

BUILDING LITERACY IN THE AGE OF INFORMATION: TECHNOLOGY AS A TOOL FOR SUSTAINED CONTENT STUDY

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Abstract

As the definition of literacy takes on newer and broader dimensions, encompassing proficiency with a variety of media, ESL students who wish to participate fully in an academic environment must not only move toward a greater control of the English language, but must also become familiar and comfortable with technology. Integrating technology into the college ESL course and using it as a key tool for sustained content research provides students with both the raw materials for analysis and interpretation of language and content and the opportunity to construct meaning within and across a variety of texts. This paper describes how to use the Internet as part of a high intermediate sustained content curriculum to develop ESL students' literacy skills through an activity called focus discipline research. The paper details the curriculum and activities, providing examples from the study of environmental science, presents the results of student feedback and performance data and discusses the effect of technology on literacy skills.

To be considered literate in the age of information one must possess a range of functional, academic, critical, and technological skills. The implications of such a broad definition of literacy are especially profound for ESL students, who must acquire these skills in a second language. Both qualitative and quantitative research (see for example, Pally, 2000; Kasper, 2000a, 2000b) have shown that the literacy skills of college ESL students may be effectively developed through the creation of a functional language learning environment that engages them in meaningful and authentic language processing through planned, purposeful, and academically-based activities. These activities are designed to teach students how to extract, question, and evaluate the central points and methodology of a range of material, and construct responses using the conventions of academic/expository writing. Students acquire and refine literacy skills as they process and produce texts and complete a range of assignments of progressive complexity that derive from the sustained and focused study of one or more academic disciplines.

Sustained content study, in which students do extended reading, writing and research in one academic discipline, has been found to be effective in improving ESL students' literacy skills, more quickly enabling them to pass basic skills assessments and enter the college mainstream (Kasper, 2000b; Pally, 1997; 2000). The extensive body of instructional and informational resources found on the Internet not only facilitates, but also promotes extended study of a subject area. Through its extensive collection of

reading materials and numerous contexts for meaningful written communication and analysis of issues, the Internet creates a highly motivating learning environment that encourages ESL students to interact with language in new and varied ways. Used as a tool to promote linguistic skills and knowledge construction in the context of sustained content study, the Internet helps ESL students develop and hone the range of literacy skills they need to succeed both in college and in our digital age of information.

This paper describes how to use the Internet as part of a high intermediate course called “Developing Fluency in Reading and Writing for ESL Students.” This course is the first of a two course developmental sequence in reading and writing. High intermediate here is defined as an entry level TOEFL score of approximately 425. This ESL class meets six hours per week in three two-hour blocks for twelve weeks. Students meet in the computer lab each week for one of those two-hour blocks. My course follows a sustained content curriculum that develops ESL students’ literacy skills through an activity called focus discipline research. This paper details the curriculum and activities, providing examples from the study of environmental science, presents the results of student feedback and performance data and discusses the effect of technology on literacy skills.

Focus Discipline Study

A focus discipline is a subject area (e.g., psychology, biology) that individual students choose to research extensively over the course of the semester (Kasper, 1998). I ask my students to choose a focus discipline from the ten subject areas contained in their textbook.¹ Students base their choice on personal interest and/or college major, and because students have chosen to do extensive research in that discipline, they are actively invested in a learning experience that is personally meaningful and important.

Students begin reading and writing about their chosen focus discipline from the very first assignment in the course. The same procedures are followed for each of the focus disciplines chosen for study during the semester. I assign initial background readings from the textbook (Kasper, 1998), and I design guided Internet search activities, as well as specific research questions and writing prompts for each separate focus discipline. Students access and read additional texts through the Internet and library research that they do for each writing assignment. Students who choose the same focus discipline form a "focus discipline group." In the physical classroom, focus discipline groups meet to discuss salient issues under study. Students from each focus discipline group then summarize and share what they have learned with the class as a whole. In this way all students develop a foundation in all focus disciplines chosen for study during the semester.

In addition, while students spend the major portion of the semester reading and writing about the specific focus discipline they have chosen and working within their focus discipline groups, there are several lessons in which the entire class studies one or more topics within another discipline. I design these “whole class” lessons based on a discipline included in their textbook (Kasper, 1998), but not chosen as a focus discipline during that particular semester. These “whole class” assignments are given several times

throughout the semester. Since the chosen focus disciplines vary from semester to semester, these “whole class” assignments also vary. So, for example, if environmental science, psychology, computer science, and business were chosen as focus disciplines, I might design a “whole class” assignment based on linguistics or diet and nutrition. The assignments are similar to those that would be given to students choosing linguistics or diet and nutrition as focus disciplines. These “whole class” assignments introduce students to the vocabulary and concepts of an additional discipline and give them the opportunity to work with different students who are not in their focus discipline group. Just as they do for their focus discipline work, students read textbook selections and conduct Internet research for these “whole class” assignments. They also work in groups to discuss their readings and research findings. They then write an essay of three to four pages on an assigned topic. Additional details and examples may be found on the “Student Work” pages of the course web site.

In the collaborative groups that are part of both focus discipline and “whole class” activities, learning becomes not only an individual endeavor, but also a collective one as group members work both individually and collaboratively to collect information and discuss discipline-based issues. Recent research (see e.g. Crook, 1994; Kahn, 1998) has demonstrated that collaborative learning yields a number of significant educational benefits to ESL students that can empower them in their efforts to gain full access to an English-speaking academic environment. This is especially true when the collaboration engages students in academic tasks that require independent problem solving and critical thinking (Kasper, 2000a; Warschauer, 1999). Through a process of collaborative, constructive, and creative activities, these academic learning communities provide the context for ESL students to create, share, apply, and critique their own new knowledge, rather than just absorb knowledge created by others.

Focus Discipline Research and the Internet: Technology Meets Content

Through sustained content study, focus discipline research engages students in extended practice with both language and discipline-based concepts, enabling them to become "content experts" in a subject area of their own choosing. Adding technology to the mix reinforces learning and promotes the acquisition of literacy skills (Kasper, 2000a).

My ESL students hone English language skills, build their overall knowledge base, and develop literacy through their use of text-based computer-mediated communication (CMC), intensive reading and research using Internet hypertext documents, and their production of written essays and an extended project based on their research efforts. All materials used are instructor generated. These materials are designed to expose students to and encourage them to read a variety of texts and provide prompts for writing that allow students to explore and master different forms of discourse, such as description, comparison and contrast, analysis of cause and effect, and argumentation.

Internet resources facilitate text comprehension by giving students the advantage of reading print texts with the benefit of immediate visual reinforcement provided by pictures and/or slideshows usually included in web pages (see for example the

environmental science resource “Global Warming: Focus on the Future”). The integration of print and visual resources helps to clarify comprehension, consolidate concepts, and reinforce learning (Kasper, 1998). According to Chun and Plass (1997) visual media can aid the comprehension of print media in two ways: (1) by facilitating the construction of referential connections between the print and visual representations of the material, and (2) by adding supplemental information to the mental model of the text. Because the resulting text representation consists of the collaborative effects of processing information that has been presented in a multimedia form, students are able to draw upon both visual and verbal cues to aid in and enhance comprehension.

In addition, the Internet exposes ESL students to a wider range of English than is usually found in traditional print media, and even simply browsing the Internet engages students in an interactive learning experience that is not only visually stimulating (Muehleisen, 1997), but also cognitively challenging (Warschauer, 1999; New London Group, 1996). As students become more comfortable surfing the Internet, they discover that it is a vast resource that can be used to develop not only content area knowledge, but also linguistic proficiency. They become engrossed in learning as they explore web sites related to their focus discipline, and apply what they have learned to real-world/life situations. Using the computer encourages learner autonomy and initiative as students explore a variety of discipline-based questions, formulate their own hypotheses, and interact with peers, communicating newly acquired knowledge (Hanley, 1994). This type of student-centered, constructivist instructional environment results in greater confidence, higher motivation, and an increased sense of responsibility for learning (Black et al., 1994; Caprio, 1994).

Focusing on Environmental Science

To illustrate my pedagogical approach, I will describe the work done specifically by students who choose to focus their study on the discipline Environmental Science. As stated previously, the same procedures are followed for each of the focus disciplines chosen for study during the semester.

One of the topics studied by students who choose environmental science as a focus discipline is the greenhouse effect, its immediate and possible future impact on our weather, and the resulting effects on issues in disciplines such as business, nutrition and politics. The greenhouse effect has been in the news and so is a timely topic these days, and one for which there is a great deal of information to be found on the Internet (see for example, <http://kccesl.tripod.com/environmentfd.html>).

Students’ study of environmental science begins with an exercise that asks them to consider how the climate of the earth has changed over the past ten years. They are asked if they have experienced or heard about unusual storms, floods, drought, famine, or heat waves. They are asked to explain how they think these events are related to global warming. These questions prime students to read and understand assigned texts by activating preexisting schemata, or background knowledge.

The greenhouse effect is a somewhat abstract topic, and one that requires some understanding of complex chemical principles. The visual resources found on The EPA Global Warming web site provide a highly effective way to concretize these abstract scientific concepts and thereby facilitate comprehension. This web site illustrates the greenhouse effect through a diagram depicting the earth, the sun, and the ozone layer. While viewing this visual, students go step-by-step through an analysis of what happens when the sun's ultraviolet radiation mixes with man-made pollutants. The web page facilitates comprehension in two ways--it serves as a visual pre-reading exercise, and it provides students with an imagery link to the complex scientific concepts that will be presented in the controlled hypertext, "The Greenhouse Effect."

Controlled hypertext provides students with guided practice that takes them step-by-step through a hypertext document and helps to facilitate their acquisition of the cognitive strategies necessary to navigate and comprehend nonlinear texts. Providing students practice in navigating hypertexts is important for a number of reasons. First, as students continue researching topics in their focus disciplines, they will make extensive use of hypertext documents available on the Internet. Hypertext documents provide easy access to multiple cross-references on related topics across several documents, or screens; this enables a natural juxtaposition of ideas and allows a flexible means of exploring those ideas (Tierney et al., 1997). Moreover, because it fosters a nonlinear pattern of exploration and discovery, reading hypertext helps to promote the cognitive flexibility necessary for the integration and consolidation of knowledge gleaned from a variety of sources (Spiro et al., 1992). However, while hypertext can promote the development of students' literacy skills, without instruction in how to navigate hypertext effectively, students may become lost in a sea of information, potentially experiencing cognitive overload (Rouet & Levonen, 1996).

To provide students with guided practice in navigating hypertext, I designed "The Greenhouse Effect" as a controlled hypertext consisting of a series of four linked texts on various aspects of global warming. At the end of each text, there is a hyperlink that takes students to another text, which is contained within the same web site. Thus, in such a hypertext, the direction and content of the reading is controlled as students are guided through the various links related to the main text.

As stated previously, this hypertext consists of a total of four hyperlinked texts. The first text that students read is an online version of the greenhouse reading contained in their textbook (Kasper, 1998). This text presents students with a definition of the greenhouse effect and explains the cause/effect relationship between greenhouse gases and global warming. The text details the environmental, chemical, and political implications of ozone depletion and global warming. Thus the reading provides a general description of the Greenhouse Effect and discusses the many areas of our everyday lives that are affected by environmental factors. The reading also offers a general view of what may happen if the Greenhouse problem is not solved in the near future. As students read the online version of the text, they also engage in vocabulary building through glosses I have built into the text.

The initial text provides students with background knowledge on the greenhouse effect. At the end of the first text, there is a link that takes students to the second text, which is taken from the Climate section of the EPA's Global Warming Site. After students finish reading the second text, they click on a link that takes them to a third text, which describes Climate Trends. At the end of this text, students find another link that takes them to the fourth, and final, text, which provides a Greenhouse Timeline. An online reading comprehension exercise tests students' understanding of the texts and their ability to articulate what they have learned.

To continue building students' skills in searching for, sorting through and evaluating Internet texts, I next give them a guided research activity. Students begin by reading the text *Four Nets for Better Searching*; this text provides suggestions for how to conduct an effective Internet search. Students then study an Evaluation Criteria Chart, which recommends five criteria for evaluating web sites. Finally students complete an Evaluation Exercise that directs them to four different web sites on global warming and asks them to evaluate each site based on the five criteria provided in the Evaluation Criteria Chart. They are then asked to expand their knowledge base through an independent Internet search. To do this, students need to become familiar with Internet search engines, such as Yahoo!, AltaVista, Google, or Vivisimo. They must learn how to enter keywords to identify the information they want. Then once the Internet search engine has returned a list of "hits" for the keyword, students must go through the list to identify the most appropriate and/or useful information.

Searching for and evaluating Internet resources helps students practice and build key literacy skills. Lepeintre and Stephen (1995) maintain that a successful Internet search requires the use of critical reading skills such as predicting content, categorizing, guessing meaning from context, skimming, and scanning, and they believe that as students navigate through the large amounts of information on the Internet, they unconsciously practice these critical reading skills. Students now are ready to assume more autonomy in selecting and reading hypertexts appropriate for their research. To expose students to different perspectives on global warming, I direct them to a collection of articles published in the Global Warming section of the New Scientist web site. Among this collection are texts that provide a greenhouse timeline, describe the potential consequences of global warming and explain the politics of climate change. Students are now encouraged to freely explore and choose the texts most interesting to them. As they carry out this Internet search activity, ESL students become actively engaged in the linguistic tasks of reading English, developing vocabulary, and interpreting language structures used in the Internet texts and in the research tasks of searching for, accessing and evaluating information.

As students read the texts on the New Scientist web site, they are exposed to contrasting opinions on global warming and the issues related to it. This provides an opportunity to teach students the elements of comparison and contrast and of argumentation in which they describe and evaluate differing viewpoints. Students work with their focus discipline group to discuss and evaluate the arguments for treating the Greenhouse Effect as a serious problem with dire consequences versus those for viewing it as a natural climatic

phenomenon. Whatever their personal viewpoints, the topic always sparks lively discussion. Because climate plays such a major role in everyday life, students become very involved in researching this topic, and almost all of them, even those typically shy and quiet, express an opinion. Thus, Internet research becomes a highly motivating vehicle to developing linguistic and content knowledge, as students actively practice basic language skills and the critical thinking and analytical skills necessary for college-level work.

Focus Discipline Research: Writing Assignments

After students have read and conducted research, they produce a series of writings on various topics within their focus discipline. The first two written pieces are three to four pages in length. The third piece is a research paper of between five and seven pages in length.

The first focus discipline assignment in environmental science asks students to analyze and predict what a future world might be like if the greenhouse effect worsened. They are given the following essay prompt, which encourages them to use the facts gained from their research as a basis for predicting possible future scenarios:

“Imagine that it is the year 2050. Although governments and their citizens were warned about the dangers of the greenhouse effect as early as the 1970's, they did not take the necessary steps to prevent it from worsening. As a result, global warming and ozone depletion continued unchecked. In a well-organized essay, describe what life would be like in 2050 under these conditions. What would be the state of the climate? What would the nations of the world look like? What would be the day-to-day living conditions of the people of the world?” Students have presented many interesting scenarios in response to this topic. Their responses demonstrate both attention to facts gathered through their research and creativity in describing possible future occurrences.

The second focus discipline assignment asks students to describe recent changes in global climate, answering the following questions in the essay: Have the predictions of scientists been correct? Has there been a gradual increase in global temperature over the past several years? Has there been an increase in storms and in unstable weather patterns?

Engaging students in the sustained content study that accompanies focus discipline research is an excellent way to prepare them for complex academic tasks like writing research papers. As students do the research necessary for the shorter essays, they actively practice searching for and sorting through related pieces of information. They learn how to put this information together in an organized fashion. In so doing they gradually gain the skills they will need to prepare a longer research report that requires them to cull all of the information gathered previously and to draw interdisciplinary connections.

The third focus discipline assignment is the research paper, which asks students to describe and analyze the impact of politics on efforts to solve the problem of global

warming. Students now are asked to narrow the focus of their Internet search to the politics of global warming. This search activity gives students the opportunity to actively practice the search and evaluation skills they have learned, as it prepares them to write a research project that requires an interdisciplinary analysis. In this research project, students must put together all of the information they have gathered through the textbook reading and the Internet research and write a research paper of five to seven pages on the following topic:

" Considering all the information you have collected in your research, how have politics impacted efforts to contain the problem of global warming? What role have major world powers such as the United States, England and Russia played in this political process? What role have the developing nations played? Do you think that international meetings such as those held in Montreal and Kyoto have been successful? Explain your responses."

The research paper is key to developing both critical and academic literacy skills. Research papers are a component of many mainstream college courses; however, teaching students the skills they need to conduct and report on research is often neglected in ESL courses. It is very important to include research assignments in college ESL courses so that ESL students will be prepared to tackle the responsibilities of the academic mainstream. My ESL students have done very well with this research assignment. They have produced cogent essays that demonstrate their research efforts and their ability to synthesize what they have learned through those efforts. The final versions of the focus discipline essays and research projects that my students have produced are extremely thoughtful and coherent examples of strong academic writing that demonstrate not only improved literacy skills, but also a growing ability to critically analyze interdisciplinary relationships. The examples provided in this paper are typical of the quality of work produced by the students in this course.² By focusing on one subject area, which they have chosen to study, students acquire knowledge in a subject area that is important to them. Their growing expertise in the focus discipline offers them the opportunity to experience a new role--that of the expert, the teacher, the knowledge provider. Becoming a "content expert" in a focus discipline of choice has fostered in my students a greater confidence in their ability to use English to express not only personal experiences and opinions, but also newly gained academic knowledge.

Student Feedback

A sustained content curriculum of focus discipline research requires students to play an active role in learning and so they should also play an active role in assessing the efficacy of the learning process. To obtain students' reactions to technology-enhanced focus discipline research, I ask them to complete an online end of semester Feedback Questionnaire on the overall learning experience. This feedback questionnaire asks students to evaluate the usefulness of doing focus discipline research, the value of working with the focus discipline group and to provide their insights on the experience of writing the focus discipline essays and the research project. In addition, the questionnaire asks students to describe what they believe to be the most helpful aspect of the course.

In their responses, ESL students have indicated a belief that participating in focus discipline research helped them develop linguistic, academic, social, and technological skills. Specifically, 98% of students have mentioned a greater confidence in their ability to conduct research and report findings, expressing pride in being able to map out a project and see it come to fruition. Ninety percent of the students have expressed enthusiasm generated by mastering new technologies and the excitement of sharing newly gained knowledge with peers and teachers. Ninety-eight percent of students have stated that the most helpful aspects of the course are having the opportunity to do focus discipline projects and to learn how to use the Internet for research. They say that the experience of conducting and writing up the results of extended research will help them in their future college classes.

Students have mentioned the ease with which they could find information from a variety of sources; they are also cognizant of the necessity of evaluating Internet resources carefully. Seventy-five percent of students have indicated that they now view all information more critically than they had before; they are less likely to accept something as fact just because it was published, either in print or online. Even students who entered the course with little experience with technology say that completing the various activities in this course has helped them feel confident in their ability to use technology for a variety of tasks and purposes and that the skills they learned in this class will serve them well in their future classes as well as in the workforce.

Students also appreciate being given the responsibility for their own learning and have said that they benefited from the opportunity to discuss and critique both their own and others' interpretations of resources. They believe that the classroom methodology and the focus discipline group provided them with a supportive context in which to build the skills they needed to monitor learning and effectively articulate the results of their research. Finally, many students have noted that teamwork is a part of many jobs, and that learning how to work with other people will be very helpful when they enter the workforce.

Effects on Writing and Reading Performance

Although students' responses to my focus discipline research curriculum have been very positive, their progress in college depends upon their performance on separate end-of-semester assessments in writing and reading. At my college, writing skill assessment is both formative and summative. Formative assessment of writing skill consists of a portfolio of revised essays produced over the course of the semester. The summative assessment consists of a two-hour timed essay examination; the essay is based on a reading given to students one week before the examination.

The writing portfolio consists of a cover letter to the reader, two revised pieces, including all drafts, and the timed essay examination. Portfolios are cross-graded by another instructor of the same level course, and this instructor's rating determines the portfolio grade. All instructors' ratings are normed to a departmental standard of what constitutes a passing portfolio. The portfolio may be rated as either S (satisfactory) or U

(unsatisfactory) in each of three categories: Finding and Organizing Material, Developing and Refining Ideas, and Mechanical Accuracy. To pass, a portfolio must be rated as Satisfactory in each of these three categories.

Student's reading skill is assessed summatively through a timed departmental final examination that requires them to read and interpret an academic text and to compose short written answers to various types of open-ended questions. Students have two hours to complete the reading examination and must correctly answer a minimum of 65% of the questions to pass it. Like the portfolio, the reading examination is cross-graded by another instructor of the same level course, and this instructor's rating determines the reading grade. All instructors' ratings are normed to a department standard of what constitutes a correct answer. According to English department policy, the same instructor may not grade both the reading examination and the portfolio.

In discussing performance data, it is important to note that all ESL classes at my college follow content-based curricula. Some follow a curriculum of mixed content, where students read and write about a variety of content-based issues. However, a number of ESL classes are linked with mainstream courses such as sociology or history, and so follow a sustained content curriculum linked to topics in those mainstream courses. These sustained content classes also engage students in collaborative learning communities; however, they do not incorporate technology as a key component of the course. Although these classes do provide students with a sustained content curriculum, they do not offer them a choice in terms of the subject area studied. Students who register for these classes must study the content of whichever mainstream class is linked with the ESL class. What makes my ESL course unique is that it offers students the opportunity to choose a focus discipline; it puts the student in charge of the content of his/her course. In essence, then the content of my course becomes specific to the interests of each individual student.

Comparisons of student performance in these three types of high intermediate level content-based courses yields some interesting and unexpected results. The results of end-of-semester assessments indicate that a curriculum of technology-enhanced focus discipline research significantly improves ESL students' performance on individual tests of both reading and writing skills. This is true whether the focus discipline curriculum is compared with mixed content-based or with linked sustained content courses. In contrast, there is little, if any, difference between performance in the mixed content versus linked sustained content courses.

When pass rates on the portfolio writing assessment are compared, focus discipline research yields an 83% pass rate; mixed content-based instruction, a 54% pass rate; and linked sustained content, a 53% pass rate. The difference between focus discipline research and the other two methods is statistically significant based on a chi-square test ($X^2=9.16$; $p < .01$). In terms of their performance on the reading assessment, once again high intermediate students who engage in technology-enhanced focus discipline research outperform students in both mixed content and linked sustained content courses, with pass rates of 69%, 46%, and 53%, respectively. The difference between focus discipline

research and the other two methods is marginally significant by a chi-square test ($X^2 = 4.96$; $p < .10$).

Finally, my college allows high intermediate students who pass both the reading and the writing assessments to skip a level of developmental English instruction. Once again, when compared with students in both mixed content and linked sustained content courses, a significantly higher percentage of high-intermediate students who engage in technology-enhanced focus discipline research are able to skip a level of instruction. The percentages are as follows: technology-enhanced focus discipline research, 59%; mixed content-based instruction, 33%; and linked sustained content study, 37%. The difference between focus discipline research and the other two methods is significant by a chi-square test ($X^2 = 5.04$; $p < .05$).

The preceding results suggest that focus discipline research is effective in building basic literacy skills like reading and writing. It also appears that the focus discipline research yields greater benefits to literacy development than does other content-based pedagogy. However, do these benefits derive from focus discipline research itself, or does the integration of technology further facilitate literacy development?

Answering this question requires an examination of pass rates attained by students exposed to focus discipline research plus technology versus the pass rates of those exposed to focus discipline research alone. I instituted focus discipline research pedagogy into my courses as early as 1997. At that time, however, computer and Internet resources were not made available to ESL students at my college. Students in my early focus discipline courses worked in groups, but used traditional print resources available in the college library for their research. When compared with my present students, students in my early focus discipline courses without technology used the same textbook, wrote on the same topics and were required to pass the same types of institutional assessments.

A post hoc examination of pass rates attained in by students who engaged in focus discipline research without the benefit of computer and Internet resources, revealed a pass rate of 75% on the writing assessment.

Students who engaged in the technology enhanced focus discipline curriculum described in this paper achieved a pass rate of 83% on the writing assessment. Although the pass rate is higher for those students who used technology, differences in these percentages are not statistically significant based on a chi-square test. In contrast, significant differences are found in a comparison of the pass rates on the reading examination. While 69% of the students who engaged in focus discipline research with technology passed the reading examination, only 47% of the students who had engaged in focus discipline research without technology passed it. This difference is significant by a chi-square test (chi-square = 4.17; $p < .05$).

Thus, for the high intermediate ESL students at my college, technology use appears to have significantly facilitated reading skill development, while leaving writing skill

development basically unchanged. In view of the writing requirements involved in doing focus discipline research, this result is not entirely surprising. Whether students used electronic or traditional print resources, the focus discipline writing assignments required them to articulate and synthesize knowledge. Moreover, with or without technology, students worked collaboratively in focus discipline groups. As Bruffee (1993) and others have noted, collaborative learning communities, be they face-to-face or online, encourage active participation in learning, foster processing of interdisciplinary themes and concepts, and teach students how to construct and articulate the knowledge they need in order to produce strong written projects.

In contrast, technology appears to have facilitated the development of students' reading skills. Once again, this result is not entirely surprising. Students who use the information technology resources available on the Internet have immediate access to a far wider variety of texts than is available in the college library. Students would need to spend many hours in the college library to access even a small percentage of the informational sources available to them online. As one of my ESL students noted, an effective Internet search can turn up many more "hits" in far less time than a trip to the college library. As a result, students who use technology read more texts over the course of the semester. As Nelson and Schmid (1989) found, when students continually engage in extensive and extended reading, vocabulary and language structures become increasingly familiar, intertextual associations become clearer, and a broader base of schematic knowledge that may be used to guide the construction of meaning of subsequent texts, such as the final reading assessment, is developed.

Conclusion

As the definition of literacy takes on newer and broader dimensions, encompassing proficiency with a variety of media, ESL students who wish to participate fully in an academic environment must not only move toward a greater control of the English language, but must also become familiar and comfortable with technology. Integrating technology into the college ESL course and using it as a key tool for sustained content research provides students with both the raw materials for analysis and interpretation of language and content and the opportunity to construct meaning within and across a variety of texts. By learning to use English as a means of acquiring, expanding and articulating knowledge, ESL students build literacy and gain the skills they need to succeed in college.

Endnotes:

¹ The textbook *Interdisciplinary English* (Kasper, 1998) contains readings in linguistics, environmental science, computer science, psychology, sociology, business, anthropology, diet and nutrition, biology, and mathematics.

²This paper has described the work done by students who choose Environmental Science as a focus discipline. Additional examples of students' work in other focus disciplines may be found on the course web site at <http://kccesl.tripod.com/>.

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