of the learning effect. The effect of different types media (e.g., video, graphics, text, interactive features) on learning and thinking are still matters of dispute (e.g., Kozma, 1983). One important issue, for example, is whether interactive media promote learning or whether the increased attention of the learner and the time-on-task associated with such materials are the real reasons for the learning potential (Cennamo, Savenye, & Smith, 1990; Feldman & Schoenwald, 1989). One could argue, of course, that it hardly matters what features of interactive materials produce the desired effect, the effect being the actual objective. If this type of instructional system incorporates critical thinking skills development, and if the results are positive, most instructors and students would find the objections purely academic rather than substantive.

A better understanding of neurophysiological principles involved in learning, memory and analyzing will further contribute to learning designs. Classroom teachers are not usually schooled in these principles, but this level of research is gradually being made more accessible to educators (Simpson, 1994). Eventually, however, the expanded use of interactive and other types of multimedia on Web or CD-ROM for acquisition of skills such as critical thinking will itself lead to much better research on the thinking-learning process. For one thing, the interactive media make it possible to track the learner's problem-solving and analysis strategies (Kumar, Helgeson, & White 1994). Tracking is easily built into the software program and provides both the student and the teacher information about where

the difficulties occur in such processes. As more data become available from such tracking, the information will have a positive effect on the development of quality materials to facilitate learning and thinking. It will also lead to better assessment instruments.

A related area of materials development is Intelligent Tutoring Systems (ITS). This will eventually help to optimize the instructional potential of interactive software (Polson & Richardson, 1988). ITS systems are specifically designed for high level interaction. The student is guided through a learning-analysis process by the program, and the "intelligent" aspects provide the student with feedback about his/her thinking strategies, offering assistance as needed. The student is directed through explanations, examples and practice routines as many times as necessary until the learning-thinking objective is attained. This type of system allows students to digest information, master concepts, and think through processes at their own individual pace without any classroom pressure or embarrassment. This technology is still expensive, but teachers can incorporate components, or similar components in their instructional materials. Such mechanisms would be very productive for the development of thinking skills in reading and other types of courses.

COURSE DESIGN

A first-step Web-based reading course (1998-1999)

Last year I attempted the initial design for Web-based reading courses, and tried out the design in three university ESL/EFL reading courses at the University of Tsukuba. The three courses represented content materials for science (Shizen), computer science (Joho), and sports (Taiiku) students. The objectives at this stage were: (1) to develop reading skills levels, with the assumption that most of the students, regardless of their starting levels, should be able to read textbook-level English in their respective fields by the end of the year; (2) to develop vocabulary substantially, including expressions encountered in general reading, and idioms and jargon relating to the different fields of the students; (3) to develop skills in locating the important information and identifying the general structure of an article.

The courses began with regular text (articles from magazines, for example) or CD-ROM materials. The classes were then phased in to a Web format gradually in the first semester. In the second and third semesters, almost all materials were Web-based. Here, subject matter was related to the students' respective fields: science articles in one class, computer technology articles in another class, and sports articles in the third class. By the middle of the third semester, Web-pages for two of the courses (computer science and science) were finally on the Web, making it possible for students to access the third-semester reading lists at any time from any computer anywhere with an Internet connection. Students could simply click on a reading title on the list and access the Web-site directly—the article,

graphics and its links. A text-only copy (HTML file) of each article was also provided on the Web-page as a backup in the event a Web-site was unavailable when students attempted to access it. The text-only copy, of course, did not have the graphics or links.

For each of the readings on the semester reading list (one article per week), the exercises and vocabulary were stored in computer files in the multimedia lab where the class was held. That way, students did their actual assignments for each reading during class time. They were able to submit the assignments either on paper or by email in class. Paper copies ("hard" copies) of all readings were made available in class, but students could also copy the articles to a floppy disk if they chose.

Twice each semester, students were given a "free choice" Web-assignment. The purpose was to help them learn to search for material, especially in their respective fields of study at a level they could handle, work with linking (especially to museums, graphics, other types of sites), and to learn to evaluate the material. A written guide was provided for this purpose. Sites students recommended in the classes were collected on a list and distributed to the respective class.

In each class, there were two objective (multiple choice) exams each semester. These were used as an index for the effectiveness of the study exercises and for students' reading skill development (especially level) over the year. What the exam scores demonstrated was that students' reading ability in all three classes greatly improved over the year (including the low-level sports group). All groups could read both regular text-like material and popular material. For example, text-like material contains certain jargon related to a field, but popular magazines and news articles treating the same topics use a great many idioms which are actually more difficult for students than the more technical text. For this reason, students benefit from guided practice with different types of materials on a given topic.

What was also clear from the exams was that critical reading skills did not improve over the year. Students did not receive direct attention to this area of skill development. The study questions that I wrote for each reading included at least one inference question, but there was not a great deal of focus on inference in class. Invariably, when each week's assignment was graded, the inference questions were the ones students had the most difficulty with. When the questions and answers were reviewed in class, the answers were aligned with the relevant passage(s) by means of an OHT, and the answers were explained. Clearly, however, this identification-and-review approach did not help students to progress in any of the three classes. So, while students' ability to grasp the major points of an article fairly quickly improved (they were under time pressure in class), their ability to identify the correct information in an article, and their ability to make "subjective" evaluations ("*this article is _____ because...*") also improved, their analytical skills reflected both their habit of rote learning and the fact that analytical skills must be directly taught.

The next step: Targeting critical thinking skills (1999-2000)

To develop the skills in analysis, interpretation (through inference), and the more objective evaluation expected of college-level students, I will introduce a focused approach in the Web-based courses this year, isolating a specific skill each week in class. Inference and analysis require a level of cognitive abstraction that does not occur overnight. These skills are just as difficult to acquire in the native language as in a foreign language—they are independent of the language issue.

This year I will be using the Web-based syllabus beginning in the first semester, but will go beyond the simple semester reading schedules which listed a single reading for each week. The readings will contain pop-up vocabulary in the text, and there will be several other additions to the Web-page including a bulletin board for class communication on the readings and links; a glossary; some practice routines; and, a listing of related interactive materials on the Web where this would be helpful. This year, the first semester will be given over to focused practice on analytical skills, using the one scheduled reading for that week plus important Web-links that help to explain the content of the reading (in science and technology, this is more important than it is in sports). I am presently developing a set of practices on CD-ROM (now that I have purchased a CD-Writer), but I believe it is just as easy to do this in a Web-based format that students can access on the class Web-page. Of course, it is possible to develop material for the class on a CD-ROM, then copy that to the Web-page also. Some level of interactivity will be built into these exercises, but time constraints on my part will prevent full development in this regard.

In the second semester, the Web-page for each class will contain a mini-selection of three choices each week on a particular topic. More interactive sites on the Web will be introduced where possible, since the readings will be more difficult and will contain processes or concepts that often require some degree of visual representation. The mini-selection will give students some options, but will also be restrictive enough to allow me to focus on skill development in a structured way. The study questions for each of the articles will be more difficult in this semester, with more emphasis on the strictly analytical side. Likewise, the "free-choice" selections for each semester will also require more analysis (especially as it is very clear that students have no problem—even in the first semester—giving a subjective analysis of readings). On each of the exams, the students will answer the questions for their respective reading choices.

In the third semester, the class schedule of readings will be expanded even further to a kind of e-library on the class Web-page; here, students will make up their own individual reading schedules from the choices on the class menu. They will also, in this semester, work more extensively with topic searches on the Web. At the end of the year, they should

be proficient readers who are able to handle a range of levels and types of readings. They should also be proficient in computer literacy, and critical skills where these apply to reading.

CONCLUSION

It is assumed that the approach described for this year, that is, a deliberate and extended focus on critical analysis skills in the reading courses, will produce results in three classes. In any case, pre-test and post-test analyses will be made at the end of the year, so that the results can be objectively evaluated. The relationship between Web-resources (e.g., graphics and links which should help to build associations in concepts and processes) and the development of the analytical skills under consideration here will also be evaluated. Part of this experiment will be reported at an international conference in the United States this year, and two articles in this general area of research will be submitted for publication before the first semester. It is hoped that extended contacts with people working on intelligent tutoring, Web-based instruction and types of interactivity will further help this particular teacher in the development of better reading courses in ESL/EFL.

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