THE IMPACT OF ELECTRONIC WRITING PROFICIENCY ON STUDENT WRITING PERFORMANCE

by

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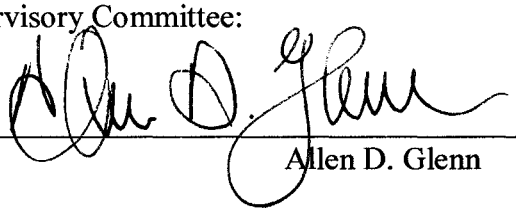

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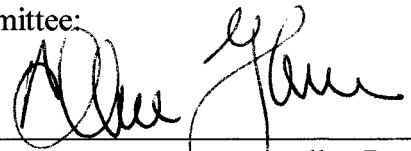

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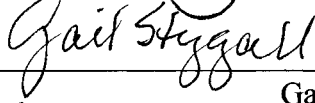

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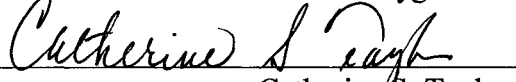

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Abstract

THE IMPACT OF ELECTRONIC WRITING PROFICIENCY ON STUDENT WRITING PERFORMANCE

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Three classrooms of students in a computer-integrated writing course at the University of Washington participated in a research study that asked, *How does the electronic writing proficiency of university students in an introductory writing course, writing from a literature base, impact their writing?* The study examined the relationship between student perceptions about their writing process, word processing skills, and writing achievement.

Surveys, keystroke capture software, ratings from final drafts, field notes from classroom observations, and interviews with students and teachers provided data for analysis. Using path analysis, it was found that only 5.6% of the variance in the final draft score could be attributed to perceptions or word processing skills.

High electronic writing proficiency consists of non-negative perceptions of using a word processor to aid writing, a perception that there is some benefit to using the technology, and demonstrating that use of the technology. High electronic writing proficiency also consists of computer skills that are required to write the document: knowing how to open, save, close, and create a new document; set the font; and cut, copy, paste, and delete text; and keyboard at least 20 words per minute. For both aspects, skills must be at a level that they do not interfere with the writing process.

Students who knew more functions of a word processor did not use those functions when writing, nor did printed papers demonstrate the use of a word processor. However, students with different final grades showed some differences in how they used the word processor to write.

The study also found that students followed instruction explicitly. Comments in peer reviews, as well as text edits and revisions mirrored instruction. The nature of the assignments determined how word processing features were utilized. Only papers published online used dynamic texts with hyperlinks, graphics, color, and a variety of fonts. Results also indicated that neither word processing skills nor perceptions determined the quality of essays, but instruction that integrated technology to support the pedagogy of the writing classroom resulted in high quality student work.

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PREFACE

> Perhaps the appropriate question is not do but will media influence learning... If there is no relationship between media and learning it may be because we have not yet made one. If we do not understand the potential relationship between media and learning, quite likely one will not be made. And finally, if we preclude consideration of a relationship in our theory and research by conceptualizing media as "mere vehicles," we are likely never to understand the potential for such a relationship. (Kozma, 1994)

Robert Kozma's statement intrigued me when I first read it. It made me start to think more about potential changes in how computers could be used to change learning and to question if that change was possible.

From anecdotal evidence, I knew that media influenced learning. Media changed expectations. Students engaged with fast-paced, colorful media in video games, television, and movies that they saw and consequently expected more than lectures in their classes.

Media also were a vehicle for learning, sometimes powerfully and sometimes mundanely. Educational software was used to reinforce skills, albeit sometimes as "drill and kill" exercises. Computers made events visible that could not be done otherwise because they were too big, too slow, or too dangerous. Computers performed calculations and graphed equations. Computers were also used as fancy typewriters that included a feature to check spelling and grammar.

The full potential of the relationship between media and learning had not been made by applications that treated the media as "mere vehicles". I wanted to know how technology could be more than an instrument. Could technology be used to transform learning? If so, what skills did students and teachers need to make the leap to a different

way to use computers? How did students perceive their experiences with computers and did those perceptions influence how technology was used?

If media could be more than vehicles, I thought it should be able to do so at all levels across the curriculum. Since word processing is used across the curriculum and by students of all ages (Becker & Lovitts, 2000; Becker & Ravitz, 1999), I thought word processing was the place to begin to see if there were basic ways that computers could change the learning process.

The conceptualization of this study began when I read Kozma's article and I started to look in-depth at the research into writing with computers. To restate the Apple Classrooms of Tomorrow (ACOT) study question,[1] on a global level, I wanted to understand what happens when computers are used to stimulate thinking about learning. How do teachers change their teaching and how do students change their perceptions of learning when computers are utilized as a support and a catalyst for learning? On a local level, I wanted to know what happens when computers are used to support the writing process beyond acting as a sophisticated typewriter. How does instruction in the writing classroom change and how do student writing processes change when computers are used to instigate ways of writing not possible without the technology?

[1] The ACOT question asked, "What happens when computers become a significant resource in classrooms? How does a critical mass of technology affect the way teachers teach and learners learn? (Dwyer, 1996)

ACKNOWLEDGMENTS

The author wishes to thank all who have helped and supported her through the doctorate program. First, thanks to my supervisory committee for their help and support: Dr. Gail Stygall, who inspired me to look more deeply at writing and helped me arranged the study; Dr. Catherine Taylor, who gave me her expertise in helping me make sense of the data and made statistics come alive; Dr. William Winn, from whom I took my first class after years away from university work and made me realize that this was the program to pursue; Dr. Nathalie Gehrke, who encouraged the most interesting and thought provoking discussions about teaching students to think and learn; and especially thanks to Dr. Allen Glenn, the chair of my committee, who mentored, challenged, encouraged, advised, questioned, and guided me through the program and this dissertation study with expertise.

This research study would not have been done without the assistance of those who contribute their expertise and talents to teaching writing. I wish to thank those in the CIC program, especially Dr. Kimberlee Gillis-Bridges, Meg Roland, Veronica Robertson, Cara Lane, and Robert Weller for their time and assistance. In addition, my gratitude goes to Richard Eaton and the WinWhatWhere Corporation who provided me with a sufficient number of copies of WinWhatWhere Investigator® software to conduct the study. I also want to thank Audrey Fellinge, who graciously shared her knowledge and insight into teaching writing and, then, helped coordinate the first pilot study. Most importantly, special thanks goes out to the teachers and students who participated in this study without whom this research would not have been a success.

In addition, the author wishes to thank all her family and friends who encouraged her to pursue a dream and nurtured her along the way. My university support group, Dr. Sara Kim, Dr. Ana Elfers, Dr. Shirley Palmer, and Nina Rook, provided encouragement and shared their experiences over the last five years, even after most of them completed

their studies. I have profited enormously from their wisdom, understanding, and special friendship. My family listened, encouraged, and would not let me stop; Beca who read the manuscript more times than she wants to admit; Kim who urged me to keep working on the paper and who gave me wonderful phrases to use; Kevin who carpooled with me to our classes at the University and shared the experience of college life with me; and Larry, my husband who just hugged me when I needed it. To all, I'm thankful for their love, support, and faith in me.

DEDICATION

To my children and grandchildren,

Kimberly, Rebecca, Kevin, Alexander, Tessa, Ethan, and Caitlin.

May learning with technology enrich their lives in new, yet unfounded ways.

CHAPTER I
INTRODUCTION

> Ever since the days when students wrote in chalk on slates, or dipped quills into ink pots, technology and writing have been closely connected. But computers are affecting students' writing in ways unlike any other technology in the memory of their instructors. (Leibowitz, 1999)

Writing requires a technology: chisel on stone, pencil on paper, chalk on slate, type on paper, or keyboarding on a computer. As technologies advanced, the way students perceived writing and communication changed. With the advent of computer technologies, written words became changeable until printed. Words could be modified with a touch of a key whereas words written on paper were immediately, and permanently placed. Since writers viewed the text as changeable, they planned and modified text more as they wrote, not before ink touched paper. Students began to rely on the computer to review the text to check spelling and grammar rather than carefully rereading the text themselves. The computer made the writing task faster, which encouraged students to write for longer periods of time, but discouraged them from revisiting and revisualizing the text. Improvements associated with careful rereading did not appear in final student drafts. Students wrote and revised a draft, allowed the computer to check for mechanical errors, and never looked back.

On the other hand, with computers, student writing became accessible to more readers than just the teacher. Computer monitors made writing visible to all who came close enough to see the words on the screen, thus enlarging the social nature of the writing process. E-mail, web publication, and bulletin board postings on a local area network allowed feedback, not just between the teacher and students, but between students, as well. The use of technology and these resultant changes raised questions on how, or if,

computers in the writing classroom could assist students to produce better written documents.

Chapter I briefly summarizes the types of questions the literature provided on computers and writing. The chapter then addresses unanswered questions in the research and presents the issue that this study examined as well as a brief overview of the construct electronic writing proficiency which was developed to conceptualize the issue. The chapter concludes with hypothesized results.

COMPUTERS AND WRITING LITERATURE SUMMARY

The information society of the twenty-first century requires high school and college graduates to be skilled and knowledgeable about technology (Cuban, Kirkpatrick, & Peck, 2001) in all areas of the curriculum. Students in primary grades begin learning how to use technology with word processing, the most commonly used computer application in the schools, being one of the first applications used.

To begin examining how computers affected student writing, early studies compared the quality of handwritten drafts to word processed drafts with conflicting results regarding which medium produced the higher quality draft. Later studies, addressed student perceptions about writing on computers, how the writing process changed when students used a word processor, and differences in cognitive resources needed for writing with computers. Studies also examined keyboarding skills needed for writing with a word processor.

The literature on computers and writing also pointed out that word processing cannot be separated from writing instruction. Students tended to use the media and revise as taught (Bonk & Reynolds, 1992; Cochran-Smith, 1991).

Also, the body of research in writing with computers addressed the ease of use factors that computers provided and collaboration facilitated by computers. Study results did not prove that writing with computers improved writing.

> Professors say students come to college accustomed to writing in the unstructured, chatty style of e-mail discussions, but not in formal prose. Students submit essays that are longer but not better written than those in years past. Worse, many students do not revise or even proofread their work, relying instead on software to check spelling and grammar. ... The possibilities are exciting, but their effectiveness is largely unproved, say faculty members who teach writing. Many of the professors are looking for ways to make good use of the tools that students are already using. (Leibowitz, 1999)

Questions remain about how students could use computers for word processing to improve student writing performance.

Based on the existing literature in writing and computers (as discussed in Chapter II), observations and interviews conducted as part of the pilot studies[2] for this research, as well as personal experience, the construct *Electronic Writing Proficiency (EWP)* was developed to help synthesize and conceptualize the issues around computerized writing and to provide a possible hypothesis for testing. Briefly, the construct is composed of three elements, the ability to use specific and varied features of a word processor, competency in writing, and understanding how a word processor impacts the writing process[3] as illustrated in Figure 1: EWP Components.

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[2] See Appendix C: Pilot Studies.

[3] Additional explanation of the EWP construct is included at the end of Chapter II.

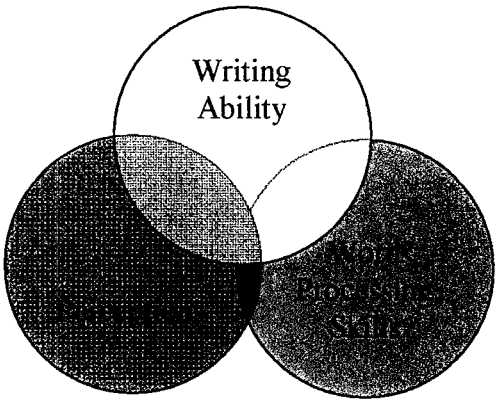

Figure 1: EWP Components
A: Word processing knowledge, B: Prior writing achievement
C: Understanding how a word processor impacts writing

QUESTION

To provide insight into what skills, knowledge, and perceptions assist students in the writing process when they use a word processor, this study asked,

> *How does the electronic writing proficiency of university students in an introductory writing course, writing from a literature base, impact their writing?*

To examine this question, additional questions required answers.

- How do student perceptions[4] about their writing process impact their writing?

[4] Student perceptions about writing with a word processor capture how students believe they use a word processor. Perceptions include items such as students believing that they can organize and reorganize their text with greater ease, feeling that they edit to a greater extent and produce better final drafts, being aware that they capture more of their thoughts and can then enlarge upon them, believing that they view text in a different manner when using a word processor, knowing that they can reread their text from the monitor and thus modify it easily, or feeling that they just write better.

- What differs in the writing process for students with higher and lower levels of electronic writing proficiency?
- What differs in the final draft for students with higher and lower levels of electronic writing proficiency?

This study examined how students wrote using the technology in an authentic classroom situation, using the hardware and software available in the classroom.

EXPECTED RESULTS

Derived from previous research and the first pilot study,[5] the hypothesis of the study proposed that students who had a higher level of electronic writing proficiency would use more of the affordances of the computer to write, would perceive that they wrote differently on the computer compared to when they handwrote a document, would utilize instructions and suggestions given to them by their instructor that matched their style of writing with a word processor, and would produce a higher quality draft compared to students with a lower level of EWP.

Furthermore, the hypothesis proposed that after a student's skills in word processing, including keyboarding speed, reached a certain level, lack of skills would no longer negatively impact a student's writing. Hypothetically, a writer needs basic skills in keyboarding and word processing; basic commands to cut, copy, paste, and delete text, to open, close, and save a document, and to apply text attributes; and the ability to use word processing tools to check spelling and grammar. It was also expected that practicing writing strategies would help students compose well-written compositions, not just knowing more word processing functions.

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[5] See Appendix C: Pilot Studies.

PREVIEW OF FOLLOWING CHAPTERS

By using electronic writing proficiency (EWP) as a framework, this research study examined the question: *How does the electronic writing proficiency of university students in an introductory writing course, writing from a literature base, impact their writing?*

Chapter II: Literature Review summarizes the literature on writing using technology. The chapter divides the literature into sections on general findings, writing development, and instruction. A framework for investigating the question is also included as well as expected results.

Chapter III: Methodology details data collection methods and procedures. The chapter discusses students and teachers who participated in the study, as well as the qualitative and quantitative instruments used to collect data. The chapter also includes an overview of the data analysis procedures and the expected results.

Chapter IV: Data Analysis and Findings discusses results from the surveys and grades from the writing samples, presents the results of the data analysis, and concludes with an examination of the feasibility of the data model using path analysis.

Chapter V: Implications and Discussion summarizes the findings presented in Chapter IV and then examines possible explanations for the results. The chapter discusses issues with using technology for research, specifically the issues encountered in conducting the study. The chapter covers a revision to the electronic writing proficiency construct and implications for the classroom and for using technology in research as well as questions for further study.

The Appendix contains the instruments used for the study, a synopsis of the Northwest Regional Educational Laboratory 6+1 Traits of Writing Rubric, information about the

computing facilities at the University of Washington, assignments and rubrics used by participants in the study, and pilot study data including instrument development.

CHAPTER II

REVIEW OF LITERATURE

> Without writing, the literate mind would not and could not think as it does, not only when engaged in writing but normally even when it is composing its thoughts in oral form. More than any other single invention, writing has transformed human consciousness. (Ong, 1982)

INTRODUCTION

Others agree that "writing is thinking" (Carter, 1993; Cuban et al., 2001), that writing is a way of discovering and learning (Villanueva, 1996), and that writing changes how people think and communicate (Hassett, 1996; Perkins, 1985). Writing is a way to socially share knowledge, to think about what has been said and then respond (Klein & Olson, 2001). According to David Olson (1988), writing alters knowledge by allowing the reader to reflect on text. In the twenty-first century, writing means writing with pen and paper in addition to writing with a word processor.

> As books and writing changed the way people think and learn, so computer use that enables information flow and conceptual change may stimulate similar changes in our mental organization and thought processes. (Hokanson & Hooper, 2001)

The computer makes new forms of literacy[6] more accessible (Williams, 2001). Teaching students to write means teaching students to write utilizing the pen and the

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[6] Today's college students have gained a degree of computer literacy. A 2002 survey study of college students at 27 public and private colleges and universities in the continental United States reported that all students who responded had used computers before college. (According to the Pew Internet and American Life Project study report, students in the study matched the demographics of all US college students as reported in *The Chronicle of Higher Education*, Almanac Issue 2001-2, 158(1), August 31, 2001 and Almanac Issue 2002-3, 159(1), August 30, 2002.) Students used the Internet to share files, watch and listen to streaming media, to send and receive e-mail messages, participate in academic mailing lists, and search for academic resources. The college students also used technology for their academic work (Jones, 2002).

computer. Furthermore, the goal of writing with computers involves developing technological and critical literacy[7] in students.

> Most classrooms in the Western world enter the world of literacy and computer in two main directions. One is with sharp focus on computer literacy and the other with increased emphasis on writing as an interactive-developmental process. (Hertz-Lazarowitz & Bar-Natan, 2002)

Components of gaining technological and critical literacy include teaching students to write better and teaching students to use the technology tools available.[8]

Chapter II examines the literature on writing with technology to provide a foundation upon which to examine how students may use computers as more than a mere instrument to improve student writing performance and to teach students critical literacy skills. The chapter begins with the Apple Classrooms of Tomorrow research and then summarizes other studies that compared handwritten essays to essays written using computer software. The chapter then addresses the literature on student use of computers with regard to student perceptions, the writing process, and qualities of the final draft. Subsequently, the chapter presents the Electronic Writing Proficiency (EWP) construct that visually depicts elements entwined in writing using a word processor. The chapter concludes with commentary from the literature on other elements that impact the EWP model.

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[7] Technological literacy, which is constructed in social settings (Fine, 2002), includes the ability to use computers and other technology to enhance learning (Kellogg, 1993; Selfe, 1999), to use the keyboard, to retrieve information, and to understand the uses of computer applications and tools. It is knowing how to use the computer as a tool in a learning situation.

Additionally, critical computer literacy implies understanding how computers and technology relate to uses, possibilities, and how those meanings relate to us (Duffelmeyer, 2001).

[8] Becker and Lovitts also include teaching students how to use technology to "acquire information and ideas" as a goal (Becker & Lovitts, 2000).

ACOT STUDIES

The Apple Classrooms of Tomorrow (ACOT) research project was one of the first longitudinal studies (1985-1995) conducted examining the relationship between technology and education.[9] In the ACOT study, as David Dwyer, one of the lead researchers on the project, summarizes:

> We describe what happens when students use technology as a tool for building their own knowledge—and examine the impact on the kinds of skills they develop... And we explore ways to deepen our understanding of how technology can be used as a tool for learning. (Dwyer, 1996)

Although the ACOT study included using technology in elementary and secondary schools across the curriculum, a primary component of the research addressed computers and writing.[10]

When students began to use the computers for writing at the beginning of the ACOT study, students said that the word processor was a means to produce neat, accurate, typewritten text. Students followed conventions with regard to the layout of text, subject matter, and wrote for the teacher as the audience for their work. At the start, students resisted using the computer because they did not know the keyboard, however, they realized that the computer made changing text easier (Baker, Gearhart, & Herman, 1990).

By the end of the second year of the study, raters judged that secondary students improved the quality of their essays in their rewrites (Baker et al., 1990). By the fourth year of the study, some students incorporated graphics, sound, and animation as a way to improve sharing ideas. ACOT students saw the technology as a way to develop

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[9] At the time of this study, most students and teachers had little or no previous exposure to computers. They needed to acquire computer skills. Also, they had not looked at the possibilities that adding computers to the classrooms could open for them. The ACOT study examined such changes.

[10] Student achievement was assessed by the Iowa Tests and by collecting writing samples. Raters scored writing samples based on overall impression, organization, content, and style.

dynamic texts and to communicate their ideas more clearly: Students thought that they could write better because they used the computer (Tierney et al., 1992). Over the first five years of the ACOT studies, raters found that as students gained skills with writing and acquired skills in using more and varied features of the word processor, writing quality improved (Tierney et al., 1992).

Students became more engaged in their work and showed more enthusiasm toward learning than before the study added computers to the classrooms (Baker et al., 1990). Over time, students began to choose to use the computer to write rather than use pencil and paper for assignments. Students edited their papers without coaching and spent more time on assignments. Even some "low achieving" students achieved greater success when they used the technology (Sandholtz, Ringstaff, & Dwyer, 1994).

ACOT researchers also found that using computers did not isolate students, but contributed to the social dimensions of literacy.

> Literacy is a social act. Oftentimes what is written, dramatized, or symbolized is intended for others; usually it has involved others in the selection and formation of ideas. Students' engagement with computers is no different. (Tierney et al., 1992)

Students perceived that using technology in the classroom included collaboration and sharing of ideas. Using technology meant learning together.

The ACOT study found that teachers and students required time to acquire computer skills and move through the stages of development[11] before they could utilize the technology to their advantage (Sandholtz, Ringstaff, & Dwyer, 1990). In addition, the

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[11] The stages of integration have been labeled differently by various authors. Dwyer, Ringstaff and Sandholtz (1990) in the ACOT studies, describes the stages as entry, adoption, adaptation, appropriation, and invention. Moersch (1996-97) describes them as nonuse, awareness, exploration, infusion, mechanical integration, routine integration, expansion, and refinement. Ferris, Roberts, and Skolnikoff (1997) label them, awareness, spread of acceptance, and impact on curriculum.

study found that teachers were the key to creating a learning environment that balanced using the technology, collaboration, and direct instruction.

Summary

The following table, Table 1: Summary of ACOT Findings, summarizes the ACOT study findings and lists questions investigated by further studies that expanded upon each finding.

Table 1: Summary of ACOT Findings

FINDINGS	QUESTIONS
1. Student engagement with computers contributed to the social dimensions of literacy.	• What changes in the quality of student writing could be attributable to changes in the classroom, the increased amount of sharing of ideas, and including other students as the writing audience rather than only the teacher as audience?
2. Students had to learn the keyboard before they overcame resistance to use the computers.	• How many words per minute did students need to type before keyboarding became a non-issue?
3. Students demonstrated more enthusiasm toward learning and spent more time on assignments when they used the computers.	• What impact on writing quality could be attributable to the change in attitudes?
4. Students perceived that they wrote better with a word processor than when they used pen and paper.	• Did the final draft improve due to student perceptions, due to using the word processor, or due to other causes?
5. Students used varied features of the word processor. Students used technology to create dynamic texts.	• What changed in the writing process with the inclusion of a word processor?
6. Writing quality improved as students gained skills with writing and in using more features of the word processor.	• What changed, if anything in the writing process when students used computers? Could the improvements in writing be attributed to increased skills in writing, increased skills with a word processor, or the interaction of both? Did using a word processor contribute to higher quality writing? What other factors contributed to the improved quality?

Numerous early research studies addressed one of the last questions: Do writers generate higher quality text with a word processor than they do with pen and paper?

PEN AND PAPER VERSUS WORD PROCESSED TEXT

Research comparing handwritten to word processed text showed conflicting results. A group of studies showed that word processed text was of higher quality, but another group of studies did not confirm those findings. This subsection presents an overview of those studies. Later subsections address other questions that the ACOT study findings generated—on perceptions of using the computer, qualities of the final draft, and the writing process when using computers.

Higher Quality with Word Processed Text

In a meta-analysis by Robert Schramm (1991) analyzing early research comparing handwritten and computer written texts, the quality of word processed texts showed a small, but significant, improvement over handwritten texts. On the other hand, Schramm noted that one-third of the studies did not reach the same conclusion. A later meta-analysis by Bangert-Drowns (1993) reached a similar conclusion as Schramm. Almost two-thirds of the 32 studies in the analysis concluded that using a word processor improved the quality of the final draft with the difference being small, but significant.

Later studies, such as one by Owston, Murphy, and Wideman (1992) with eighth grade students that examined the effects of using a word processor on the writing process and the quality of the final draft, confirmed the findings of the Schramm and Bangert-Drowns studies. Using Microsoft Word,[12] the students produced text of higher quality

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[12] Over one and one-half years prior to the study students had used a word processor for four 40 minute classes every six days. Students appeared to be able to keyboard as quickly as they carefully wrote by hand, although few students could touch type. Most could use a spelling checker and could move a block of text. Those students who could not perform these two basic tasks were given additional instruction.

when using the computers to write than handwriting a composition. The researchers partially attributed the higher quality drafts to the prior experience students had with the technology and the use of word processing software with a graphical interface, pull-down menus, and mouse-controlled functions which allowed students to utilize the functionality that word processing offers. Students did more rereading and checking of their work when using the computer, although some used few, if any, of the affordances of the computer.

Likewise, the remedial students in a study by Palumbo and Prater (1992) showed significant gains in the final product when word processing tools were used for instruction, although, according to the researchers, the small class size may have also produced the effect.

Snyder (1993). found that eighth level students created higher quality text when they used a word processor than when they handwrote. After further studies, she concluded that writing better on a computer depended on more than just familiarity with a computer and keyboarding skills. It also depended on the writing and revising strategies students use, instruction, the teacher's goals and strategies conveyed to students, and the social context of learning in the classroom and school (Snyder, 1999).

No Significant Differences Between Technologies

In other studies, students showed no significant difference in the quality of writing regardless of the media used to compose text (Daiute, 1986; Hawisher, 1987; Hawisher & Fortune, 1989; Markel, 1994; Slattery & Kowalski, 1998).

In the Bernhardt, Edwards, & Wojahn (1989) study, the first draft of word processed text received a lower rating than handwritten text, but received a slightly higher rating with the final draft, although not significantly. The students' compositions demonstrated no significant differences with regard to revision, fluency, or conventions, but the word

process texts received higher holistic scores as well as higher ratings for organization and support.

In a study with college students, Slattery and Kowalski (1998) found that first-year students expanded the writing process and revised for global organization whereas junior and senior college students focused on sentence-level concerns. Slattery and Kowalski offered several suggestions as explanation: instruction did not exploit the potential of the computer, the technology did not affect writing quality, and word processing skills and knowledge were not developed sufficiently to take advantage of using a word processor.

Familiarity with the word processor improves the writing process as exemplified in a study by Kellogg (1993). He looked at how college students wrote with pen and paper versus the computer and found that the more experienced computer user took advantage of opportunities made available through the use of the word processor. Processing time also revealed a quantitative restructuring effect in that the time spent reviewing remained relatively constant across phases of writing for those using a word processor. This quantitative restructuring effect was actually most pronounced for the highly experienced users. The more experienced computer users did more local editing and made fewer notes for planning than less experienced users. Also, the more experienced computer users showed no significant differences in the quality of text they produced whether they wrote on the computer or with pen and paper (Kellogg, 1993). The computer changed the writing process, but did not improve final draft quality.

Results of the studies did not confirm the improved quality of the final draft as found in the ACOT study. Study results also differed regarding the writing process, including editing, revising, and planning. Some studies found that writers planned less (Daiute, 1986; Hartley, 1991; Hawisher, 1987), others found that writers planned to a greater extent (Kellogg, 1993; Krendl & Lieberman, 1988). In some studies, writers wrote shorter essays (Daiute, 1986; Hawisher, 1987), whereas in others, writers continued to

write for longer periods of time (Hawisher & Moran, 1993; Kellogg, 1993; Krendl & Lieberman, 1988; Tone & Winchester, 1997; Womble, 1985). Similarly, some research found that writers revised less (Daiute, 1986; Hawisher, 1987), whereas other research found that writers revised more (Lutz, 1987).

Summary

The inconclusive findings from comparing handwritten and word processed text indicate that using the word processor alone did not increase or decrease the overall quality of student compositions. Moreover, the research findings did not always agree with regard to characteristics of the writing process when students used a computer or qualities of the final draft. However, the research agreed more often with regard to the positive perceptions of writing on computers that the ACOT studies presented. Furthermore, research provided additional data on the questions raised by the ACOT study on perceptions of using the computer, qualities of the final draft, and the writing process when using computers.

PERCEPTIONS

Consistently, students liked using the computer to write (Bahr, Nelson, & Meter, 1996; Hawisher, 1989; Kurland, 1996; Zvacek, 1992) and the studies provided several reasons. Students indicated that it was an easier assignment (less physically demanding) to keyboard than handwrite an (Cochran-Smith, 1991; Greenleaf, 1994; Moxley & Warash, 1992); the computer saved time and was more efficient (Bernhardt et al., 1989; Levine & Donitsa-Schmidt, 1998; Lutz, 1987; Steel & Hudson, 2001; Wood, Willoughby, Specht, & Porter, 2002); and produced neat, readable text (Bernhardt, Edwards, & Wojahn, 1992; Cochran-Smith, 1991; MacArthur, 1996; Montague, 1990; Moxley, 1994; Owston et al., 1992; Russell, 1999; Simic, 1994; Womble, 1985). In addition, students had higher perceptions of their ability to write and edit their documents (Kurth, 1987) when they used the technology. In fact, the undergraduate students in Markel's (1994) research felt that the computer improved their writing if the

computer was used routinely and about half of the students in the study by Bernhard, Edwards, and Wojahn (1992) felt that they made better grades due to the use of the word processor.

Other study results backed up the claims and indicated a significant increase in student attitudes of writing when using computers (Baker, 2001; Deadman, 1997; Hartley, 1991; Hawisher, 1989; Kiefer & Smith, 1983; Krendl & Lieberman, 1988; Kurth, 1987; Lepper & Gurtner, 1989; Pufahl, 1986; Schramm, 1991; Womble, 1985; Zvacek, 1992). Dalton and Hannafin (1987) found that the computer "made the writing process more tolerable" for seventh grade remedial students. Moore and Karabenick (1992) found an increase in self-esteem as well as a significant increase in positive attitudes toward writing and computers in fifth graders. Even the weakest students in O'Brien's (1984) study insisted upon using the computer. Other findings indicated that students participated more in class (Faigley, 1990), were more intensely engaged in writing (Deadman, 1997; Snyder, 1993; Trupe, 2002), and began writing immediately when they came to class, unlike their peers who did not use computers (Kurth, 1987).

If students had a positive attitude toward the media at the start of a lesson, the use of the technology proved more effective than if students had a negative or neutral attitude (Reed, 1990). Positive attitudes resulted in changes to the writing process beyond just spending more time with writing (Phenix, 1984). Because the computer allowed students to modify text and reorganize text without recopying it, the computer decreased student resistance to revision and students were more likely to revise text and correct errors (Crafton, 1996; Daiute, 1986). Also, for some students, revision became more iterative within the writing process with a word processor, thus students perceived that reviewing and editing was easier (Lutz, 1987).

Not all research has indicated positive results of using a word processor, however. The computer screen distracted some writers (Kellogg, 1993); some writers found it uncomfortable to read online (Albertson & Marwitz, 2001), and the limited amount of

text visible on a monitor may have contributed to limited revisions (Bereiter & Scardamalia, 1987b; Takayoshi, 1996; Womble, 1985; Wood et al., 2002). On the other hand, the screen may have aided visualization of the text (Bolter, 1991; Hawisher & Moran, 1993; Takayoshi, 1996; Tierney et al., 1992; Zinsser, 1983) and facilitated collaboration between peers (MacArthur, 1996). Also, the screen contributed to a different awareness of audience (Trupe, 2002).

Summary

The computer motivated students to write (Bahr et al., 1996; National Assessment Governing Board, 2000; Brown, 1985; International Society for Technology in Education, 2001; Lepper & Chabay, 1985; Yelland, 1999). It produced readable text and encouraged revision. Students participating in other studies perceived benefits to using the media just as the ACOT students did. Returning to the questions raised by the ACOT study, according to other studies, what changed in the writing process when students used computers?

WRITING PROCESS

The writing process (generate content; organize content; transcribe content and ideas into text; review, revise, and edit content; and evaluate what has been written and change text once again (Hayes & Flower, 1980; Miller, 2002)) is chaotic, messy, and recursive. Students need to stop, "think, talk, dream, and write some more" (Noskin, 2000). Phases of the process overlap and occur simultaneously. Components act in parallel (Bourdin & Fayol, 1994), making the process complex and demanding of a large amount of memory resources for all writers (Berninger & Swanson, 1994; McCutchen, 1995). When students use the computer, they require less cognitive load because the computer helps automate transcription and manages lower level operations.

Automating transcription,[13] frees more resources for other aspects of writing (Butterfield & Nelson, 1989; Eggen & Kauchak, 1996). With less cognitive effort toward the physical aspect of writing,[14] students have more capacity to think about content—what to say and how to say it (Cochran-Smith et al., 1990). The word processor not only changes the cognitive load, but the restructuring and redefining processes of writing are different with the word processor and it's more than just making it easier or faster (Baker, 2001): A shift occurs between the process and product of writing.

The computer highlighted the recursive web nature of writing—plan, translate, revise, review—without a specific order to the process (Takayoshi, 1996). Researchers found that when students wrote using a computer, they integrated the translating and reviewing processes to a larger degree than when they hand wrote compositions (Fitzgerald, 1987): It was difficult to differentiate between the planning, editing, and revising processes. Writers revised as they wrote on the computer; they did not have to erase, but just cut, copied, pasted, and inserted text as they proceeded (Ransdell & Levy, 1994).

With the computer, students found a way to try out things to say (Lutz, 1987). Students were more willing to experiment (Kurland, 1996) which led to the expansion and development of ideas and content (Baker, 2001; Daiute, 1986). They thought about what could be said and how it should be said (Blair, 1996). Because the text was changeable, students' writing included more exploration of ideas, more revision, and more rearrangement of text (Cuban et al., 2001).

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[13] As studies by Bourdin and Fayol (1994) have shown, adults, who could write easily, no longer could do so when they had to write in all upper case letters, that is, when they had to compose differently. An increase in cognitive load decreased writing quality.

[14] Forming letters impedes young writers (Cochran-Smith, Kahn, & Paris, 1990; Hartley, 1991), but by the age of 10, cognitive and motor aspects of transcription usually become fluent and no longer require additional cognitive resources.

In general, studies found that writers revised[15] more when they used a word processor, however, revisions differed from handwritten texts.[16] When students[17] used the computer, they made more surface level changes—changes to words, grammar or the appearance of the text—rather than macro level changes—changes that restructure text or alter meaning (Bridwell, Sirc, & Brooke, 1985; Bridwell-Bowles, Johnson, & Brehe, 1987; Fitzgerald, 1987; Hawisher, 1987; Lutz, 1987; Owston et al., 1992; Snyder, 1993; Womble, 1985). Studies found that writers using a word processor made surface changes first and may have stopped revising before making macro level changes (Womble, 1985).

For those who thought revision was error correction, the computer reinforced the concept (Crafton, 1996). Several researchers have proposed reasons for lack of meaning level revisions. According to Markel (1994), surface level revision may have been due to the built-in editing features which could disrupt the flow of writing, whereas, according to Crafton (1996), it may have been due to how the computer "shifts rhythms of composition at the same time it tends to obscure the rhythms of the language". Hawisher and Moran (1993) theorized that the built-in editing features of the word processor which inhibited reflection and the rereading of text caused surface level revision. For some writers, using the computer to recopy text may have decreased the quality of the writing because by recopying text, writers interact with the content in a

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[15] Revision involves reading the text critically, identifying and fixing problems, using the learned task schema, and having sufficient working memory resources to finish the task (Wallace et al., 1996). When beginning and less experienced writers revise, they reformat or change a word: They do not restructure text or alter meaning (Reynolds & Bonk, 1996). However, all writers focus on spelling, grammar, and punctuation (Fitzgerald, 1987).

[16] Studies reported mixed results with regard to the amount of revision. Some students revised more when they used a computer (Hartley, 1991, 1992; Lutz, 1987), but some revised less when they used a computer (Daiute, 1986; Hawisher, 1987), and some, such as the high school students in Kurth's (1987) study, produced text of similar length, with no significant differences in the amount or quality of revisions, nor in the quality of the texts.

[17] Even older and more competent writers made more surface level changes. Although with or without the computer, older and more competent writers revise for meaning more than younger or less competent writers (Fitzgerald, 1987).

different way. They slow down the evaluation process, and reconceptualize what they have said. "[P]hysical burdens such as recopying require that the writer interact more closely with the text than he or she does when there is no reason or guidance to read the text" (Daiute, 1986). Because recopying text allows "intimate contact with writing", and when students feel the rhythm and syntax, they are more likely to revise their texts (Crafton, 1996).

The computer eliminated the drudgery of recopying text to edit or revise a draft (Huot, 1996; MacArthur, 1996; Perkins, 1985; Woolsey, 1996). Students found cutting, pasting, deleting, and copying text with a computer easy (Bernhardt et al., 1992; Levin, Riel, Rowe, & Boruta, 1985; Moxley, Warash, Coffman, Brinton, & Concannon, 1997; Pan & Zbikowski, 1997; Zvacek, 1992). Computers also assisted in correcting spelling and grammatical errors, but again, this may have had a downside for some writers. Some used the grammar check as an authority and omitted revision when they used the built-in word processing tools (Crafton, 1996). Some, especially young or inexperienced writers, may have believed that they revised completely when they had only made surface revisions with the tools (Klonoski, 1994). The computer allowed revision to occur more quickly, but writers needed more time to revise at the macro level (Hartley, 1991; Kellogg, 1993; Krendl & Lieberman, 1988).

Word Processing Knowledge

To write using the media and to make revisions to the text, students needed keyboarding and word processing skills (Susser, 1998) with keyboarding knowledge critical (Baker, 2001; Cuban et al., 2001; Russell, 1999). Once keyboarding ability became second nature[18] and a student did not have to think about where to find a key on the keyboard,

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[18]Keyboarding was not a barrier to using the computers in the ACOT studies. When practicing keyboarding for 15 minutes a day for six weeks, second and third graders could type 20-30 WPM at 95% accuracy (Bahr et al., 1996). In her study, Daiute found that the seventh and ninth graders needed more than one hour a week for six months to become fluent with word processing and keyboarding (Daiute, 1986).

using a word processor stopped interfering with resources available for planning, transcription, and revision (Bereiter & Scardamalia, 1987a; Burton, Moore, & Holmes, 1995; Cochran-Smith, 1991; Greenleaf, 1994; Hartley, 1993; Hawisher & Fortune, 1989; Kellogg, 1993; Lutz, 1987; MacArthur, 1996; Moxley & Warash, 1992; Reed, 1996).

Wetzel, as reported by Dunn and Reay (1989), found that students needed to keyboard 10 words per minute (WPM) or greater for handwriting and computer generated text to be equal. Others found that if students do not keyboard at almost 20 words per minute, the keyboard interferes with writing (Russell, 1999). For students whose keyboarding speed was .5 standard deviation below the mean or .5 standard deviation above the mean, the computer had a negative effect on their writing; for students whose keyboarding speed was .5 standard deviation over the mean (greater than 19.2 WPM), the computer had a positive effect on their writing (Russell, 1999).

Dunn and Reay (1989) provided details on the benefits of knowing the keyboard. They reported that for the 12 and 13 year-olds who were adept at keyboarding, the word processor improved their writing when judged by content, organization, style, grammar, orthography, and overall impression. However, the opposite was true for those who were poor at keyboarding (Dunn & Reay, 1989). In addition, other researchers noted that once students mastered the keyboard, the computer overcame some of the problems of poor handwriting (Bernhardt et al., 1989; Jarvis, 1997; Levin et al., 1985; Moore & Karabenick, 1992; Moxley, 1994; Womble, 1985).

Computer knowledge also affected the outcomes of studies (Reed, 1990). When students had some familiarity with the computer at the start of a study, researchers found more effects present than if students had not been familiar with the hardware or software. As students gained word processing skills, the quality of their essays improved (Bridwell-Bowles et al., 1987; Hawisher, 1987; Owston et al., 1992).

Moreover, those who were more comfortable with the hardware and software wrote essays of higher quality (Hawisher, 1987; Owston et al., 1992).

What constituted word processing knowledge for researchers? The answer varied. For Hartley, students should know how to enter, move, and delete text; and spell check a document (Hartley, 1991). The Committee on Information Technology Literacy (1999) noted that students should also be able to select a font; paginate, organize, and edit a document; and find sources on the Internet. Forcier (1996), Millman, and Clark (1997) all thought that students should know basic word processing functions defined as cut, copy, paste, move, and delete; find and replace; insert new text; create a new document; open an existing document; use the save and save as commands, and change format, including the typeface of text (Forcier, 1996; Millman & Clark, 1997). In addition, Forcier (1996) detailed other features that students may use that assist writing: column formatting, the thesaurus, footnotes, a table of contents, glossary, index, headers and footers, automatic hyphenation, orphan control, pagination, spelling and grammar check, and the use of style sheets. Susser (1998) defined basic word processing skills as the knowledge to double-space text, to underline, and center. For him, more sophisticated skills included knowing how to copy, indent, and apply text attributes. Regardless of the specific knowledge listed, all agreed that basic knowledge of the computer was essential to computer use.

Summary

Word processing knowledge and skills were essential to using the media for writing. Students had to learn the keyboard, confirming the ACOT study results. Expanding the ACOT findings, studies found that students integrated the writing processes to a larger degree when they used the computer. They experimented more readily. They utilized built-in word processing functions to check spelling and grammar. They revised at the surface level, but made fewer macro level changes. The ACOT study found that writing

quality improved, generating the question: *What differs between the drafts written by hand and those written using the computer?*

FINAL DRAFT

Consistently, studies found that those who used the computer to write had fewer spelling and grammatical errors (National Assessment Governing Board, 2000; Hawisher, 1996; Hawisher & Fortune, 1989; Moxley, 1994; Owston et al., 1992; Wolfe, Bolton, & Feltovich, 1996). Writers edited and corrected mistakes more accurately or were more willing to edit documents with a computer than to rewrite text by hand (Hawisher & Fortune, 1989; Jarvis, 1997; Klonoski, 1994; Krendl & Lieberman, 1988; Lepper & Gurtner, 1989; Reed, 1996; Tone & Winchester, 1997) perhaps because it was easier and quicker (Bridwell et al., 1985).

Raters measured the quality of a draft by more than the number of mechanical errors. Content and ideas and how they were expressed were critical to the score of a final draft. Moreover, the genre of an assignment and the topic influenced quality regardless of media used to compose. Familiarity with both (Langer, 1985; Levy & Ransdell, 1995; Reed, 1992; Viadero, 2000) improved the quality of a draft. A student's skill depended on awareness of and knowledge of the text structure associated with a genre's schema (Bereiter & Scardamalia, 1987a; Englert, Stewart, & Hiebert, 1988; MacArthur, Harris, & Graham, 1994; Newcomer & Barenbaum, 1991): Each genre of writing has a different schema, but young or inexperienced writers may not have gained familiarity with the genre or have sufficient knowledge about a topic to revise a draft, regardless of the technology used (Bereiter, 1980; Bonk & Reynolds, 1992; Butterfield, Hacker, & Plumb, 1994). More knowledge and familiarity about the subject of the paper resulted in the generation of more content plans and students needed content knowledge to be able to edit (Bonk & Reynolds, 1992; Levy & Ransdell, 1995). Additionally, the length of text depended on genre and topic knowledge (Trupe, 2002).

Teachers needed to encourage young and inexperienced writers, again, regardless of media, to keep writing so as to produce text of sufficient length to achieve a high quality draft (Bereiter & Scardamalia, 1987b) since quality and quantity were related (Jones & Pellegrini, 1996; Sadoski, Willson, & Norton, 1997). Cueing writers to keep writing, to review text, and to revise improved writing quality. As students developed writing skills, they produced longer texts and revised more.

The computer facilitated production of text. As a result, in most studies, the length of compositions increased when students used a computer (National Assessment Governing Board, 2000; Cochran-Smith, 1991; Kurland, 1996; Montague, 1990; Greenleaf, 1994; Schramm, 1991; Hawisher, 1996). However, in some research, students wrote shorter compositions on the computer (Levin et al., 1985; Womble, 1985).

When students used a computer, drafts not only increased in length, but showed other changes as well. Reed found that the drafts of eleventh grade students showed greater syntax complexity when word processed (Reed, 1996). Owston, Murphy, and Wideman (1992) found that papers of eighth grade students composed on the computer received higher overall scores as well as higher scores for organization, supporting details, and mechanics.

Summary

Studies found that students perceived that the computer helped them write and make changes to their text. On the computer, students composed longer papers with fewer mechanical errors. Student writing processes became more intermingled with less distinction between content generation, planning, organizing, reviewing, editing, and revising processes. Students experimented and tried out ideas online.

Researchers stated several factors that they believed contributed to the quality of word processed papers and the way students used the computer:

- Prior computer experience.
- Word processing skills including knowledge of the keyboard.
- The functionality built in the word processing software.
- Student writing ability.
- Student ability to use writing and revising strategies that they had been taught.
- Teacher goals and strategies.
- The social context of the classroom.
- Instructional methods.
- How the computer was integrated with instruction.

EWP MODEL

Based on the existing literature in writing and computers, observations and interviews conducted as part of a pilot study[19] for this research, as well as personal experience, the construct *Electronic Writing Proficiency* (EWP) was developed to help synthesize and conceptualize the issues around computerized writing and to provide a possible hypothesis for testing. Briefly, the EWP construct is composed of three elements, (A) the ability to use specific and varied features of a word processor, (B) competency in writing, and (C) understanding how a word processor impacts the writing process as illustrated in Figure 2: EWP Components: (A) Word processing knowledge, (B) Prior writing achievement, (C) Perceptions of how word processing impacts writing.

[19] See Appendix C: Pilot Studies.

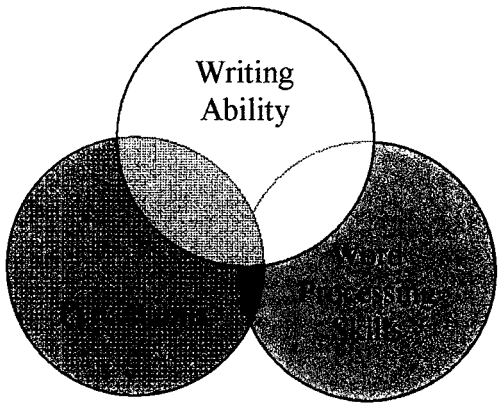

Figure 2: EWP Components: (A) Word processing knowledge, (B) Prior writing achievement, (C) Perceptions of how word processing impacts writing

Understand the Interaction/Perceptions

From the literature, one can conclude that instruction on writing using a word processor changes students' perceptions about their writing. EWP breaks out this process of student reflection on writing—the process where the computer is used as a mindtool to engage students in thinking critically about what they are learning (Jonassen, Carr, & Yueh, 1998). From the pilot study,[20] personal experience, and the Apple Classrooms of Tomorrow (ACOT) studies, it was noted that as writers gained skills with writing and with the word processor, quality of final drafts changed. Yet, over the first five years of the ACOT studies, when the writers could say they were writing differently when using the word processor and began to utilize more and varied features of the computer, the writing process changed even more and the quality of final drafts improved (Tierney et al., 1992). Also, observations conducted for the first pilot study revealed that, generally, students who used more features of the word processor wrote higher quality essays.

Electronic writing proficiency includes using a word processor for writing. More importantly, however, EWP includes how the writer understands how the word processor can be used to influence the writing process and improve the final draft. EWP

[20] The pilot studies are described in Appendix C: Pilot Studies.

is more than writing using a word processor. It is a different way to view writing. Students may say word processing is faster or easier or allows them to reread their text more easily. They may indicate that they feel they write better when they can use a word processor or that they feel their text is more organized. Writers may not be able to verbalize exactly what changes when writing electronically, but can verbalize that they have different perceptions about how they write.

Word Processing Knowledge

EWP includes not only knowing the commands available with a word processor, but how to utilize those commands to transcribe, revise, and edit text. Using high EWP produces a document that clearly illustrates competency in the seven traits of the writing assessment model[21]—organization, presentation, sentence fluency, word choice, ideas and content, voice, and conventions (NWREL, 1999a). A student demonstrating electronic writing proficiency may let the built-in functions of the computer act as a cueing mechanism to check spelling, grammar, and other conventions, as well as to check for passive voice or colloquialisms and then improve the composition based on the computer feedback. In other words, the electronic writing proficient student would know more than how to cut, copy, paste, insert, and delete text. A student with high EWP would know, for example, how to make use of style sheets to facilitate the organization of a draft, how to capitalize on the thesaurus to improve word choice, how to employ search and replace commands to ensure a consistent voice, and how to exploit the media to engage in thoughtful writing. Clearly, high EWP proficiency also

[21] The Six Plus One Writing Assessment Rubric produced by the Northwest Regional Educational Laboratory is the basis for the Writing Assessment Rubric used in this study. The Six Trait writing model, developed by educators based on qualities of student writing that were common to well written drafts, has become the standard for writing assessment for several state assessments and is used by primary through college level teachers in every state for evaluation of student work. The Six Trait Rubric is also used in several other countries around the world (NWREL, 1999a).

requires keyboarding ability to the extent that it does not interfere with the writing process.[22]

For the writer with low electronic writing proficiency, the word processor contributes to writing by simplifying the recopying of text and helping produce a neat, clean final draft. Interaction between the writing process and the word processor is minimal. In essence, the word processor is a convenient text entry tool. If the writer has problems keyboarding, the word processor does not ease composing text, even minimally. In fact, the computer may detract from the writing quality of the student with low electronic writing proficiency since the computer removes the need to recopy text by hand and recopying text may spur revision (Crafton, 1996).

A student with high electronic writing proficiency writes differently.[23] The writer captures ideas for a composition online, as the ideas come to mind, and may use a web approach[24] to writing. Even though the requirements call for a paper to be double-spaced, the student may set the document format line spacing to single to be able to see as much of the text as possible at one time to interact with the paper as a whole. The writer organizes ideas, adding headings to provide guidance as to the development of the paper. As text is inserted into the structure, the student uses the thesaurus to try to capture just the right word to convey an idea. The text is not limited to words on a page in size 10, Times New Roman font, but may include illustrations when a graphic

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[22] Russell found that students whose keyboarding was less than 19.2 words per minute wrote drafts of lower quality when using a word processor than when they handwrote drafts. The opposite was true of students whose keyboarding speed was greater than 19.2 words per minute (Russell, 1999).

[23] In the pilot study, ninth grade students with high EWP demonstrated the characteristics detailed in this paragraph.

[24] In a web approach, a writer begins at one point with an idea and adds or deletes at will, jumping from section to section as desired as ideas come to mind. There is not a linear, predefined path to follow. Text may even be in multiple documents or accessible only online.

augments an explanation, or hyperlinks[25] to provide additional information. When the writer thinks of something to add or change in a part of the paper, she scrolls to that section and modifies the text. After scrolling through the first draft of the document to reread it, deleting, inserting, and modifying text to convey just the right message, the writer prints a draft to capture a feeling for the entire piece that cannot be accomplished on a computer screen alone.

The writer demonstrating high electronic writing proficiency utilizes technology to complement her personal writing style and to relieve her of tedious chores with writing, freeing her to concentrate on how to convey the message using writing strategies learned and instruction she has received.

Using the EWP concept as an organizational framework, this study aimed to provide data on how perceptions about writing, the writing process, word processing skills, and writing achievement together increase the quality of the final draft. Past research has shown that word processing changes student writing, but it has not fully explained the relationship between technology and writing, nor has it looked at how electronic writing proficiency impacts student writing.

OTHER IMPACTS TO THE EWP CONSTRUCT

In 1985, Clark stated that instruction, not the media, accounted for differences in outcomes when using technology. Wenglinsky's (1998) research supported Clark's statement on instruction. Wenglinsky showed that how computers were used made a difference, not just using the computer or the amount of time spent with the computer.

As shown by the ACOT and other studies discussed previously, technology affected student writing.

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[25] Hyperlinks are words that when chosen move the reader to another section of text in the same document or in another document.

> The word processing studies show that a tool can dramatically alter the qualitative nature of writing operations and restructure the pattern of allocating attention to these operations. Yet, because the restructuring effects have no link with improving access to what the writer knows... no corresponding gain in writing performance occurs. (Kellogg, 1993)

Teachers must provide the link through instruction. The word processor alone did not induce changes in the text, but knowledge of the computer and word processing, coupled with knowledge of knowing what to do as a writer, would allow students to understand what was needed for writing and would lead to using the word processor effectively (Pufahl, 1986).

Technology, in and of itself, could not improve student learning. The word processor offered the opportunity to revise essays with less effort than recopying a handwritten essay; however, instruction was needed to make revision occur (Cochran-Smith, 1991).

As Hanor points out:

> Students do not experience computers autonomously without the influence of the teacher. In the examination of students' experiences with computers, contributions by the teacher necessarily affect students' aesthetic development and the ability to make informed choices. (Hanor, 1998)

Two studies, one by Greenleaf and the other by Riel, exemplify how teachers influenced student use of the technology.

The Greenleaf study in a remedial high school writing class looked at computers as a part of an interaction between social and pedagogical variables. Greenleaf found that the classroom environment became more flexible; students collaborated more, and interacted with their teacher as well as their peers as they composed. Generally, students added to the end of text rather than use the affordances of the computer, until the teacher provided additional time and support for editing and revising. Greenleaf argued that

> [s]pecific contexts and teachers seem to be profoundly important to the ultimate deployment of computer technology...how teachers make use of computers, the ways they organize writing instruction, and the social environment of the classroom as it is constructed by participants, may themselves also shape the influences computers can have on student learning and writing. (Greenleaf, 1994)

The kinds of activities in which the students engaged, the goals and directions provided to them, and the classroom environment affected the writing process for the students in Greenleaf's study. Students took advantage of the features of the word processor for revising and editing their text *when* the teacher provided additional time and assistance for those activities (Greenleaf, 1994).

In the Riel (1989) study with four classrooms of elementary students,[26] the computer was used to complement existing instructional methods. The teachers also had varying levels of computer expertise. Regardless of the instructional methods used, students appeared to work more on their assignments and to help edit other student's work. The interactive capabilities of the computer improved the quality and fluency[27] of student writing. Peer interaction facilitated learning. Riel concluded that computers positively impacted student learning, although to a greater extent in some classrooms than others.

> [T]he results of this research suggest that a combination of features (computer knowledge, teacher experience, the integration of the computer into functional learning environments) had a positive effect on students' learning. (Riel, 1989)

Teacher experience and the integration of the computer into the writing classroom positively effected students' drafts (Riel, 1989).

When the teacher encouraged revision of word processed text, students revised and edited (Greenleaf, 1994). Specific instruction on revision or the use of prompts during

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[26] Students in the study were diverse with regard to socioeconomic class, ethnicity, and levels of past academic achievement.

[27] Fluency is defined as coherent, complex, appropriate and inventive text (Chenoweth & Hayes, 2001).

the writing process increased the amount and type of revision that a writer did (Bereiter & Scardamalia, 1987a). How a teacher used prompts and technology differed by classroom and impacted the way students used computational media (Chambless & Chambless, 1994; Greenleaf, 1994; Hawisher & Fortune, 1989; McCutchen, 1995; Michaels, 1990; Moxley & Warash, 1992; Reilly, 1992; Zellermayer, Salomon, Globerson, & Givon, 1991)

> Computers alone cannot solve the problem of teaching students to read and cannot transform unskilled writers into skilled ones. Computers, however, can help organize a learning environment that makes a new social organization for writing possible. (Riel, 1989)

The teacher and pedagogy implemented impacted how computers were used in the writing classroom.

Students needed to be engaged in the work, to think about what was happening, for learning with technology to show significant differences over learning without the use of technology. How computers were used mattered (Kozma, 1991; Salomon & Gardner, 1986; Wenglinsky, 1998) and teachers were key to how computers were used (David, 1996; Hiltz, Coppola, Rotter, & Turoff, 2000; Knight & Knight, 1995; Knupfer, 1995; Reilly, 1996).

When computers were added to the writing classroom, teachers found more peer teaching and collaboration (Dooley, 1999; Greenleaf, 1994; Hawisher & Selfe, 1991), and more interaction and sharing between students (Hawisher & Selfe, 1991; David, 1996; Jones & Pellegrini, 1996). When writing was published online, whether on a local area network or on the Internet, the classroom became more active, less predictable, and opportunities increased for peer response (Richards, 2000).

The collaboration between students helped develop critical thinking because students discussed, clarified, and evaluated ideas (Gokhale, 1995). Students became more

critical, more detailed (Bardine, Bardine, & Deegan, 2000), and less vague in their peer comments. They focused on the text, not the writer, and found online peer feedback easier than face to face (Boyle & Rigg, 1999).

The literature suggests that teachers should provide writing instruction, mixed with computer instruction, to teach concepts of the computer and word processing software (Greenleaf, 1994; Klein & Olson, 2001; Montague, 1990; Wong, 2001), not just teach formal techniques of writing. Susser (1998) argued that most student writers never learned how to use word processing features and take advantage of the power of a word processor in a meaningful sense, to exploit the power of the computer. In fact, Besser (1995) suggested that "[e]ducators would do better to teach the concepts behind word processing rather than the skills. But that is a far more difficult task." Furthermore, the emphasis of instruction should be on writing, not on the word processor (Bjorklund, 2000; President's Committee of Advisors on Science and Technology, 1997).

CHAPTER SUMMARY

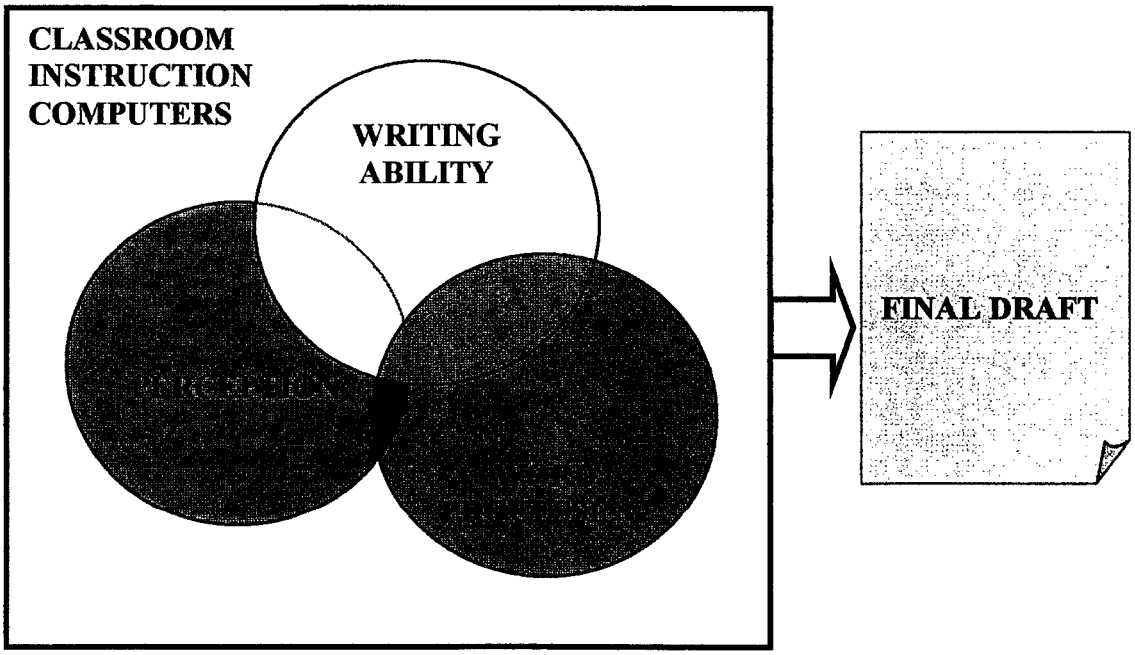

Figure 3: Literature Summary

As shown in Figure 3: Literature Summary, student writing is impacted by a number of factors as the previous review of the research acknowledged. Within the social environment of the classroom, students are impacted by other students, instruction, and the guidance provided by their teacher. Student perceptions of writing, skills with the technology, and writing ability interact within that context. The final drafts produced result from the combination of all the factors.

CHAPTER III
METHODOLOGY

INTRODUCTION

The construct electronic writing proficiency (EWP), presented in Chapter II: Review of Literature, describes the interaction and dependencies of writing achievement and command of the writing process with knowledge of how to utilize a word processor and its built-in tools to support and contribute to the writing process. Simplistically, the construct represents how well a writer writes using a word processor. Using the construct as a framework, this study examined the question, *How does the electronic writing proficiency (EWP) of university students in an introductory composition course that uses literature as a base affect student writing?* Chapter III: Methodology provides details regarding the data collected: the participants and their course of study at the university, the instruments, and the procedure followed for data collection. The chapter concludes with an overview of the data analysis procedures and the expected results.

STUDY DESIGN

The study involved three beginning English composition classes at the University of Washington[28] that were taught by two teaching assistants in the Computer-Integrated Courses (CIC) program. The study used an ex post facto design where the relationship among the variables—perceptions about using a word processor, the writing process, word processing skills, and the quality of the final draft—could be tested (Pedhazur, 1997); the variables were not manipulated.

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[28] All three classes were five credit courses and teachers devoted class time primarily to writing instruction.

The ex post facto design gave increased flexibility in examining the complexity inherent in writing with a word processor as outlined in the previous section. Even though causality could not be determined by this research method, causality could be eliminated if no relationships were found (Wiersma, 1986). Lack of control from not manipulating the variables, the major weakness in the design, was overcome by data triangulation through survey results, final papers, interviews, and observations (Tuckman, 1994).

To gather data for the study, students completed surveys regarding their use of features in a word processor and their perceptions of writing using computer technology. In all three classes, students worked on their final papers for the last two weeks of the quarter. During the last week of the quarter, the researcher observed one class session for each of the three classes where students worked on their essays. The keystroke capture program recorded the word processing functions that students used when writing. The teacher and researcher evaluated the final drafts of the compositions, which were normally assigned papers, based on the teacher-customized rubrics[29] that covered the six plus one traits of the Northwest Regional Education Laboratory model writing evaluation form (Appendix A: Instruments). In addition, the researcher interviewed selected students[30] and the teaching assistants regarding their perceptions about using computers for writing.

Qualitative data from the observations, interviews, and keystrokes of the writing process[31] provided additional information to understand the results and to explore alternative explanations. Field notes from the observations documented classroom instruction and collaboration that occurred. In the interviews, students talked about their

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[29] A copy of the rubrics can be found in Appendix D: Assignments and Rubrics.

[30] Six students were interviewed who were identified by the teachers as different from students who normally take the CIC program courses in that they were very diligent or were slackers compared to the rest of the group.

[31] Keystrokes were captured using WinWhatWhere Investigator® software.

perceptions of using a computer, and teachers shared their insights into the differences between classes taught in the CIC program and the traditional expository writing program.

PARTICIPANTS

School

The University of Washington provides an alternative for traditional beginning composition classes that utilizes a computer writing lab for instruction. The Computer-Integrated Courses (CIC) program "is dedicated to developing innovative computer-integrated approaches to teaching argumentative writing, literature, critical thinking, and research skills" (Computer-Integrated Courses, 2001). In the CIC program, the computer-integrated versions of 100 and 200 level writing classes alternate between two rooms, the traditional classroom and the computer writing lab, with machines connected to a LAN[32] and the Internet. The computer-integrated classes cover the same material as the conventional courses and have the same general goals—"producing and analyzing persuasive arguments using collaborative methods, the process model, and revision strategies" (George et al., 2001)—but incorporate instruction utilizing computer technologies to aid writing.

> The CIC program is designed to produce computer-integrated instruction in which the computer use becomes a natural part of the reading, writing, and critical thinking processes...[I]t's a way of easing students into the idea of writing-as-process by freeing them from the demand for strictly product-oriented prose. (George, et al., 2001)

The program emphasizes writing and thinking processes over the technology; students learn sufficient technology skills[33] to be able to utilize the technology to help

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[32] A local area network is commonly called a LAN.

[33] Each instructor in the CIC program selected which technologies to use in her course. The CIC Resource manual tells instructors to focus on the technologies that will advance their

accomplish the pedagogical goals of the program. In this study, when a required writing activity needed a new computer function, the teachers showed students how to perform the function using the computer attached to the projector in the classroom. Students then used the demonstrated skills.[34]

Teachers and students in the lab use several software products for writing and instructional purposes—Microsoft Word 2000; BABEL, the Electronic Bulletin Board; CommonSpace;[35] Netscape Composer; and Microsoft PowerPoint®. The software on the computers in the writing lab also included functions for viewing multimedia presentations, editing pictures, sending electronic mail, and browsing the Internet. In addition to the writing lab facilities, students could use any of the computer labs and technology available on campus or their personal computers to complete CIC assignments.[36]

Teachers

Sixteen teaching assistants in the CIC program were invited to participate in the study. Two female teachers agreed to participate. One teacher had taught writing in the CIC

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pedagogical goals and to make their students responsible for learning the basic commands of the technologies that they choose (George et al., 2001).

[34] For example, one teacher showed students how to access the Comment Function in Microsoft Word by clicking on Insert and then Comments on the standard toolbar. Then, she typed in a brief comment about a section of text that she had previously highlighted. She told students that comments should focus on sentence level changes, the object of the last lesson, but that comments that would help the writer of the paper improve the final draft should also be made. Students then used the comment function to provide feedback to fellow students.

For another example, when teaching students to use Netscape Composer for their final projects, the teacher would demonstrate one aspect of the program at a time, such as adding, repositioning, and resizing graphics on a web page. After the demonstration, students, working in groups of three, would perform the same task while the teacher walked around the room helping any group that needed it.

[35] BABEL and CommonSpace are described in Appendix B: University Computing Facilities.

[36] A detailed description of the lab facilities can be found in Appendix B: University Computing Facilities.

program for three years and the other teacher had taught six years in the computer writing lab. Both teachers, who were in the final year of their doctorate programs in English, had worked as the assistant director for the Computer-Integrated Composition program. The CIC assistant director's "main role is to provide pedagogical support and to develop the CIC curriculum" (George et al., 2001). The assistant director also conducts training sessions for teaching assistants before they teach in the computer writing lab for the first time, showing other teaching assistants how to use the lab, how computer skills may be taught, and what may be done in the lab. The assistant director also assisted other teaching assistants in the lab and, throughout the quarter, provided pedagogical and technical consultation on teaching in the lab. Both teachers not only used technology and the writing lab to teach beginning composition courses, but, as the CIC assistant director, used their knowledge and expertise to assist others in the same endeavor.

Students

Three classrooms of beginning composition students, who used the computer to write in the CIC lab[37] and were taught by the teaching assistants who agreed to take part, participated in the study. Complete data[38] were obtained on 49 students at the University of Washington from beginning composition classes that used literature as a base—14 students in the first class, 20 students in the second, and 15 students in the third: 35 females and 14 males. All students assigned to the composition classes of the teachers who volunteered for the study were asked to participate. Five students elected

[37] According to the teacher in the pilot study, students often appear surprised that the class will be held in the writing lab. Students who strongly oppose using the computers in class will drop the course, although few students do drop (Teacher interview, November 2001).

[38] Fifty students agreed to participate, but one failed to submit a final assignment, a critical piece of the data needed for analysis. All other students completed the surveys, had keystrokes recorded if they used the computer for writing during the class period, and submitted the final paper.

not to participate, four students were absent on the day when data were collected, and one student was dropped from the study because the final paper was not submitted.

Underclassmen, primarily, enroll in the beginning composition courses, but the classes in this study were not limited to freshmen or sophomores; participants included 1 senior, 6 juniors, 11 sophomores, 21 freshmen, and 10 who did not provide information about their class. Six students had Hispanic surnames and 14 students had Asian surnames.

Writing achievement did not vary significantly among students in this study. Students accepted to the University of Washington, a highly competitive university,[39] have demonstrated high academic skills. Therefore, students do not represent a cross-section of the general populace, nor an average group of high school graduates. Most students at the University graduated in the top quarter of their high school class[40] and took classes that prepared them for university work. However, since writing for college level courses differs from high school writing in goals, objectives, and instruction, students rarely enter with outstanding composition skills and the knowledge for high performance at the university level. As validated by the teaching assistants, students in this study were all capable writers: none required remediation, nor were any outstanding. The students were not struggling writers who required formulaic structures to learn basic writing strategies, but they were not yet accomplished academic writers. Students strove to express their own views in their own voice and worked on trying to make their writing clear and interesting.

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[39] Entering students at the University in 2000 had a 3.63 average GPA and a combined verbal and math SAT score of 1159. Undergraduate population at the University in 2000 was 26.2 percent students of color. 52 percent female, and 86.7 percent state residents (University of Washington demographic data, 2001).

[40] Of the students who reported class rank, 79 percent indicated that they graduated in the top quarter and 98 percent graduated in the top half of their high school class.

All students who participated in the study demonstrated basic word processing skills, based on classroom observation and confirmed by the keystroke capture software log file output. Students obtained assignments online, researched information, integrated information obtained into assignments, presented work using technology, and composed papers with a word processor without assistance. Every student used touch-typing methods to enter data.[41]

Course of Study

The three classes in the study, like all Computer-Integrated Courses, maintained the pedagogical goals of the expository writing program at the University—the study and practice of good writing—but also were designed to teach students the basic commands needed for technological competency of the course software. CIC courses differ by instructor and topic as each teaching assistant plans the readings, assignments, and use of the technology to fit the course. No two classes in the CIC program have exactly the same readings, syllabus, or objective for the final paper. Nevertheless, in all three classes in the study, students wrote papers using Microsoft Word, put a copy of their papers on the classroom LAN, provided comments and peer feedback to others electronically, and contributed to classroom discussions of writing using the Bulletin Board software.

In each class, as students composed their final papers during the last two weeks of the quarter, they received peer feedback from one another as well as feedback from their teacher. The teachers were also available for consultation during the quarter. Even though the topic and presentation of each final assignment differed, the essence of each assignment was creating an academic essay. The essays ranged from three to six pages[42]

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[41] This observation was noted and, again, confirmed by the teachers; no one appeared to "hunt-and-peck" at the keyboard, but rather touch-typed.

[42] The essays posted on the Internet were single-spaced with varying fonts and margins. Printed versions of the essays, not including the chapters from *Great Expectations* or *Pride and*

in each class. Each rubric stressed the content of the composition over other elements.

The first class in the study, a 100-level composition course, concentrated on writing as a process. Students wrote about what they found in several short literary selections from Alan Lightman, Julio Cortazár, and Jorge Luis Borges. Students also read and commented on short selections from the *Bible*, *The Bhagavad Gita*, and the *Tao Te Ching*. The teaching assistant used the web to post assignments and the syllabus, used online and oral class discussions, and provided specific exercises in forming an argument, in writing a peer review, and in using different voices for writing. Her primary goals were to encourage students to use their own voice, to develop an academic argument, and to learn to write without having to follow a formulaic five paragraph essay format (Teacher interview, March 2002). For the final assignment (Appendix D: Assignments and Rubrics), which was used for this study, students wrote on a topic derived from the works by Julio Cortazár. Students selected their own topic and used one or more of the short stories to support their argument. The essays were evaluated using the rubric in Appendix D: Assignments and Rubrics.

The second class in the study, a 100-level composition course, also focused on writing as process. Students in this class, however, used works presented in a history class that was linked to the composition course as the material for essays. Students in this class were required to take the history class as well. The linked classes were intended to enrich one another. The history class was used as an "occasion to learn about and practice writing" (Student course materials, March 2002) and to gain writing skills that could be used in other areas as well. For the final assignment (Appendix D: Assignments and Rubrics), which was used for this study, students wrote an essay on the history of different cultures in an area or region and how the cultures conflicted or cooperated in daily life. As a topic, students could choose the L.A. riots, its causes and

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Prejudice, converted to a standard font, such as Times New Roman, reset with the default margins in Word, and double-spaced, ranged from three to six pages.

its effects; the cultural conditions in either film, *Do the Right Thing* or *Lone Star;* or choose a city or region looking a specific incident or event. The essays were evaluated using the rubric in Appendix D: Assignments and Rubrics.

The third class in the study, a 200-level composition course, examined works from English literature, *Pride and Prejudice*, *Great Expectations*, and excerpts from *The Pickwick Papers*. Students viewed various ways that the novels were presented—movie, video, text, and television production. The teacher posted student papers online to let her students visually see what others were doing. Students then provided peer feedback with online comments using the Bulletin Board software program. During the quarter, the teacher had students assemble an electronic archive of materials that they would use on their final project, which was to choose and interpret a theme found in either *Pride and Prejudice* or *Great Expectations*, or in both works. Students were required to post their final paper on the web using a teacher provided outline specifically created for an interactive paper. Students linked each part of the paper from a home page and the teacher posted the final assignments on the web. The Critical Introduction page explained the significance of the chosen theme and presented an academic argument including supporting details. The About This Site page described the contents of the site, useful information in navigating the site, and, optionally, information about the author. On two other pages that were linked to their sites, students copied two chapters from *Pride and Prejudice* and/or *Great Expectations;* they annotated specific words, phrases, or paragraphs with links to other information that supported the argument presented in the introduction. Students also provided a Supplementary Information section that contained historical details, hyperlinks to related materials, and information from scholarly reviews; and a Bibliography section that detailed all resources used to construct the site. In addition, students supplied hyperlinks to listed online resources. The essays were evaluated using the rubric in Appendix D: Assignments and Rubrics.

The final assignment for each class required students to write an academic essay. Students choose a topic[43] related to the last class readings, presented an original argument on the topic, and backed up the claim with evidence. The teachers required papers to be organized, cohesive, and coherent; to be written in a voice appropriate to the topic; to use correct grammar, punctuation, and to cite references correctly.

PROCEDURE

The study looked at the variables—perceptions about using a word processor, the writing process, writing achievement, word processing skills, and quality of a writing sample once during the quarter. To maintain an authentic student writing situation and to observe how students used technology to compose, data were collected from classroom assignments, using the hardware and software available in the computer writing lab classroom. The coursework assigned by the teachers and the technology available for student use were not manipulated as part of the study. The students completed standard assignments detailed in the syllabi[44] at the beginning of the quarter. For the study, students received no special instruction, from the teacher or researcher, on writing or using the technology available in the lab. Teachers maintained their current instructional techniques and directions for writing and for using the technology.[45] However, normal instruction in the CIC program included not only guidance for students to become better writers, but direction on using aspects of the technology for writing.

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[43] Topics for the final paper differed within each class as well as between the three classes in the study.

[44] For easy access and constant availability for students, the syllabus for each class was posted online, a standard practice for teachers in the CIC program.

[45] The instructional pedagogy used in the lab usually differs from the instructional techniques used in traditional classrooms since the technology opens up new possibilities for teachers. The computers allow students to spend more time in class writing and allow teachers more opportunities to work on various aspects of the writing process such as peer editing and revision.

To collect quantitative and qualitative data to investigate the impact of electronic writing proficiency on student writing in college composition class, the study used surveys, interviews, field notes on class observations, captured keystrokes of student writing for a standard assignment, and evaluated the final papers students submitted.

Figure 4: Procedure Diagram provides an overview of the steps in the study design. A further explication of each step follows the figure.

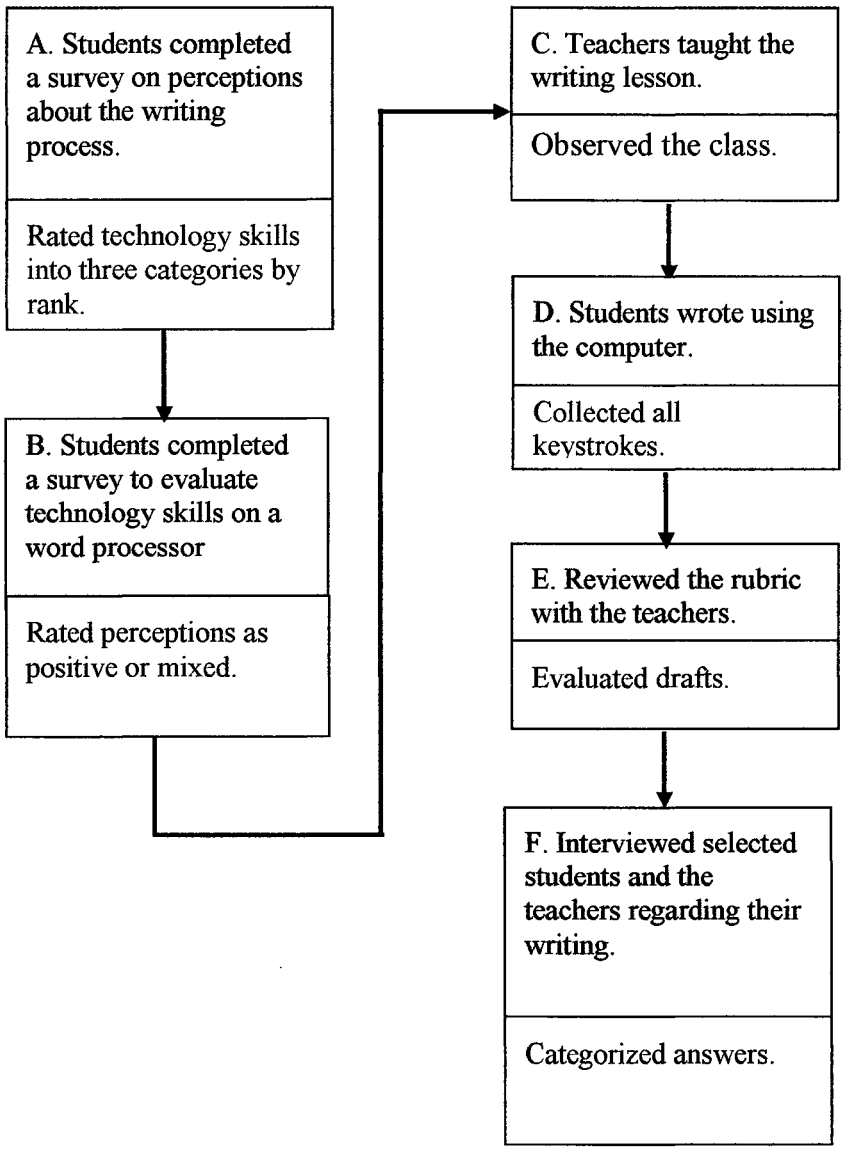

Figure 4: Procedure Diagram

Surveys (Steps A and B)

At the beginning of the observed class, each student received a copy of two surveys developed by the researcher[46] (Appendix A: Instruments) to complete in class. The

[46] The survey instruments were tested in the pilot studies and revised based on results of those studies. Appendix C: Pilot Studies discusses the instruments and the changes made.

Perceptions of Writing Response Survey measured how students approached the writing assignment, what was difficult and easy about writing with a word processor, and whether or not students liked writing when using a word processor. The survey included an open-ended question that asked: *Are there any comments you would like to make regarding how a computer helps you to write?* The researcher encouraged students to provide their thoughts about writing with technology, especially how a computer helped or hindered their writing. Both surveys were used in the first pilot study and modified as a result of those studies (Appendix C: Pilot Studies).

For each question, students were asked if they *Strongly Agreed*, *Agreed*, *Disagreed*, or *Strongly Disagreed* with a statement about using a word processor. One to four points were given for each statement; higher points were awarded for stronger positive perceptions about the use of the computer for writing. Scores of 36 and above would indicate positive perceptions of using a word processor, scores of 24 or less would indicate negative perceptions of using a word processor, and scores of 25 to 35 would indicate mixed perceptions of using a word processor.[47] To analyze the data, the scores were converted to categorical data—positive perceptions, mixed perceptions, or negative perceptions.

The Word Processing Tasks Survey[48] asked respondents if 20 different features available in a word processor were new or familiar. Students were given two points for each task that was familiar and one point for each task that was new. To analyze the data, the scores were converted to categorical data by rank, the lower third were labeled *Meet Standard*, the middle third were labeled *Standard Plus*, and those in the upper third were labeled *Exceed Standard.*

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[47] If a respondent answered all questions *Agree* or *Strongly Agree*, the resultant score would be 36 or higher. If a respondent answered all questions *Disagree* or *Strongly Disagree*, the resultant score would be 24 or lower.

[48] The instrument was developed and tested in the pilot studies (Appendix C: Pilot Studies).

Research has shown that keyboarding speed may interfere with writing if a student keyboards at less than 20 words per minute (Russell, 1999). Therefore, the first class to participate in the study was asked to complete the Keyboarding Speed Survey to ensure that keyboarding problems did not interfere with the writing process. After logging into the Keyboarding Survey web site, students clicked on a button to begin a keyboarding test. A short passage appeared at the top of the screen which students were given two minutes to type. The online survey recorded the amount of text typed and stopped the survey after two minutes. The time started when they pressed the Enter key to begin the survey.

However, when the class simultaneously attempted to access the web site, only a limited number gained access. Others received an error message that the site was not available. Consequently, only nine students completed the Keyboarding Speed Survey.[49] Since all students who completed the survey typed over 20 words per minute, the teachers had not observed any problems with keyboarding, and access issues arose around use of the site, further use of the Keyboarding Speed Survey was discontinued.

Observation (Step C)

For one class period, the researcher observed each class as an entity as students worked on their texts, noting collaboration and interaction, teacher instructions, how much of the session was spent on the computers, and the types of activities that occurred in the classroom. During the observed session in the last week of the term, the researcher watched for general trends as students reviewed, edited, and revised the final papers. On the day the researcher observed the classes, students were at different positions in the recursive writing process. Some students worked on revising their essays, some

[49] A detailed error analysis could not be done at the point students received the error message indicating that the site was not available. Therefore, an adjustment was made so that the study could proceed and students could begin work on their writing assignment. Additional details regarding issues that arose with the installation, testing, and use of the software in this study are covered in Chapter V: Discussion and Conclusion.

collaborated over changes to paper copies of the essays, and some students said that they were ready to submit their papers. Students who were not ready to turn in the final papers completed them outside of class and submitted them at the end of the quarter. Prior to the final draft being submitted for evaluation, compositions were reviewed and revised over several class sessions before the one-class snapshot of writing taken in this study.

Keystroke Capture (Step D)

WinWhatWhere Investigator® software documented the writing process. The researcher configured WinWhatWhere to capture all keystrokes when students used the software that was pertinent to the writing process in the CIC course—Bulletin Board, CommonSpace, Word, and Netscape Composer. WinWhatWhere did not record mouse clicks, including choosing buttons on the toolbars, using the scroll bars, closing a dialog box, or using the mouse to reposition the cursor in the text. In other words, some of the functions students used within the word processor could not be recorded. However, the software captured all keys students pressed to enter or modify their text regardless of the software program used to enter that text. To maintain privacy and maintain the approved limits of the study, the software did not capture keystrokes for logging in nor capture data from software programs not used as part of the writing curriculum.

In an attempt to maintain the natural setting in which students in the CIC program often write, the software ran in the background; a small green light on the task bar showed that it was active and recording keystrokes, but students could not see a record of what they had done. There was no splash screen[50] on startup to remind students that their writing was being recorded. Keystrokes, which were labeled by machine and time stamped, were sent via e-mail to the researcher for later analysis, which avoided

[50] A splash screen is the first screen that may appear when a piece of software starts. Often, it will have the logo of the company that owns the software and a copyright will appear. Other information such as version number, serial number, or licensee may also appear.

potential contamination or deletion of files stored on the hard drive and, in addition, maintained the security procedures required by the University.

Since data on the writing process varied greatly between students and students were at various places in the writing process, the keystroke data were used descriptively in the analysis. Using the time stamps added to the keystrokes, the results were qualitatively broken into separate categories—peer review, on the Internet, sidebar tasks, editing, reviewing, and revising. The time spent on each task was noted and the types of activities being done within each category were also recorded.

Final Draft (Step E)

For each class, teachers provided a scoring rubric[51] for the final draft. The rubric was written specifically for the class. To ensure a common understanding of scoring for the final essays, the teachers and researcher reviewed the rubrics using example essays to illustrate the grading criteria. Although each rubric focused on content and ideas over other elements, each of the rubrics covered the seven categories—ideas and content, conventions, voice, word choice, organization, sentence fluency, and presentation—of the Six Plus One Writing Rubric developed by the Northwest Regional Education Laboratory (NWREL, 1999a). To ensure a common understanding of how to implement the rubric, the teacher and researcher walked through the components of the rubric noting how students in sample papers either met or failed to meet each requirement and the impact on the final grade for each point. The teacher and researcher then evaluated each paper. Grades given by the researcher and the teacher were averaged for the final draft score.

Evidence of how the word processor was used for the final draft was noted. The researcher looked for such items as different fonts, color, layout, graphs or diagrams,

[51] The rubrics, customized for each class, were based on Northwest Regional Education Laboratory Six Plus One Writing Model Rubric guidelines. A copy of each rubric is included in Appendix D: Assignments and Rubrics.

bold or italic type, or hyperlinks. Did students use superscript, subscript, or small caps in their documents? Did they apply italic, underline, or bold attributes to text? Were hyperlinks used? Were there symbols or special characters such as an Em-dash or foreign language characters in the essay? Did the essays contain varying fonts or font sizes? Were there any bulleted or numbered items? Did students use graphs, charts, or pictures? What information, if any, was placed in headers and footers? In other words, the researcher looked for anything in the paper that distinguished it from the same paper typed on a typewriter.

Interviews (Step F)

The researcher conducted semi-structured interviews with the teaching assistants who were asked about their instructional philosophy and beliefs regarding using computers to teach writing, their classroom use of a word processor, prior experience, and how they integrated technology into the classroom. In addition, the researcher asked the teaching assistants to identify students who represented the extremes of their class with regard to motivation and achievement.[52] Students, whom the teaching assistants identified, were then interviewed to further understand how students use the word processor for writing and to obtain more information about students' perceptions of using technology for writing (Gall, Borg, & Gall, 1996).

According to the teachers, the writing classes generally consist of students prepared to participate and who readily work on the assignments given. Normally, students work hard. However, occasionally there will be one who does not display much effort or enthusiasm among the group. Those who showed less interest in the class and in using the technology were interviewed as part of this study. Students were asked how they utilized the computer during the writing process and what they perceived as the benefits

[52] From the observations and survey results, there appeared at first blush little difference in the students. Since interviews needed to be conducted while students were accessible, the researcher asked the teaching assistants for input to select students to be interviewed.

or problems with using technology and the writing lab for instruction. The selected sample consisted of six students,[53] three male and three female. In addition to the semi-structured interview with the six students, 29 students provided comments on the Perceptions of Writing Response Survey about using the computer for writing.

DATA ANALYSIS

The study provided qualitative and quantitative measures regarding four variables—knowledge of word processing functions, perceptions of writing with a word processor, writing process, and quality of the final draft. Field notes from the classroom observations, student comments on the survey forms, and interviews with selected students and the teachers were used qualitatively to verify the scoring of the surveys.

First, a preliminary data analysis checked for group equivalency. Using quantitative data from the surveys and grades on the writing assignment, an analysis of variance examined class differences in word processing knowledge, perceptions of writing with a word processor, and grades on the writing sample. Equivalency between classes was also checked through a qualitative analysis based on classroom facilities, course goals and objectives, requirements for the final assignment, use of technology in the classroom, and teacher expertise. Then, a qualitative analysis of written and oral comments on perceptions and the writing process followed. Perceptions were categorized as positive, mixed, or negative perceptions of using a word processor and statements about using technology to learn were analyzed. The writing process was categorized into peer review, on the Internet, sidebar tasks, editing, reviewing, and revising; and the amount of time spent on each category as recorded.

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[53] The student sample was quite homogenous; grades were generally A's and B's and all had a basic knowledge of word processing. The students interviewed represented the extremes of the participants with regard to attitude using the computer for writing and previous grades on class assignments, as assessed by their teacher.

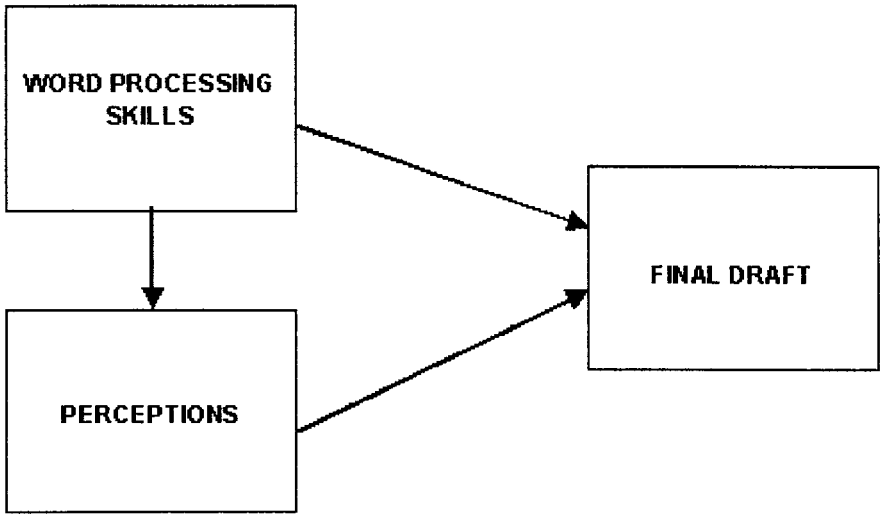

Figure 5: The Model of Relationships Between the Variables
Word Processing Skills, Perceptions of Writing with a Word Processor,
and Quality of the Final Draft.

Relationships as predicted by the literature between the quality of the final draft, word processing skills, and perceptions of using a word processor for writing (Figure 5: Model of Relationships Between the Variables) were analyzed via path analysis. The chi-square statistic from a structural equation model analysis could not be used since it is not reliable at sample sizes less than 100 (Boomsma, 1987; Curran, Bollen, Paxton, Kirby, & Chen, 2002; Schumacker, 2001).[54] Therefore, since N = 49 for this study, a path analysis rather than structured equation modeling was used to analyze the data.

Path analysis, a multiple regression analysis technique, was used to study trends within the data. Path analysis analyzed the relationship between the variables since the data could be studied as a group case: Path analysis addressed the construct EWP and the component parts in its entirety, looked at the tenability of causes and effects the variables had on one another and looked at an alternative model.

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[54] Even though there were an insufficient number of participants for the chi-square statistic, there were a sufficient number for a reliable regression equation since in the social sciences, about 15 subjects per predictor variable were required for a reliable regression equation or about 45 subjects for this study (Stevens, 1996).

EXPECTED RESULTS

The hypothesis, derived from the literature and the pilot studies,[55] proposed several outcomes. Writing ability would play a more determinate role in the quality of the final draft than word processing skills. A student's word processing skills and their perceptions about how using a word processor impacts their writing only needs to reach a certain level for a student to have high EWP. A student with a higher level of electronic writing proficiency would demonstrate the use of more word processing features during the writing process than a student with a lower level of electronic writing proficiency and produce a higher quality final draft. The final draft submitted by a student with a higher level of electronic writing proficiency would show more characteristics of text that was written on a computer, that is, the presentation of the paper would show characteristics of word processed text; it would be apparent that a word processor was used, not a typewriter. A student with a higher level of electronic writing proficiency would perceive that the word processor was more valuable for composing an essay than a student with a lower level of electronic writing proficiency.

CHAPTER SUMMARY

Chapter III discussed the research method for data collection and data analysis. Chapter IV: Data Analysis and Findings, discusses the data obtained from the survey instruments and grades from the writing sample, outcomes from the tests for equivalency between classes, and the results of a path analysis analyzing the relationship between variables. The chapter also covers student and teacher perceptions of writing as provided by interviews and comments, and information garnered from the keystroke capture program about how students used the word processor.

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[55] Appendix C: Pilot Studies provides details on the pilot studies.

CHAPTER IV
DATA ANALYSIS AND FINDINGS

INTRODUCTION

This study sought insights into the following question: *How does the electronic writing proficiency (EWP) of university students in an introductory composition course that uses literature as a base affect student writing?* In order to answer this question, the following additional questions were examined:

- Equivalency: Could the three groups in the study be considered equivalent so that all students could be considered part of the same group for further statistical analysis?
- Perceptions: How did student's perceptions[56] about their writing process impact their writing?
- Writing Process: What differed in the writing process for students with higher and lower levels of electronic writing proficiency?
- Word Processing Tasks: What differed in the final draft for students with higher and lower levels of electronic writing proficiency?
- Path Analysis: Does the theorized data model represent a feasible explanation for the data?

Chapter IV: Data Analysis and Findings presents survey data and grades from the writing samples followed by the data analysis for each of the additional questions listed

[56] Student perceptions about writing with a word processor capture how students believe that a word processor benefits or hinders their writing.

above. The chapter concludes with an examination of the feasibility of the data model using path analysis.

SURVEY RESULTS AND GRADES ON WRITING SAMPLE

Word Processing Tasks Survey

The Word Processing Tasks Survey (Appendix A: Instruments) measured knowledge of word processing functions: It asked respondents if 20 different features available in a word processor were new or familiar. Figure 6: Word Processing Functions lists the tasks that were presented on the survey form. To score the survey, students were given two points for each familiar word processing task and one point for each new task with a possible range of 20 to 40 points.

Students reported that they knew how to perform most of the tasks. Even 10 of the 12 lowest scoring students knew how to use 14 of the 20 functions of the word processor, with the lowest scoring student knowing 11 functions. All 49 students knew how to do 8 of the 20 skills inventoried and 48 knew how to perform two additional tasks. Adding a Cross Reference, a task not used in any of the final papers, was the only function that less than half of the students knew how to perform.

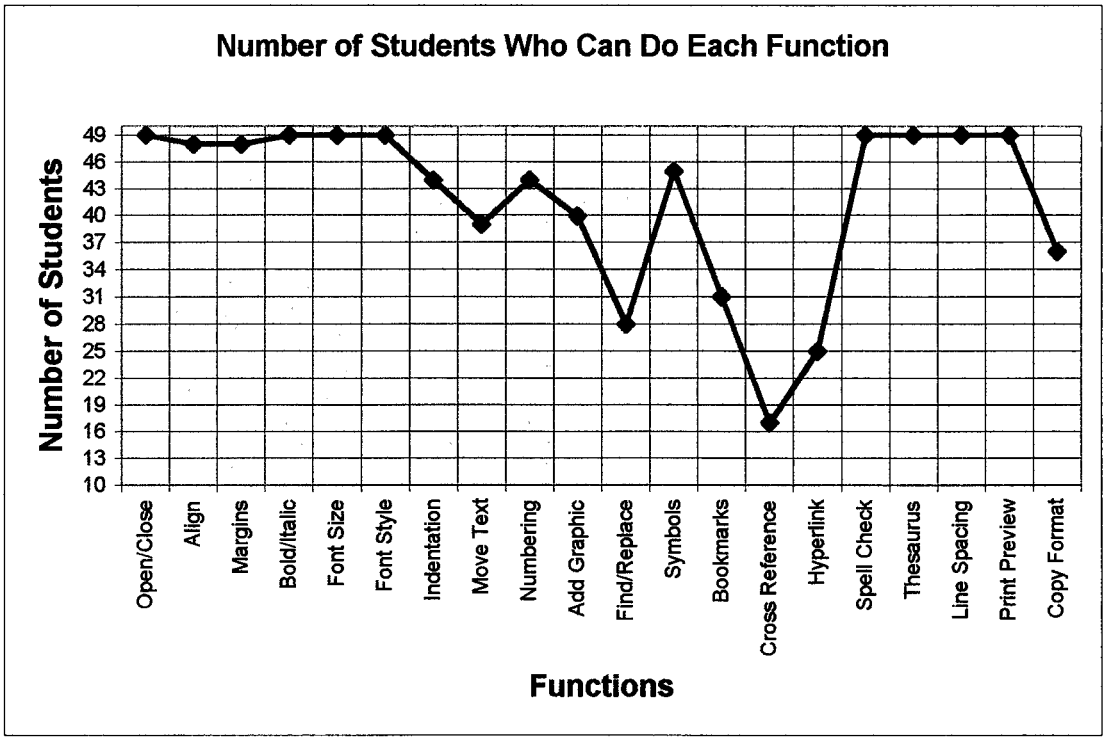

Figure 6: Word Processing Functions

Of the 10 functions that more than two students reported were new, eight were not required to write the final paper in any class. Of the two tasks that were required only for the project posted on the web, 25 students knew how to create a hyperlink and 40 knew how to insert a graphic. Two students in the web-based project class reported that they did not know how to add a graphic to a document and six students said that they did not know how to add a hyperlink even though all final projects contained both elements.

The scores were converted into three groups based on rank. Results, shown in Figure 7: Word Processing Task Knowledge, indicated that all students could use the computer for the writing tasks required by their courses.[57] Twenty-one students were rated *Exceed*

[57] Since students were required to double space, use Times New Roman or similar font for their work, use a readable font size (12 pt, for example), open, close, and save a document, print, and spell check the paper before turning it in, these skills were considered the minimum to

Standard, 16 students *Standard Plus*, and 12 students *Meet Standard*. Few differences existed in the number of functions between students in the three categories. The student's scores for knowledge of word processor functions were high: 37 of the 49 students could perform at least 16 of the 20 tasks. The high student scores indicated that all could use the computer for the writing tasks assigned in their class.

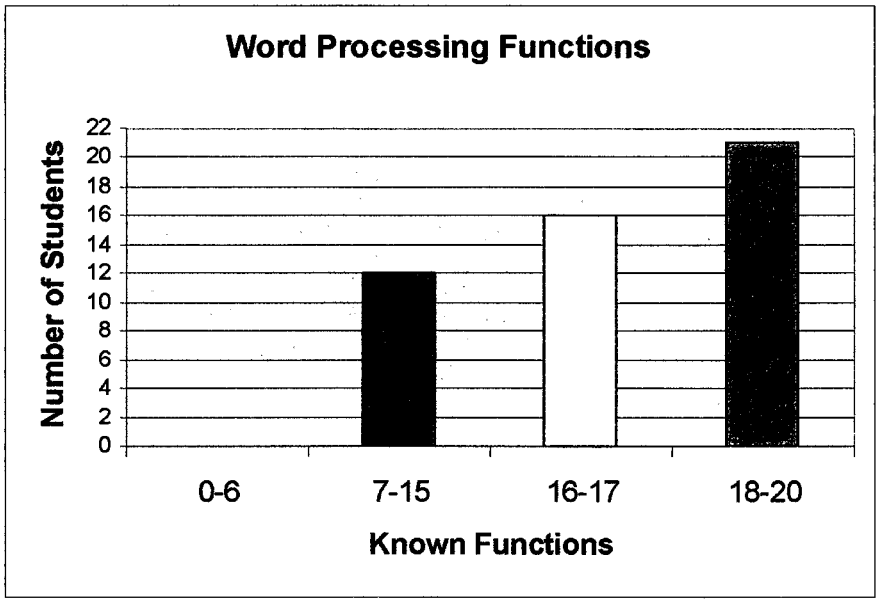

Figure 7: Word Processing Task Knowledge

Perceptions Survey

The Perceptions of Writing Survey (Appendix A: Instruments) measured perceptions of writing with a word processor. Components of the survey included what was difficult and easy about writing with a word processor and the perceived benefits of using the computer for writing. In addition, students were asked whether or not they liked writing and if they like writing when using a word processor. For each statement about the perceived benefits of using a word processor, students were asked to respond *Strongly Agree*, *Agree*, *Disagree*, or *Strongly Disagree*. Students were given four points for each

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Meet Standard. Students who could only perform these tasks would receive a 26. A score of less than 26 was defined as *Not Meeting Standard*.

Strongly Agree answer, three points for *Agree*, two points for *Disagree*, and one point for *Strongly Disagree*.

The scores were converted to categorical data. If a student answered all questions *Agree* or *Strongly Agree*, the resultant score would have been 36 or greater: a score of 36 or more was rated as *High Perceptions*. If a student answered all questions *Disagree* or *Strongly Disagree*, the resultant score would have been 24 or lower: a score of 24 or less was rated as *Low Perceptions*. Scores between 25 and 35 were rated as *Mixed Perceptions*.

Twenty-three students received scores of 36 and above, indicating positive perceptions of using a word processor. Twenty-five students received scores between 25 and 35, indicating some positive and some negative perceptions of using a word processor. Only one student with a score of 23 had negative perceptions; for statistical purposes, the student was included in the *Mixed Perceptions* category.[58]

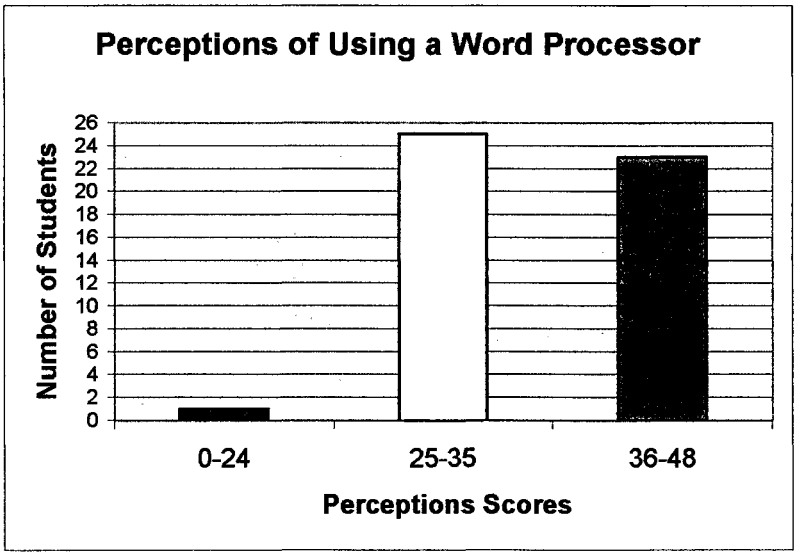

Figure 8: Perceptions of Writing with a Word Processor

[58] The student was included in the mixed category because the answers on the students' survey ranged from *Strongly Agree* to *Strongly Disagree* and because statistical analysis cannot be performed comparing groups when there is only one in a group.

Two statements, *I like to write* and *I like to write with a word processor,* asked to obtain overall perceptions of writing regardless of medium used and of writing specifically with a word processor, were evaluated separately. The survey also included an open-ended question that asked, *Are there any comments you would like to make regarding how a computer helps you to write?*

More students like to write with a word processor than like to write: 43 students *Strongly Agreed* or *Agreed* that they like to write with a word processor whereas 35 students responded similarly that they like to write. Fourteen students *Strongly Disagreed* or *Disagreed* with the statement, *I like to write*, whereas six students *Disagreed* with the statement, *I like to write with a word processor.*[59] More students responded with a positive answer when the question included a word processor.

Table 2: Change in Perception When Using a Word Processor details the differences between the survey answers from the response to *I like to write* to the second statement, *I like to write with a word processor.* The column labeled *I Like to Write* shows the number of students who responded to the question with each of the four answers listed in the leftmost column. For the number of students with each response to the statement, *I like to write*, the four columns on the right of the number show the number who gave each of the four responses to the statement, *I like to write with a word processor.* For example, two students *Strongly Disagreed* with, *I like to write.* For those two students, one responded *Strongly Agree* to *I like to write with a word processor* and one responded *Agree* to the statement.

[59] No one *Strongly Disagreed* with the statement that they like to write with a word processor.

Table 2: Change in Perception When Using a Word Processor

	I Like to Write.	I Like to Write with a Word Processor.			
		Strongly Agree	Agree	Disagree	Strongly Disagree
Strongly Agree	**11**	2	7	2	0
Agree	**24**	7	16	1	0
Disagree	**12**	3	6	3	0
Strongly Disagree	**2**	1	1	0	0

0	Yellow, upper right – decrease in perceptions when using a word processor
0	White, diagonal – constant perceptions with or without a word processor
0	Blue, lower left - increase in perceptions when using a word processor

Not all students gave the same response to the two questions, nor were the changes consistent across groups, based on the first question. The ratings dropped for most of the students who *Strongly Agreed* that they liked to write. However, for all but one student, those who *Agreed, Disagreed,* or *Strongly Disagreed* with the first statement, the ratings remained constant or increased when asked if they liked to write when they used the computer.

- For the 11 students who *Strongly Agreed* that they liked writing, only two still *Strongly Agreed* that they liked writing with a word processor. The other nine students decreased their perceptions: Seven *Agreed* that they liked to write when they used a word processor, and two students, *Disagreed* with the statement.

- For the 24 who *Agreed* that they liked to write, 7 increased their perceptions, 16 remained constant, and 1 decreased.

- Of the 12 students who *Disagreed* with the first statement, 3 gave the same answer when using a word processor, but 6 students increased their opinion to *Agree* and 3 students increased their opinion to *Strongly Agree*.

- Both students who *Strongly Disagreed* with *I like to write*, liked to write with a word processor.

Perceptions Summary

Except for those students who *Strongly Agree* to the statement, *I like to write*, student perceptions of writing became more positive with the addition of a word processor.

Essay Grades

The teacher and researcher reviewed the rubrics for each class (Appendix D: Assignments and Rubrics). Then, they examined one or two papers from each class, noting how each met or failed to meet the criteria specified in the rubric and what grade would be associated with such work. The scorers rated each essay on a scale of 1 to 10 in each category of the rubrics—Style, Integration, Structure, Exploration, and Specifics in the rubric for the web-based project and Topic, Information, Organization, Argument, Rhetoric, and Conventions in the rubric for the other two classes. After totaling the points for the paper, the grades were converted directly to a 4.0 scale. For example, using the rubric for the two classes, a score of 60 received a 4.0, a 59 or 58 received a 3.9, and a score of 57 received a 3.8.

The teachers and researcher used the papers as samples to independently score other essays. The two grades were averaged for the final draft score used for evaluation in this study.

The grades clustered at the upper end of the scale. Using the University of Washington standard grading scale, 10 students received A's (3.9 - 4.0), 27 students received A-'s

(3.5 - 3.8), 9 students received B+'s (3.2 - 3.4), 2 students received B's (2.9 - 3.1) and 1 student received a C (1.9 - 2.1) as shown in Figure 9: Grades on Final Assignment.

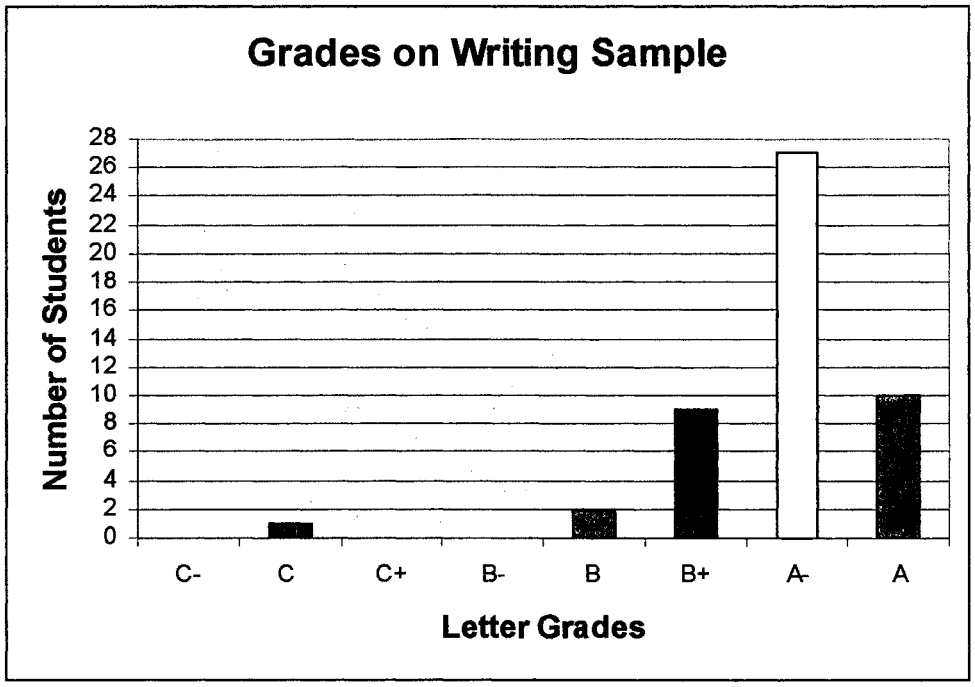

Figure 9: Grades on Final Assignment

The raters gave the same score to 25 of the students: 19 scores differed by 0.1, two scores by 0.2, and three scores by 0.3. Interrater reliability, calculated by the Pearson correlation coefficient ($p < .01$), indicated the percentage of agreement and the degree of consistency between the two raters: Consistent scoring between the two raters (Table 3: Interrater Reliability) occurred between each of the teachers and the researcher as the correlations were .921 and .979, respectively.

Table 3: Interrater Reliability

		Rater 2	Rater 3	Mean	Standard Deviation	N
Pearson Correlation	**Rater 2**	1.000	.921	3.605	.247	35
	Rater 3	.921	1.000	3.620	.301	35
		Rater 1	**Rater 3**			
Pearson Correlation	**Rater 1**	1.000	.979	3.392	.515	14
	Rater 3	.979	1.000	3.450	.476	14

The average grade given by each rater, 3.393 versus 3.450 and 3.620 versus 3.606 respectively, indicated that neither the teacher nor the researcher was more lenient than the other, another indication of consistency between raters.

GROUP EQUIVALENCY

Could the three groups in the study be considered equivalent so that all students could be considered part of the same group for further statistical analysis? The students needed to belong to the same population to run a statistical analysis that treated them as one group: The groups needed to be equivalent. Because the three classes differed by teacher, assignments, and course, tests of means checked for group equivalency based on the questions:

- Were there significant differences in pedagogy and classroom assignments between classes?
- Were there statistically significant differences between groups based on class rank—freshman, sophomore, junior, or senior?
- Were there statistically significant differences between the instructors' grading?
- Were there statistically significant differences in final grades between participants and nonparticipants?

- Were there statistically significant differences between the three classes based on final grades, perceptions of writing with a word processor, or knowledge of functions within the word processor?

The results for each test indicated that no statistically significant differences existed between the teachers or the classes; the classes were assumed equivalent for the rest of the statistical analysis.

Pedagogy and Classroom Assignments

Were there significant differences in pedagogy and classroom assignments between classes? Since no two classes in the CIC program used the same syllabus, nor were taught exactly alike, none could be considered a replica of another. All three classes used the same computer laboratory, had equivalent assignments, and focused on teaching students to write an academic essay. Table 4: Class Comparison compares the three classes by equipment used, final assignment, teacher background, and instruction.

Table 4: Class Comparison

	Web-Based Project Class	**Literary Analysis Class**	**Cultural Reflection Class**
Classroom:	CIC lab	CIC lab	CIC lab
– Configuration	Computers arranged in pods of 3	Computers arranged in pods of 3	Computers arranged in pods of 3
– Hardware	Pentium III, Windows 98, 256 MB RAM, connected to a LAN, Internet access	Pentium III, Windows 98, 256 MB RAM, connected to a LAN, Internet access	Pentium III, Windows 98, 256 MB RAM, connected to a LAN, Internet access
– Software	Word, Bulletin Board, CommonSpace, Netscape, Netscape Composer, PowerPoint	Word, Bulletin Board, CommonSpace, Netscape, PowerPoint	Word, Bulletin Board, CommonSpace, Netscape, PowerPoint

Table 4 continued

	Web-Based Project Class	**Literary Analysis Class**	**Cultural Reflection Class**
Instruction:			
– Course Readings	Two novels, *Pride and Prejudice* and *Great Expectations*	Short literary selections from Alan Lightman, Julio Cortazár, and Jorge Luis Borges	From a linked history class plus additional readings on cultural implications from the readings
– Course objective	Create an academic essay	Create an academic essay; writing as process	Create an academic essay; writing as process
– Teacher goals	Develop an academic argument with supporting evidence; present the argument publicly on the Internet	Encourage students to develop their own voice; develop an academic argument	Encourage students to develop their own voice; develop an academic argument
– Course	200-level, 5 credit	100-level, 5 credit	100-level, 5 credit
– Use of LAN and Internet	Post assignments and the syllabus; online and oral class discussions where students can contribute anonymously	Post assignments and the syllabus; online and oral class discussions where students can contribute anonymously	Post assignments and the syllabus; online and oral class discussions where students can contribute anonymously
– Exercises	Create a web page, assemble an electronic archive of materials for the final project, write a peer review	Form an argument, develop a voice, write a peer review	Form an argument, develop a voice, write a peer review
– Collaboration	Peer feedback, online discussions	Peer feedback, online discussions	Peer feedback, online discussions
Final Assignment:			
– Topic	Role of a theme in *Great Expectations* and/or *Pride and Prejudice*	Self-selected topic derived from one or more of the Cortazár short stories	Contact points between cultures in a particular city or region in America; how the cultures have conflicted or cooperated in daily life
– Time frame for writing	Last 2 weeks of the quarter	Last 2 weeks of the quarter	Last 2 weeks of the quarter

Table 4 continued

	Web-Based Project Class	**Literary Analysis Class**	**Cultural Reflection Class**
– Length	3-6 pages	3-6 pages	3-6 pages
– Format	Interpretive web edition; Graphics, color, hyperlinks	Printed on paper; Double-spaced, Times New Roman 12 point or larger	Printed on paper; Double-spaced, Times New Roman 12 point or larger
Rubric:			
– Content and Ideas	Focused theme with examples and details to support a claim	Focused argument with supporting evidence	Focused argument with supporting evidence
– Organization, Sentence Fluency	Thematic unity, transitions, organized, coherent	Unified with smooth transitions	Unified with smooth transitions
– Word Choice, Voice	Appropriate style, sophisticated use of language	Appropriate tone and voice	Appropriate tone and voice
– Conventions, Presentation	Easy navigational structure, free from mechanical errors	Free from mechanical errors	Free from mechanical errors
Teacher Expertise:			
– Leadership	Assistant director of the CIC program	Former assistant director of the CIC program	Former assistant director of the CIC program
– Experience	3 years teaching in the CIC lab environment	6 years teaching in the CIC lab environment	6 years teaching in the CIC lab environment
– Education	Final year of PhD program in the English department	Final year of PhD program in the English department	Final year of PhD program in the English department

All three classes met in the same classroom and used the same hardware and software. The teachers taught students how to write an academic essay. Students began with a topic, an argumentative claim, derived from the class readings, supported the claim with data from the readings, and presented the essay in an organized, coherent, and grammatically correct paper. Both teachers utilized the LAN for posting assignments and for class discussions. Both stressed collaboration and required peer feedback on

class papers. In addition, the teachers had similar requirements for the final papers for each class: the same length, a focused theme derived from the class readings presented during the quarter, and rubrics that emphasized content and ideas. The teachers, who were in the midst of writing their doctoral dissertations, had both worked as the assistant director of the CIC program. Both had assisted other teaching assistants in the writing lab as well as had taught in the lab for at least three years. Based in this analysis, the three classes were considered equivalent.

Class Rank

Were there statistically significant differences between groups based on class rank—freshman, sophomore, junior, or senior? Of the participants, 1 was a senior (2.04%), 6 were juniors (12.25%), 11 were sophomores (22.45%), and 21 were freshmen (42.86%): 10 did not identify their class (20.40%).[60]

Freshmen (mean = 3.569) received slightly higher grades than sophomores (mean = 3.445), juniors (mean = 3.558), or the senior (3.35). However, the unidentified class group had a slightly higher grade average (mean = 3.680). The statistical analysis did not include seniors since only one identified senior participated in the study: the group's size was too small for any reliable analysis. Mann-Whitney test[61] U values were not statistically significant ($p < .05$) for any of the comparisons as shown in Table 5: Grades by Class Rank. Having more experience writing at the university did not increase grades for students in the study. No statistically significant difference between classes existed; class rank did not make a difference in the final grades students received.

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[60] Providing information about class rank was optional.

[61] The non-parametric Mann-Whitney test was used instead of an ANOVA because the Mann-Whitney test does not make any assumptions about the distribution of the data: The students were homogenous. Each of the groups were compared and the critical values of U (U_{crit}) appear in the table.

Table 5: Grades by Class Rank

	N	Sophomores	Juniors	Other
	21	U = 103.5	U = 66.0	U = 126.5
		U = 127.5	U = 60.0	U = 86.5
Freshmen		U_{crit} = 65.0	U_{crit} = 28.0	U_{crit} = 58.0
	11		U = 31.5	U = 70.0
			U = 34.5	U = 40.0
Sophomores			U_{crit} = 13.0	U_{crit} = 26.0
	6			U = 39.0
				U = 21.0
Juniors				U_{crit} = 11.0
Other	10			

Instructors' Grading

Were there statistically significant differences between the instructors' grading? The first instructor, who taught one class in the study, gave an average grade of 3.5 for all students in her class, an A-. Similarly, the second instructor, who taught two classes in the study, gave an average grade of 3.6 for all students enrolled in her class, also an A-. An analysis of variance, used to calculate the source of variation of the means (**Error! Not a valid bookmark self-reference.**), found no significant difference between the grading of the two instructors ($F(1,55) = 3.052, p < .05$).[62]

Table 6: Grading by Instructor

Source of Variation	SS	df	MS	F	F crit (1,55 df)	Sig.
Between Groups	0.296	1	0.296	3.052	4.020	0.086
Within Groups	5.233	54	0.097			
Total	5.528	55				

[62] The analysis did not include one student from each teacher. The C final grade was eliminated from one instructor because it was an outlier and the student who did not turn in a final assignment on time was eliminated from the other instructor.

Participants and Nonparticipants

Table 7: Grades of Participants and Nonparticipants

Source of Variation	SS	df	MS	F	F crit (1,56 df)	Sig
Between Groups	0.012	1	0.012	0.083	4.016	0.774
Within Groups	8.230	55	0.150			
Total	8.242	56				

Were there statistically significant differences in final grades between participants and nonparticipants? Participant volunteers (N = 49) scored slightly higher (mean = 3.555) than those who did not volunteer (N = 8) for the study (mean 3.513), although the difference was not statistically significant ($F(1,56) = 0.083, p < .05$) based on an analysis of variance (Table 7: Grades of Participants and Nonparticipants).[63] Both participants and nonparticipants received an average grade of an A-.

Final Grades, Perceptions, Word Processing Functions

Table 8: Comparison of Final Grades Between Classes

Source of Variation	SS	df	MS	F	F crit (2,47 df)	Sig.
Between Groups	0.505	2	0.252	0.432	3.204	0.652
Within Groups	26.308	45	0.585			
Total	26.813	47				

Were there statistically significant differences between the three classes based on final grades, perceptions of writing with a word processor, or knowledge of functions within the word processor? Based on an analysis of variance, there was no statistical difference between the three groups based on the final grades ($F(2,47) = 0.432, p < .05$, Table 8: Comparison of Final Grades). The mean grade for each group was an A- (mean = 3.535,

[63] The analysis includes the final grades for all submitted projects: The 0.0 grade for the essay which was not submitted was ignored.

3.597, and 3.625, respectively). All classes had a student who received a 4.0. The minimum grade differed between the three groups by 0.2 (2.85, 2.95, and 3.15).[64]

Table 9: Comparison of Perceptions Between Classes

Source of Variation	SS	df	MS	F	F crit (2, 47 df)	Sig.
Between Groups	0.803	2	0.401	1.625	3.204	0.208
Within Groups	11.114	45	0.247			
Total	11.917	47				

No significant difference ($F(2,47) = 1.6525$, $p < .05$) between the three groups' Perception Survey scores existed, based on the results of an analysis of variance (Table 9: Comparison of **Perceptions**). However, the mean perception scores varied between the groups—1.267, 1.538, and 1.55 respectively. The slightly less positive scores in perceptions of using a word processor for writing in the Cultural Reflection class (mean = 1.267) may have reflected the teacher's observation that the class showed less enthusiasm and less involvement in computer-based activities in the writing lab than other classes that she had taught previously (Teacher interview, March 2002).

Table 10: Comparison of Knowledge of Word Processing Tasks Between Classes

Source of Variation	SS	df	MS	F	F crit (2,45 df)	Sig.
Between Groups	1.302	2	0.651	0.976	3.204	0.385
Within Groups	30.010	45	0.667			
Total	31.313	47				

The Web-Based Project class had slightly higher word processing knowledge than the other two groups with a mean score of 2.385 (Literary Analysis class mean = 2.00 and Cultural Reflection class mean = 2.267). However, the range of skills in the Web-Based Project class varied greatly: Students in the class self-reported the highest skill level and

[64] Since one volunteer failed to turn in the final assignment and one received an abnormally low final grade, those two students were eliminated from further statistical analysis since their scores could distort the analysis.

the lowest skill level. Comparing the means between the three classes using an ANOVA, the classes did not differ with statistical significance ($F(2,45) = 0.976$, $p < .05$, Table 10: Comparison of Knowledge of Word Processing Tasks Between Classes).

Equivalency Summary

Based on comparison of the means of the three groups for word processing skills, perceptions of using a word processor, and final grades, no significant statistical difference existed between them. Likewise, there was no statistical difference between the grading of the two instructors. In addition, a qualitative analysis indicated equivalency in assignments, instruction, equipment used, and teacher expertise.

PERCEPTIONS

How did student's perceptions about their writing process impact their writing? The Perceptions survey and interviews provided data on student and teacher perceptions of using technology for writing to answer the question. The analysis broke the question into two parts:

- How did students perceive that the computer helped them to complete their writing assignment?
- How did students perceive that the computer hindered them in completing their writing assignment?

Computers Help the Writing Process

How did the computer help the writing process? Students, regardless of grades, perceptions, or word processing skills, commented that the computer helped them write primarily due to convenience factors: Technology made writing faster, easier, and more efficient, especially with editing and revising text. Student's comments consistently indicated that using technology was much faster than handwriting text.

> I type faster than I write, therefore I am more able to compile my ideas in a[n] ... efficient manner. So many of my ideas have come from the ability to type down good chucks of ideas down more quickly. Those lines are then saved and can be used later. (Student Q[65] comment, March 2002)

Students also liked "the ability of correcting, adjusting, and reorganizing with a lot more ease than in writing" (Student EE comment, March 2002). They found the word processor made it easier to "rework ideas" with the editing and revising process being the most valuable (Student L comment, March 2002). In addition, three students commented that the computer helped them create a neat and polished paper (Student V, Student Z, and Student T comments, March 2002).

Three other students noted the criticality of the computer to their writing process, as one stated: "I couldn't do them any other way" (Student JJ comment, March 2002). Because of the way they wrote, they found the computer invaluable. Not all students agreed.

Computers Hinder the Writing Process

How did the computer hinder the writing process? Students said that certain features of the word processor may not always be beneficial and they may not use all features, but no one commented that the computer hindered their work. The student who "can't spell if my life depended on it" (Student L comment, March 2002) found the built-in spell check function useful. Other students noted that they needed to be cautious, especially with the built-in grammar function: "You never have to worry about spelling however grammar must be carefully checked since Word does a crappy job of doing it for you" (Student Q comment, March 2002). On the other hand, one student urged caution with both grammar and spell check functions: "The computer can sometimes mess me up by giving me the wrong word or grammar to use" (Student L comment, March 2002).

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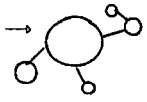
[65] Students were randomly assigned letters in the sequence A, B, C, ..., WW. In this document, students are referenced by those letters rather than by name.

Students disagreed regarding the benefit of the computer for some writing tasks. One believed that computer text is "more organized than handwriting" (Student F comment, March 2002), whereas another thought that "handwritten [text] helps me organize my ideas" (Student S comment, March 2002). A third student thought that a combination of handwriting and computer-based writing worked best.

> Generally, I am just able to get my ideas down faster because I type faster than I write, but it doesn't necessarily mean that they are better or more organized. My best papers result from me using the computer initially and then hand-editing the essay on a printed out version. I tend to be able to elaborate more when I do that. (Student MM comment, March 2002)

Five students concurred that they didn't "need to print a copy" of a paper to edit it, but it was easier to make corrections on a printed copy and then transfer the changes to the computer-based text (Student C, Student L, Student H, Student MM, & Student X comment, March 2002).

For all aspects of writing, the computer did not benefit all students. The screen size limited at least one student who wanted to see "the big picture, rather than 1 page at a time" (Student W comment, March 2002). Two other students found handwriting more stimulating as vocalized by one student.

> My prewriting is fairly unorganized and I use a somewhat web technique  and arrange things visually. I am an art major so black and white computer screens aren't very stimulating. (Student E comment, March 2002)

Two students also commented that they needed to handwrite at least part of their essays because their ideas flowed better when they handwrote text; three others commented that they needed to create a handwritten outline before using the computer. In a similar vein, another student noted that "in terms of organizing and editing, handwriting works better for me" (Student D comment, March 2002). The strongest negative comment was

made by a student who said he would rather handwrite because handwriting was more familiar, easier, and eliminated problems such as computer failures. This student, who said that he "hated" using the computer to write, still found the technology advantageous because he did not need to recopy text to edit his document (Student WW interview, March 2002).

Perceptions Summary

The variety of comments from students who reported different levels of word processing skills, voiced differing perceptions about the value of using a computer, and received different grades on the final papers, indicated that the students' best writing came from a combination of using the technology with human activities. Two students summarized the comments of their peers.

> Computers are helpful, to a point. I use it for the most basic word processing functions. Human activities, like quick writes and brainstorming are much more helpful.
>
> It's an easier process but just because I use a computer doesn't mean it's the machine that's helping me...I'm still the one thinking. (Student DD comments, March 2002)

Students perceived that the computer assisted them in their writing process by easing the physical demands of writing, but they still had to do the thinking.

WRITING PROCESS

What differed in the writing process for students with higher and lower levels of electronic writing proficiency? The writing process, captured by recording student's keystrokes as they worked in the writing lab, provided insight to answer the question. Students who had recorded keystrokes were divided into four groups based on the grades for their final drafts, A, A-, B+, and B. Keystrokes fell into one of six categories—Peer Review, Side Bar, Internet, Review, Edit, or Revise. The amount of time per category as well as the percentage of total time was calculated.

General Observations

Sixteen of the 48 students had no keystrokes recorded during the class period where they were instructed to complete their final papers. Students in all classes appeared to focus on their work.[66] Students conferred quietly and made handwritten notes on their drafts.

The amount of time that a student used the computer varied. Some students only spent a few minutes of the class working on the computers on the software for which WinWhatWhere Investigator® recorded their work, whereas others worked the entire period. Some students used handwritten notes from conversations with their peers instead of utilizing the computers. Another student indicated that he did not like to write in class because it was not quiet. He found the classroom distracting and preferred to work "on the paper all at once rather than in sections, moving from place to place... because usually it doesn't flow as well" (Student W comment, March 2002). Another factor in limited keystrokes had to do with the timing of the study. On the day keystrokes were captured, one student turned in her paper and others indicated that they were done. These students made few, if any, changes in their documents.

Differences in the Writing Process

What differed in the writing process? The writing process was divided into six categories, each of which is reported below. Table 11: Analysis of Keystrokes Sample shows the total amount of time, percentage of time, and the average amount of time in minutes and seconds spent by students for each grade grouping.

Peer Review: In two classes, students provided feedback to others. When the software captured the student opening a file from a different student and adding comments to the document, the task was categorized as Peer Review. Only 13.64% of the total time

[66] The researcher walked around the classroom as students worked and all conversations that were overheard centered around writing.

online was spent commenting about the essays of others in the class. Students who received an A or A- took more of their time to provide peer feedback to others (accounting for 91.4% of the total time dedicated to peer review). On average, the A and A- students spend 4 minutes and 28 seconds commenting on another students' paper, whereas the B+ and B students, on average, spent less than a minute providing feedback.

Side Bar: The Side Bar category included time when students strayed from the assignment and used the computers for other tasks, such as e-mails to friends, online chatting, searching the Internet for items to buy, or doing homework for another class. Ninety-four percent of the off-task activities came from those students who received A's or A-'s, but side bar activities on average only accounted for 6.97% of the time spent using the computers. Little time was spent using the computers that was not directly attributable to the writing assignment. Students who received higher scores strayed from the assignment more often.

Internet: The Internet category included searching for graphics, text, or ideas for the papers. It also included time spent downloading and uploading files. Some of the students would download a draft from an e-mail account, save it on the local area network in the lab, work on the document in class, and then upload it once again to their e-mail account. In this way, students always had the latest copy of the document and could access it from any computer connected to the World Wide Web. On average, 9.61% of the total time was spent using the Internet, with the percentage of time ranging from 2.36% (B grades) to 14.18% (B+ grade). Those who received an A grade averaged 3 minutes 36 seconds on Internet activities; A- students, 2 minutes 28 seconds; B+ students, 4 minutes 23 seconds; and B students, 38 seconds.

Review: Opening and closing or scrolling through a document without making any changes was categorized as Review, the second most common activity for all groups except those who received a B+ (22.99% of the total time for all students). The lower

the grade, the larger percentage of time students spent in reviewing their documents (A grade, 13.94%; A- grade, 19.97%; B+ grade, 38.76%; B grade, 44.28%). Even though students in each grade grouping did not spend any time on review activities, on average, the higher the grade, the less time spend reviewing the document (A grade 4 minutes 39 seconds; A- grade, 6 minutes 7 seconds; B+ grade 12 minutes; B grade, 11 minutes 43 seconds).

Edit: Editing activities included all changes made at the word level, such as checking spelling or grammar, using the thesaurus, modifying punctuation, or adding or deleting a word. 10.33% of the time for all students was spent editing the final drafts. Students in the B category spent no time editing. The B+ grade spent, on average, 1 minutes 24 seconds; the A- grade, 4 minutes 31 seconds; the A grade, 2 minutes 19 seconds.

Revise: The Revise category captured all changes made at the idea level. When a student rewrote or reorganized sections of the paper, it was categorized as a revision activity. Students who received an A, A-, or B on the final paper spent most of the time revising text. Students who received a B+ on the final paper spent slightly more time reviewing text (38.76%) than revising (35.27%). Students in the study spent the largest percentage of the time revising text (36.46%). On average, the A grade student spent 13 minutes 29 seconds revising; the A- student, 10 minutes 30 seconds; the B+ student, 10 minutes 55 seconds; and the B student, 14 minutes.

Table 11: Analysis of Keystrokes Sample

	Peer Review	Side Bar	Internet	Review	Edit	Revise	Total
A Grade	31:57	60:47	36:02	46:26	23:12	134:48	333:12
	9.59%	18.24%	10.81%	13.94%	6.96%	40.46%	100.00%
	3:12	6:47	3:36	4:39	2:19	13:29	34:02
A- Grade	154:08	37:39	66:45	165:39	121:46	283:29	829:26
	18.58%	4.54%	8.05%	19.97%	14.68%	34.18%	100.00%
	5:43	1:24	2:28	6:07	4:31	10:30	30:43
B+ Grade	17:47	5:43	39:30	107:59	9:22	98:17	278:38
	6.38%	2.05%	14.18%	38.76%	3.36%	35.27%	100.00%
	1:59	0:38	4:23	12:00	1:24	10:55	31:19
B Grade	0:0	0:0	1:15	22:25	0:0	28:13	52:53
	0.00%	0.00%	2.36%	44.28%	0.00%	53.36%	100.00%
	0:0	0:0	0:38	11:43	0:0	14:00	26:21
Total	13.64%	6.97%	9.61%	22.99%	10.33%	36.46%	100.0%

a - Time is noted in minutes and seconds (MM:SS). For example, 58:30 is 58 minutes and 30 seconds.
For each group, which was determined by the letter grade on the final paper, the total amount of time (row 1), the average amount of time (row 3), and the percentage of total time (row 2) on the computer was calculated for each of the six writing activities.
Yellow - less than 11% of the time on the activity.
Pink – between 11.0%and 21% of the time on the activity.
Blue - more than 21% of the time on the activity.

Writing Process Summary

Examining trends in the data for each writing process category by grade received and examining individual papers, showed some potential relationships between grades on the final paper and how students use the computer. Students who received A and A- grades spent more time providing peer feedback and less time reviewing their documents. In addition, A students spent more time on writing activities than all other students.

WORD PROCESSING

The writing sample provided the data to answer the question: What differed in the final draft for students with higher and lower levels of electronic writing proficiency? Each paper was examined for characteristics that indicated a student used a word processor instead of a typewriter.

Differences

The final drafts reflected the use of a word processor, primarily because students applied attributes to the title text—bold, italic, or underline—and increased the font size.[67] All printed papers were double-spaced or multiple spaced, although papers posted on the Internet were single spaced. All students followed the conventions outlined for the papers by their teacher. Except for the title, which was centered for most, but not all of the papers, text was left aligned. Margins for the printed papers ranged from the 1.25" default to 1". Student papers contained special characters, the Em-dash, and En-dash, and the accented Spanish letter á in Jorges Cortazár's name as well as page numbering in headers and footers. Student papers all reflected the same characteristics regardless of word processing skill level—*Exceed Standard*, *Standard Plus*, or *Meet Standard* or grade received on the final draft.

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[67] Not all students included a title, nor did they all change the font size or type or apply attributes. Likewise, not all students used special characters of page numbers.

Students who posted their pages on the Internet used hyperlinks to connect the different sections of their final project. They used color, graphics, and varying font styles and sizes to reflect the setting of *Great Expectations* or *Pride and Prejudice*. One student, who received an A grade, even added JavaScript to his pages that enabled scrollable text boxes to appear.

Based on data from the keystroke logs, students used built-in features of the word processor to write, although not all students used each function. Students who reported word processing skills as *Exceed Standard* used more word processing functions as they wrote than students who reported word processing skills as *Standard Plus*, but those who reported skills as Meets Standard used the greatest variety of word processing functions.

All groups used shortcut keys to save the document, to create a new document, to bold text, to paste text, to bring up the thesaurus dialog box, to print the document, and to close the document. All groups also sent e-mail, added hyperlinks, set the background color, reset options in Microsoft Word, and downloaded data from the Internet.

The *Meet Standard* and *Exceed Standard* groups also used a search engine on the Internet, imported and resized graphics, aligned and tabbed text, and accessed the spelling and grammar checker. The *Exceed Standard* and *Standard Plus* groups reset the zoom level. Only the *Standard Plus* group used the Find/Replace command and only the *Exceed Standard* group reformatted pictures.

Word Processing Summary

Students met the requirements of the assignment. Since the assignment posted on the Internet required more functions of a word processor be used, students in the web-based project class used more aspects of a word processor than students in either of the other two classes. However, there was no difference between the three groups in knowledge. Except for changing the font style and size in a title, few other aspects of the papers

indicated that they had been word processed instead of typed. All groups met the standard for word processing task knowledge and demonstrated use of those skills while they worked on their final drafts.

PATH ANALYSIS

Does the theorized data model represent a feasible explanation for the data? Path analysis, rather than structural equation modeling (SEM) using the chi-square statistic, was utilized for the data analysis because of the small sample size.[68] Path analysis, like SEM, helped to control for the source of systematic variation, and took into account intercorrelations among the variables as well as measurement error while looking at causal antecedents (Stevens, 1996; Mallinckrodt, 1996).

> The size of a β reflects not only the presumed effect of the variable with which it is associated but also the variances and the covariances of the variables in the model (including the dependent variable), as well as the variance of the variables not in the model and subsumed under the error term. (Pedhazur, 1997)

Betas are scale free, but population specific. Hence, they can be useful to determine relative importance compared to other variables in the group (Pedhazur, 1997). Path analysis does not discover the cause(s) of variation, but sheds light on the feasibility of the model as explanation for the variability. With path analysis, it is assumed that variables are measured on an interval scale, that there is a one-way causal flow, and that residuals are not correlated with variables that precede it in the model. Variables may be independent or dependent and may be related linearly, additively, or causally (Pedhazur, 1997).

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[68] Generally SEM using the chi square statistic is not reliable for sample sizes less than 100 (Mallinckrodt, 1996; Boomsma, 1987; Schumacker, 2001) and complete data were obtained on only 49 students in this study. Some authors suggest that a sample size less than 200 may be minimum to be adequate protection against bias (Curran et al., 2002; Kelloway, 1998). Tanaka (1987), on the other hand, has suggested that the sample size is related to the model size and that, perhaps, N = 50 may be acceptable for four measures and one latent variable, but inadequate for 20 measures and four latent variables.

A path coefficient, β[69] , the portion of the standard deviation of the final draft grade (the dependent variable) for which other variables are directly responsible (Allen, 1997), was calculated by using regression analysis with the Enter Method in SPSS and 47 degrees of freedom. The regression measured the extent of effect of perceptions and word processing skills on grade.

Path Analysis Model Summary

The calculated correlation coefficients, Grade to Perceptions (–0.203) and Grade to Word Processing (–0.119), show weak negative correlations. The higher the perceptions, the lower the grade. Likewise, the higher the word processing task knowledge, the lower the grade. Perceptions to Word Processing (correlation coefficients = –0.006) indicates that the variables are not correlated. The path coefficients of Grade on Perceptions (p_{32} = –0.204), Grade on Word Processing (p_{31} = –0.120), and Perceptions on Word Processing (p_{21} = –0.006), show no statistical significance as shown in Figure 10: Path Diagram with Path Coefficients.

[69] Path coefficients are also referred to as standardized coefficients or standardized regression coefficients (mean=0, variance=1). A path coefficient is defined as "the direct effect of a variable is its effect on a dependent variable, controlling for the effects of both causally prior and intervening variables" (Allen, 1997).

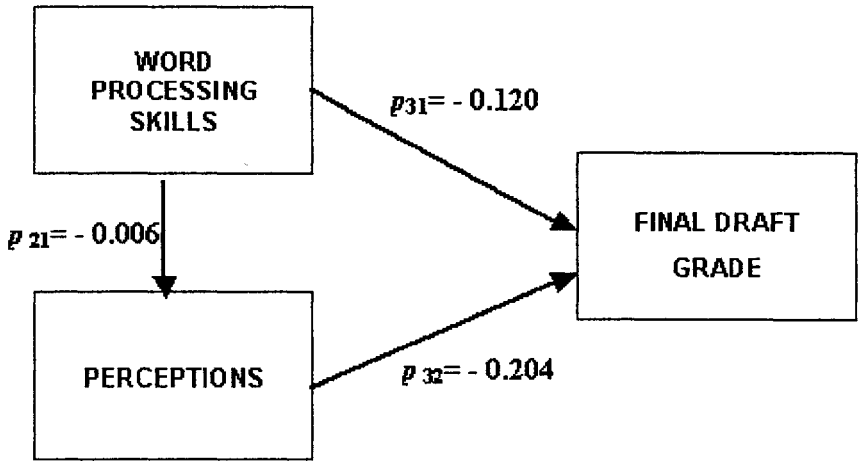

Figure 10: Path Diagram with Path Coefficients

Based on the regression analysis, only 5.6% of the variance in the final grades of the students could be associated with students' perceptions of using a word processor or their word processing skills (Table 12: Regression Analysis). Obviously, variables other than word processing skills and perceptions of using the word processor accounted for the differences in the final grades that students received.

Table 12: Regression Analysis

Correlations and Covariances

		Grade	Percept	WP
Pearson Correlation	**Grade**	1.000	–0.203	–0.119
	Percept	–0.203	1.000	–0.006
	WP	–0.119	–0.006	1.000
Sig. (2-tailed)	**Grade**	.	0.167	0.422
	Percept	0.167.		0.965
	WP	0.422	0.965.	
Sum of Squares & Cross-products	**Grade**	26.813	-3.625	-3.438
	Percept	-3.625	11.917	–0.125
	WP	-3.438	–0.125	31.313
Covariance	**Grade**	0.570	–0.077	–0.073
	Percept	–0.077	0.254	–0.003
	WP	–0.073	–0.003	0.666
N	**Grade**	48	48	48
	Percept	48	48	48
	WP	48	48	48

Coefficients

	Unstandardized Coefficients		**Standardized Coefficients**			**Correlations B**		
	B	**Std. Error**	**Beta**	**t**	**Sig.**	**Zero-order**	**Partial**	**Part**
(Constant)	3.626	0.447		8.120	0.000			
Percept	–0.305	0.217	–0.204	-1.405	0.167	–0.203	–0.205	–0.204
WP	–0.111	0.134	–0.120	–0.828	0.412	–0.119	–0.122	–0.120

Model Summary

				Change Statistics					**Durbin-Watson**
R	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	**R Square Change**	**F Change**	**df1**	**df2**	**Sig. F Change**	
0.236	0.056	0.014	0.750	0.056	1.323	2	45	0.277	2.301

An Alternative Model

The first model explained only 5.6% of the variance. Therefore, further investigation was required. An alternative explanation added two factors. The second path analysis applied a regression analysis using SPSS to the regression of the variable Grade on the variables Word Processing, Perceptions, Like to Write, and Like to Write with a Word Processor. SPSS calculated the path coefficients with 47 degrees of freedom.

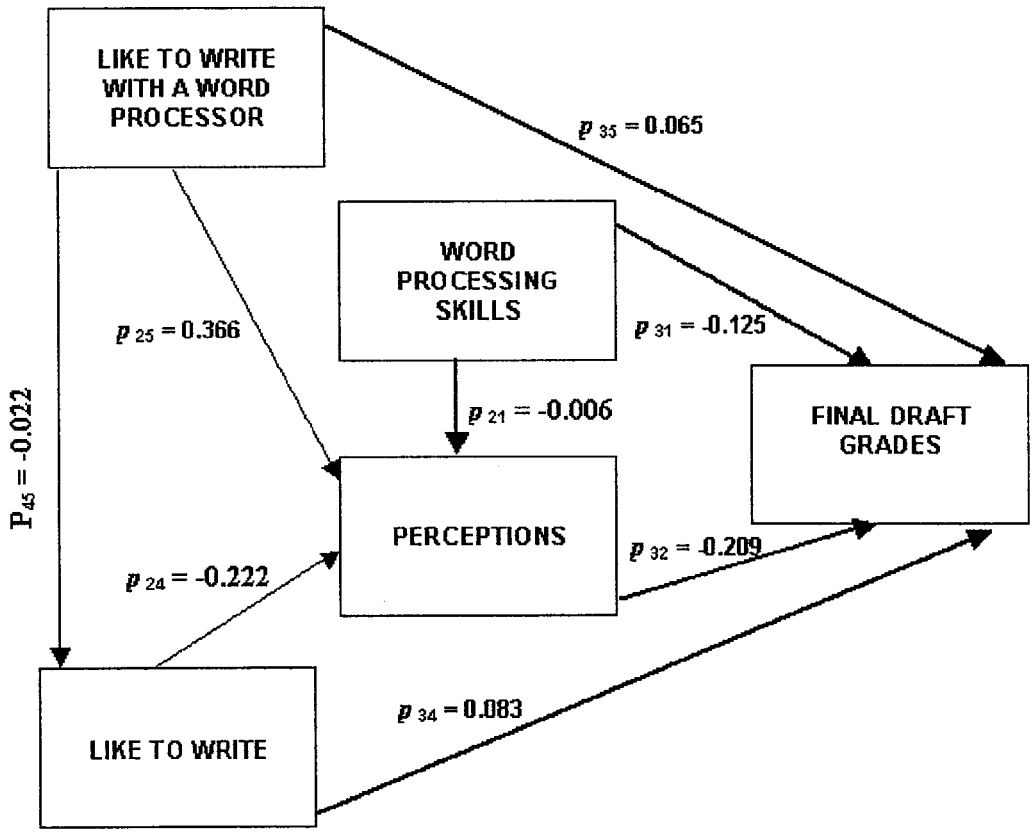

Figure 11: Path Diagram with Analysis of Five Variables

The five variables were all weakly correlated as shown in Figure 11: Path Diagram with Analysis of Five Variables. Table 13: Regression Analysis for Alternative Explanation shows the results of the regression analysis and the calculated path coefficients. The path coefficients show no statistical significance (Table 12: Regression Analysis).

Based on the analysis, only 6.6% of the variance in the final grades of the students could be associated with their perceptions of using a word processor, their word processing skills, their attitudes toward writing, or their attitudes toward writing with a word processor.

Table 13: Regression Analysis for Alternative Explanation

Correlations

		Grade	Percept	WP	Like to Write?	Like to Write with WP?
Pearson Correlation	**Grade**	1	–0.203	–0.119	0.133	–0.029
	Percept	–0.203	1	–0.006	–0.222	0.366
	WP	–0.119	–0.006	1	–0.041	0.124
	Like to Write?	0.133	–0.222	–0.041	1	–0.022
	Like Write with WP?	–0.029	0.366	0.124	–0.022	1
Sig. (1-tailed)	**Letter Grade** .		0.083	0.211	0.184	0.422
	Percept	0.083 .		0.483	0.065	0.005
	WP	0.211	0.483 .		0.391	0.201
	Like to Write?	0.184	0.065	0.391 .		0.441
	Like Write w/WP?	0.422	0.005	0.201	0.441 .	
	N (for all)	48	48	48	48	48

Coefficients

	Unstandardized Coefficients		Standardized Coefficients			Correlations		
	B	Std. Error	Beta	t	Sig.	Zero-order	Partial	Part
(Constant)	3.165	0.798		3.964	0			
Percept	–0.313	0.245	–0.209	-1.281	0.207	–0.203	–0.192	–0.189
WP Category	–0.115	0.138	–0.125	–0.836	0.408	–0.119	–0.127	–0.123
Like to Write?	7.89E-02	0.144	0.083	0.547	0.587	0.133	0.083	0.081
Like to Write with WP?	8.06E-02	0.2	0.065	0.404	0.688	–0.029	0.061	0.059

Model Summary

				Change Statistics					
R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df 1	df 2	Sig. F Change	Durbin-Watson
0.257	0.066	–0.021	0.763	0.066	0.763	4	43	0.555	2.27

Path Analysis Summary

Both models provided a poor fit for the data. Obviously, the model omitted key variables that accounted for the differences in the final products that students created. In addition, the narrow range of grades may have reduced the correlation coefficient between the variables and the validity of the analysis.

SUMMARY

All students had sufficient technical knowledge to create the final paper and meet teacher outlined expectations. All students had positive or mixed perceptions toward computers and saw some benefit to using them. The analysis of the data from surveys, interviews, class observations, and keystrokes captured did not show any significant differences between students who received varying marks on their final papers. The path analysis found little variance in the final grade attributable to word processing skills, perceptions of writing, liking to write, or liking to write with a word processor.

If the factors investigated did not account for the differences in the final grades students received, what did? Chapter V: Discussion and Implications discusses alternative explanations for the data. The chapter also discusses the technology problems that occurred in conducting this study, how the issues were solved, and implications for future research using technology. The chapter concludes with implications for the classroom and questions for further study.

CHAPTER V
IMPLICATIONS AND DISCUSSION

INTRODUCTION

Chapter V first summarizes the findings and examines possible explanations for the results from this study that asked:

> *How does the electronic writing proficiency (EWP) of university students in an introductory composition course that uses literature as a base affect student writing?*

A discussion on issues that occurred by using technology for research follows. A revision of the electronic writing proficiency construct is also presented. The chapter concludes with implications for the classroom and for using technology in research as well as questions for further study.

STUDENT RESULTS

The students in introductory writing classes that participated in this study met in a computer-writing lab at the University of Washington, and used technology for writing, writing discussions, and instruction. At the University of Washington, students self-selected their writing courses. The general topic for writing and the words, *computer integrated,* appeared on the course schedule. As reported by the teaching assistants, many students generally did not realize that they signed up for a computer-based writing class so students of varying interests and abilities appeared in the classes. Those who strongly felt that they did not want to use the computers in class often dropped the class. However, not all dropped as indicated by student responses to questions in the interviews.

For the Computer-Integrated Composition students in the study, none of the variables—

perceptions of writing, word processing skills, liking to write, or liking to write with a word processor—predicted the grade on the final draft.

Student Perceptions

How do student perceptions about their writing impact their writing? As with other studies (Zvacek, 1992; Kurland, 1996; Hawisher, 1989; Yelland, 1999), students in this study generally expressed positive perceptions about using computers. Many indicated that the computer helped in some ways, but not in all aspects of writing. On the other hand, all students in the study noted one or more ways that the word processor helped them write, but most also saw benefits to handwriting for part of the writing process.

The data did not support the hypothesis that a student with a higher level of electronic writing proficiency would perceive that a word processor was more valuable for composing an essay than a student with a lower level. No statistically significant difference in final grades emerged between the perceptions groups.

For students who had the highest perceptions of writing—those students who *Strongly Agreed* to the statement, *I like to write*—perceptions deteriorated when they used the computer. For all others, the technology improved their perceptions of writing. Also, on the Perceptions of Writing Response Survey, students commented that thinking about writing issues played a greater role in writing a paper than using features of the computer.

When writers revise and rewrite the text by hand, writers become more engaged with what they have said and focus on each word (Crafton, 1996; Daiute, 1986). When students write using a computer, they had less focus and coherence (National Assessment Governing Board, 2000). One student, who preferred to handwrite compositions, noted that students write exams and take notes by hand. For him, handwriting was natural and easy. He thought, perhaps, he was just more accustomed to writing by hand and thinking by using pencil and paper. He did not dislike using the

computer; it just seemed more natural to him to compose with paper and pencil (Student WW interview, March 2002). The computer did not yield much benefit for him, thus he preferred to handwrite essays.

Based on the research and student feedback, an explanation might be that those who liked writing by hand the most found that they could not engage with their writing in the same way when they used the word processor. For those who did not feel as much engagement with the text when writing by hand, who did not have clear handwriting, or required major revisions after their first draft, handwriting may have seemed more of a hindrance than a help. When the computer removed the burden of rewriting and students could read what they wrote, move the text around, and see the page on the screen, the computer aided their writing. Thus, for students who felt hindered by handwriting text, they liked writing more when they used the computer.

The Writing Process

What differs in the writing process for students with different levels of EWP? The data did not support the hypothesis that a student with a higher level of electronic writing proficiency would demonstrate the use of more word processing features during the writing process and produce a higher quality final draft than a student with a lower level.

Regardless of the grade on the paper or knowledge of word processing functions, students used word processing features to write, such as, quick keys to access a function[70] or uploading and downloading a copy of their paper from the Internet. How the technology was used appeared to be a personal preference. The study found no relationship between the word processing functions students utilized and final grade: Students used similar word processing features to write regardless of grade. In addition, the higher the perception score, the lower the grade received.

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[70] The function key F7 activates the spelling and grammar checker, for example.

Examination of student keystrokes for peer review, sidebar activities, Internet access, reviewing, editing, and revising text, based on the average amount of time for a student in each of the four grade groups, indicated some differences between groups.

The largest percentage of time was spent revising text for all groups except the B+ group. Reviewing text received the second largest percentage of time, however, this category was inflated for all groups because the software could not capture writing tasks that were performed without the use of a computer. If a student opened a document, did nothing on the computer, but rather worked with a paper copy of the document or interfaced with another student while the document was open, the time was allotted to review, even though the off-line activity may have fallen into another category had the software been able to capture it.

On average, students in the A and A- groups spend an average of 2 minutes 19 seconds and 4 minutes 31 seconds respectively on editing activities whereas on average, B+ students only spent 1 minute 24 seconds, and B students no time editing their documents. The fact that students who received an A or A- took more time to provide peer feedback to others perhaps indicated that they understood how to critique a paper or were willing to share that information with their classmates. Most importantly, students with higher grades spent more time on writing activities than students who received lower grades.

Word processing tasks. Word processing skills and perceptions of using a word processor accounted for only 5.6% of the variance in the final grade. Based on the interviews and comments on the Perceptions of Writing Response Survey, personal preferences for how to use a word processor appeared to play a greater role in how the word processor was used than either word processing skills or perceptions of using a computer.

Students had sufficient skills to use the technology as demonstrated by their use of the Internet, the word processor, and the LAN in class. Students used a new feature of the word processor with only a one to two minute demonstration[71] and no one asked questions about how to use a feature or asked for further information. Even when a teacher introduced a new function,[72] students watched the demonstration and then used the operation without asking for further help. In class, when students worked on the computers, no one asked for assistance with a hardware or software problem. No one asked questions about the technology, except how to use a new feature of Netscape Composer for a web page or where to find another student's document that was not posted in the correct spot. None of the students struggled with the technology.

Students demonstrated that they knew how to use a word processor to create a standard essay. All students keyboarded with sufficient speed that using the computer did not interfere with the writing process.[73] The features of the word processor that students used to write—such as spell check, the thesaurus, and moving text within a document—did not differ for students in the study, regardless of the grade received or the number of word processing functions that they knew.

Tasks that more than one student did not know how to perform were not required in writing the final essay. For example, the Find and Replace function may have made changing the text faster, but students could achieve the same result by carefully reading their documents, deleting the original text, and entering the new. Likewise, using the

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[71] Showing students once how to perform a function with the software provided sufficient understanding that they could use it without asking further questions. Technology functions did not need to be reviewed many times.

[72] For example, when the teaching assistant introduced the comment function to students, they watched the two minute demonstration and then used the function to complete the peer review exercise. None asked for help or for additional clarification with the function. Using the function for the peer review exercise provided sufficient practice for the students. No further demonstration or review was conducted.

[73] Previous research indicated that slow keyboarding or transcription problems (Hartley, 1993; Kellogg, 1993) could impact the final draft.

Copy Format function may have made the final formatting of the text easier or faster, but formatting could also be done manually to achieve consistency and to produce a document that met the formatting requirements of the course. Students could also indent paragraphs or create number lists manually, without using the automatic features of the word processor. Similarly, students could also avoid adding symbols in their text, if they desired. Even though students did not know how to apply some functions of the word processor, all knew how to perform the word processing functions critical to the creation of their final papers, as indicated by the survey results.[74]

Student perceptions of what they knew did not always match what they used. Two students in the web-based project class said that they did not know how to insert a graphic, yet used a picture in their documents. Likewise, six students said that they did not know how to add a hyperlink, yet hyperlinked their pages together for the project. Either students did not do the work themselves on their papers, which contradicts observations by the researcher and teacher, or, more likely, these students underestimated their word processing knowledge. Furthermore, students may have underestimated their knowledge because they did not understand the terminology in the survey. The assignment called for creating *links* between pages, not *hyperlinks*. Students may not have understood that the two terms referred to the same function.

The data supported the hypothesis that writing ability would play a more determinate role in the quality of the final draft than word processing skills: A student's word processing skills and their perceptions about how using a word processor impacts their writing only need to reach a certain level for a student to have high electronic writing proficiency.

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[74] During the monitored class session, no student used the Find and Replace function or the Copy Format function, created lists, added symbols, or adjusted the indentation of paragraphs.

The Final Draft

What differs in the final draft for students with different levels of EWP? All students met the requirements of the assignment and followed conventions outlined by their teachers. Students who submitted a paper copy of the final project used a limited number of word processing functions, primarily to check spelling and grammar or to access the thesaurus. Printed papers were double-spaced or multiple-spaced between lines of text. Page numbers appeared in headers and footers on some documents. Only titles included features beyond the conventional font and standard spacing of the text. Titles appeared in a different font style and size from the rest of the text and were centered at the top of the page, for some, but not all of the papers.

Students in the first pilot study said that they kept to the conventions because that was the expectation, even though the teacher had not verbalized such instruction. Students who submitted printed copies appeared to be limited by the same unspoken conventions and not take chances on the use of graphs, tables, pictures, or numbering. Students in the pilot studies exhibited the same behavior.

Students who submitted web pages utilized graphics, color, hyperlinks, and textual style elements in their documents as they wrote. Publishing the final papers on the web appeared to free students from following the conventions of a printed essay, yet the students all followed the wide guidelines given to them for the assignment.

All students in the three classes wrote a thesis statement, presented details to substantiate the thesis, organized the draft into a coherent and cohesive paper, and provided a concluding paragraph. Furthermore, all students followed standard paragraph spacing, alignment options, font attributes, and page numbering, regardless of the grade on the final paper. The presentation differed, not by the grade received, perceptions of using the computer, or word processing task knowledge, but by the requirements of the assignment.

Data Model

The data model and alternative data model explained little regarding the causality of grades on the final project. Neither model explained more than seven percent of the variance. Additional factors needed to be added to the model. The next section on instruction suggests that a pedagogical variable be included.

Summary

Scores from measures of word processing task knowledge, perceptions of using a word processor, and the writing process using a computer were not predictive of the final grades that students received. Students met the requirements of the assignment. Requirements appeared to influence final draft content and presentation. Writing instruction, as reflected by student behavior and captured with WinWhatWhere Investigator®, provided another factor to help explain the results.

INSTRUCTION

Computer-Integrated Composition (CIC) program teachers purposefully integrate instruction on the technology with writing instruction to improve student writing.

> The CIC program is designed to produce computer-integrated instruction in which the computer use becomes a natural part of the reading, writing, and critical thinking processes...[I]t's a way of easing students into the idea of writing-as-process by freeing them from the demand for strictly product-oriented prose. (George et al., 2001)

The teachers in the CIC program who participated in the study demonstrated how to integrate instruction using the computer as part of the writing process. Interviews and observations suggested that instruction in using the technology to learn how to write contributed to differences in the writing process that students demonstrated.

Teachers and students found technology useful for classroom discussion and peer feedback. The following general discussion summarizes points made by the teachers and students in interviews conducted.

The teachers thought that by discussing writing anonymously using the bulletin board, students who may not speak in class would contribute on the forum; students would take a chance and feel comfortable with their writing. Both teachers claimed that students interacted more in class, tried harder, gave more specific comments on peer papers, and learned more quickly when they used technology. Students felt that comments by fellow students improved their papers. They could see more quickly what was expected, what was acceptable, and how to accomplish it (Student VV, Student FF, and Student CC interviews, March 2002). The computers influenced what students did and how they did it; the technology made it easier for students to make changes and to feel comfortable with their writing. Although the teachers agreed that the writing process was better for students in the CIC courses, the view of the quality of papers submitted from CIC classes differed for each instructor. One thought that the papers and portfolios were better, but the other teacher thought that there did not seem to be a great improvement in the papers from the CIC classes over the papers submitted in traditional classes (Teacher interviews, March 2002).

Writing instruction utilizing technology also influenced what students did. A common technique one teaching assistant employed was to have students discuss their argument online, print out the discussion, and write their paper from the printout. She stressed that they could use the same voice that they had used online. She found that students were surprised at the way they could develop their own voice. She often heard comments such as, "I can write like that? I can say that in a paper?" By taking the online notes as a starting point, students quickly realized that they could have an academic argument in their own voice.

Teachers provided consultation,[75] direction,[76] and suggestions. Teachers gave students specific instructions regarding exercises, assignments, and rubrics. Teachers began by helping students narrow a topic. Next, the teachers gave students sufficient background material through the readings so that students could develop a thesis and support that thesis with facts. Teachers also suggested other places, such as sites on the Internet, where students could obtain additional resources. Lastly, teachers provided feedback to students and required students to comment on papers of their peers.

Another way teachers utilized the technology to reinforce writing instruction was to require peer reviews. Students used CommonSpace and BABEL, but also provided classmates' feedback by using the Comment function in Word. Students would open a classmates' document, read the essay looking for items the teacher had specified. In one class, the teacher asked students to concentrate on sentence level changes in papers that they had exchanged—to focus on grammar, content, and active verbs at the sentence level. The teacher requested students not only to find text to improve, but to suggest an alternative. Later students would edit their papers based on the peer feedback.

Students responded by rewriting sentences with passive verbs and by making suggestions to avoid over-use of a word, but also commented on the papers from a global perspective. Student suggestions to their classmates included the following:

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[75] Students could seek advice and help during their office hours and by e-mail. For example, the teaching assistants conferred with students during office hours. One student needed help in the organization of his paper. The TA suggested various ways to organize the draft other than chronologically—organize by theme or by character, weave in your main points and provide details on the relationship between each major organizational point.

[76] Students in the web-based project class often worked often in groups of three so that the teacher could walk around to each group to verify that they knew how to do each piece of the technology. Since Netscape Composer was new for most of the students, she needed to go through each option to show them how to use it. Each day she presented one piece of the technology and related it to the paper that they were developing. Students followed with their own site. By the end of the two week period, all students knew the functions necessary to create their own final paper for the Web.

- Using a metaphor to explain an example.
- Adding more evidence to support the thesis, noting where it was weak or where a closer reading of the text may lead to a different conclusion. "I think that it would be a stronger argument if you go in depth a bit more like saying how these hidden meanings shape or effect the whole meaning of the story." (Student AA peer comment, March 2002)
- Refining the claim based on one or two points taken from the readings and making the thesis more focused and clearer.
- Pointing out unclear paragraphs or examples. "This is unclear for this example. Instead [of the example cited], find something from the text." (Student KK peer comment, March 2002)
- Reorganizing the paper for better clarity.
- Writing with a stronger voice.
- Questioning a point and the logic used in making the argument to support the thesis.

In addition to suggesting improvements to the papers, students also gave one another positive reinforcement about work they considered well-done. "Great!!!! Awesome comment by Cortazár himself. Good touch" (Student BB peer comment, March 2002). The comments and suggestions about global issues demonstrated the depth of instruction students received over the quarter and that, not only did students read globally, but understood what should be changed to improve an essay.

Instruction was key. These examples reflected what students learned in class. Feedback not only focused on word and sentence level changes, but global and content ideas. Previous research suggests that students made changes at a surface level, not a meaning

level when they used the technology (Womble, 1985; Hawisher, 1987; Daiute, 1986), but the students in the study worked on meaning related revision, not just editing words and correcting mechanical errors. For all, even those with the lowest grades, most of the time was spent revising text, not just editing at a surface level.

Students in the web-based project class were required to annotate the text to support their argument as well as to summarize details from the text to support the thesis. Therefore, students required to post the final assignment on the Internet, used footnotes to annotate the text. Students in the other two classes provided details from the readings as substantiating evidence; the web-based project class took the supporting evidence one step farther. One student used pop-up boxes to annotate the text, making footnotes available by hovering the cursor over the text. The reader did not need to scroll to the bottom of the page. In the example in Figure 12: Annotation Example, the student explains how the text develops the theme of Personal Chains: The student developed the final paper on Dickens' use of chains throughout the story.

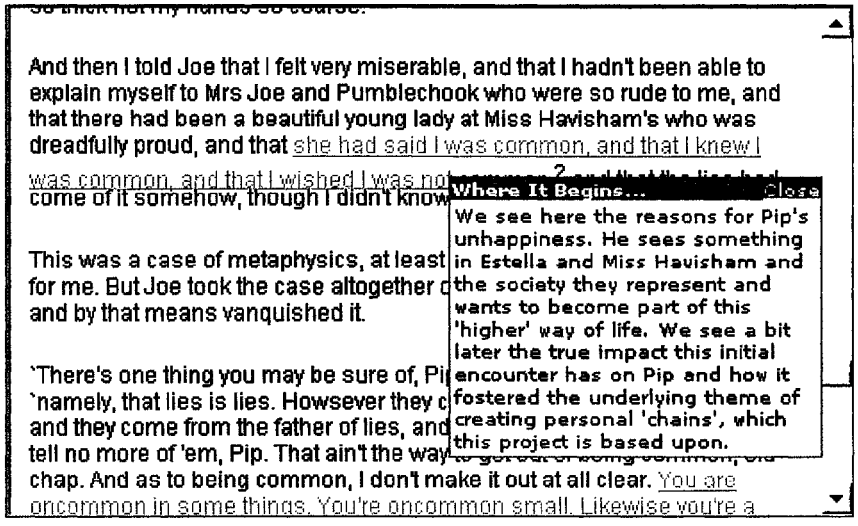

Figure 12: Annotation Example

Unlike the other two classes, the web-based project class added pictures and graphics to illustrate points on their hyperlinked web pages. Images, text characteristics, and color interplayed with the text to convey meaning. Figure 13: Sample Illustration of the Use

of Color, Font Style, and Graphics illustrates one use of font style, color, and pictures to support the theme, Beauty and Fashion in *Pride and Prejudice*. The fabric background, in a similar color to the dress of women in the picture set the tone for the text. Also, the font style chosen, Monotype Corsiva, gave a formal tone to the page, one that depicted Victorian England, the setting of the novel.

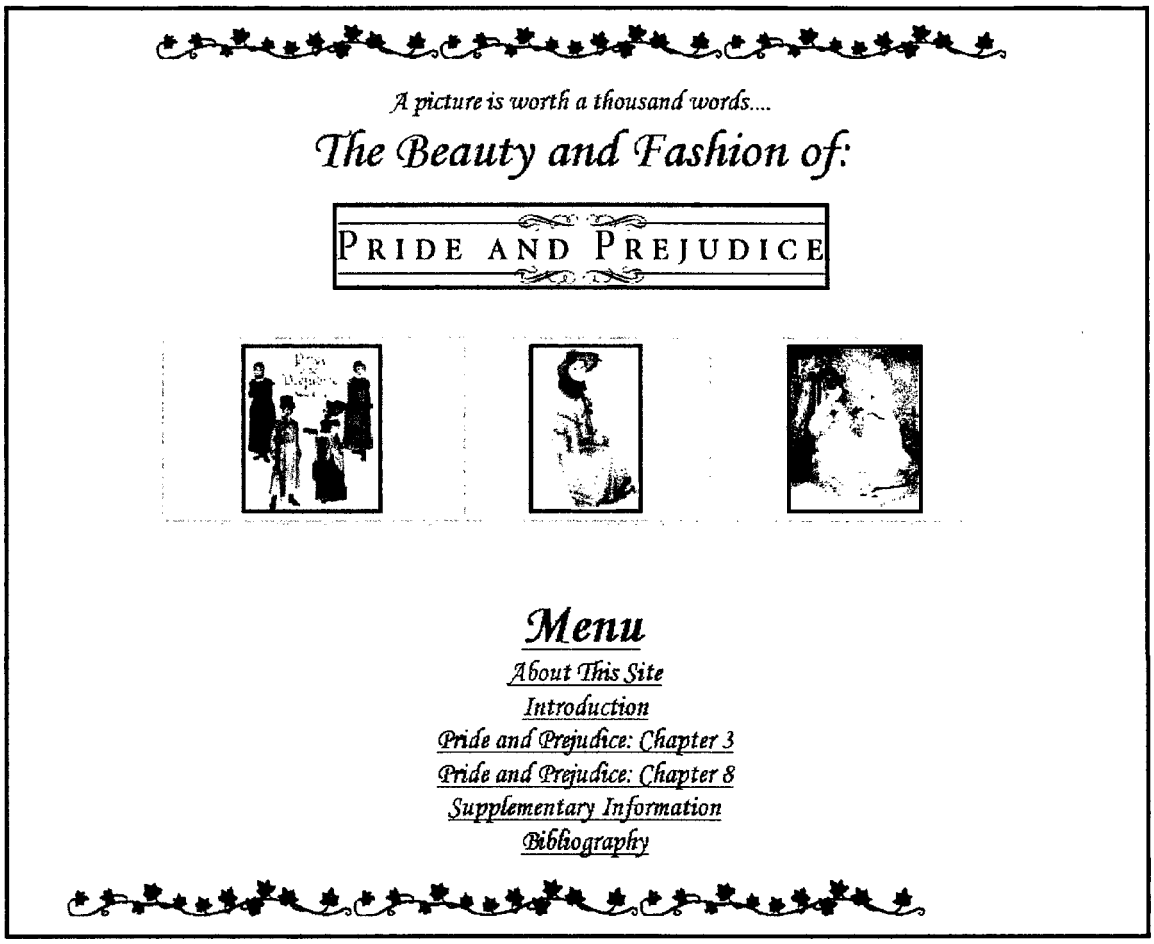

Figure 13: Sample Illustration of the Use of Color, Font Style, and Graphics

How technology was used made a difference. In this research study, the technology supported the pedagogy. Students followed directions, examples, and suggestions given in class. The way students used the computers and the final papers submitted reflected instruction received. Teachers required students to think about writing, to discuss writing using software on the LAN, observe good writing that was posted online, and

suggest improvements to papers. Teachers provided Internet sites for resources on Standard English usage and conventions, to share ideas, and to provide supporting evidence for arguments.

In this study, neither perceptions of using a word processor nor word processing skills needed to be outstanding for students to demonstrate high achievement. Part of the high achievement level was attributed to just having good students,[77] but writing instruction cannot be discounted.

Instruction Summary

Teachers taught a skill as it was needed for the pedagogy. Word processing skills did not need to be high, just high enough that students could learn additional skills as needed with a brief demonstration. Pedagogically determined skill sets resulted in high achievement. Students said that they learned about writing in the classes, but no one mentioned learning more about the computer. The technology supported the pedagogy for the teachers in this study. However, using the technology for research caused other issues to surface.

TECHNOLOGY ISSUES

This study was designed to use technology to capture the writing process with the goal to capture the process as thoroughly as possible within one class period, to minimally impact to the writing class, and to keep the writing situation as authentic as possible. The potential to gather detailed data increased by using automated means, but the utilization of technology also opened possibilities for additional problems such as hardware or software failure.

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[77] Good students get admitted to the university, which was ensured by the selection process, and good students generally do well in class.

Background

A number of issues arose with the technology even with the systems that exist at the University of Washington. Professors and students used the advanced technology systems at the University for research and for instruction. Technology and technological support existed to set up surveys, which could be coded for anonymity, and the researcher could receive the information in several ways. Within the labs on campus, local area networks (LANs) were set up for class use and could be configured with private areas for individual classes with discussions by sections. Both the LANs and the automated surveys had been used for several years. Even with these systems that had been tested, problems developed in using technology to collect data.

Surveys

The Perceptions of Writing Response and Word Processing Tasks surveys were developed using WebQ, one of the Catalyst Tools.[78] WebQ helps develop online surveys and questionnaires. WebQ, which runs on the university computers, was accessed by typing in an URL address in an Internet browser window. Even though the technology was available, when all students in a class attempted to access the site concurrently, most received a message that the site was not available. The WebQ technology did not function properly for this study and thus it was necessary to abandon the technology.

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[78] The Catalyst tools are a set of web-based tools that help instructors enhance student learning through collaboration and communication over a LAN or the Internet. The Catalyst tools were developed by the Center for Teaching, Learning, and Technology at the University of Washington to facilitate using technology in teaching. The group developed an "integrated collection of resources, training, tools, templates, and support to help educators make effective use of technology in teaching" (Educational Technology Development Group, 2000).

Keystroke Capture Software

WinWhatWhere Investigator® software issues required testing and resolution of the issues that occurred. After the initial installation of WinWhatWhere, the software was erased on all the computers: E-mail did not always send the captured data, some of the e-mail file attachments contained no data, WinWhatWhere did not automatically start for each class, and the format of the WinWhatWhere data required translation. Each issue required investigation.

WinWhatWhere Investigator® erased. After the first installation and pilot test, normal quarterly maintenance of the computers erased WinWhatWhere. Therefore, the software needed to be reinstalled on each machine rather than propagated using an image copy from one computer, the normal maintenance procedure, since students had begun storing files for the quarter on the computers. After the installation, each computer required separate testing to ensure that WinWhatWhere Investigator® recorded keystrokes for the software packages used in the writing classes.

E-mail not working. After testing for recorded keystrokes, a second test of the software verified that WinWhatWhere sent e-mail on every computer in the writing lab. For three computers, the researcher received no e-mail from the initial test. The configuration of WinWhatWhere, including the required password to send e-mail, was verified. Further testing of the software on each computer verified that e-mail with an attachment arrived for each computer.

In addition, since WinWhatWhere Investigator® sent messages every 10 minutes on each computer[79] Microsoft Outlook, which was used as the e-mail communication software, needed to be kept running to download messages as they were received. Otherwise, the number of messages on the University mail server would exceed the limit for the student researcher.

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[79] File attachments were empty if WinWhatWhere Investigator® did not record keystrokes.

E-mail attachments empty. Not all students had keystroke data e-mailed to the researcher; however, all computers sent keystroke messages with attachments. Previous tests on each computer ensured that WinWhatWhere Investigator® captured keystrokes. Class observations noted that students talked about writing, read what other wrote, and used the computers. As a precaution, after the first class, the researcher rechecked each machine to verify that file attachments with valid data were being sent, if Word, Netscape Composer, or Bulletin Board were being used.

Several causes may explain the lack of keystrokes for each student. First, the software may have failed, although testing before and after the study contradicts this explanation. The software being used by the student may not be one that was being monitored, although all the packages used specifically for writing in the class were being monitored. Students may have spent time reviewing a printout of the text rather than making changes online or students may have talked about their writing in small groups rather than make changes online. One student submitted the paper at the beginning of the class period. Others may have also completed the assignment prior to class. Not all students used the classroom time for writing on the final draft. Some preferred to write without interruptions outside of class in a quiet place rather than where others could disturb them (Student NN Interview, March 2002).

Program did not always start. When a user logged out of the computer, all programs, except Windows, ended. Since Windows did not restart, WinWhatWhere Investigator® did not restart: WinWhatWhere was configured to start with Windows. Because the University did not want the computers to restart continually, students logged in at the start of class and out before they left. Consequently, once the software was running, it worked correctly for the first class, but not for other classes during the day. For later classes, the researcher needed to walk around the room and manually restart the WinWhatWhere program.

Translations of the notation. Keys such as <32> (a space) had to be translated. Function keys, arrow keys, page up, page down, delete, space, backspace, and other special keys had a unique code that appeared in the file (Figure 14: Keystrokes Captured from WinWhatWhere Investigator®). The keys showed how a student edited their work as they composed.

Formatted	Raw
.the idea of the human race being altered by destin, altered by destiny. and inevitably doomed to come to a tragic end '	.the<<32>>if<<8>>dea<<32>>of<<32>>the<<32>>human<<32>>race<<32>>by<<8>>eing<<32>>alteredj<<8>><<32>>by<<32>>destinal<<8>><<8>><<8>>ny<<8>>,<<32>>altered<<32>>by<<32>>destiny,<<32>>and<<32>>inevei<<8>><<8>><<8>>itably<<32>>doomed<<32>>to<<32>>come<<32>>to<<32>>a<<32>>tragic end<<32>>2nd try<<32>>2ns<<32>><<8>><<8>>d<<32>>try<<32>>background color and dullness,,
2nd try	<<32>>2ns<<32>><<8>><<8>>d<<32>>try
background color and dullness,,	background<<32>>coloe<<8>>r<<32>>and<<32>>dullness<<32>><<8>>,<<46>>,<<8>>,

Figure 14: Keystrokes Captured from WinWhatWhere Investigator®

Personal preference issue. Students did not want to be required to write on the computers in class, on-demand. They wanted to choose where and how to write, by hand or on the computer. Where and when to write were personal preferences.

Attempting to capture the entire writing process when it was done in multiple locations and with a mix of electronic and handwritten text was problematic and the reality of how students wrote. The best that can be done in research examining non-manipulated

assignments is to assume that writing completed in class reflects writing done outside of class.

Online Surveys

The first class received a floppy with links to the surveys and was asked to complete the surveys online. With an entire class attempting to access the same web site simultaneously, not all could get access. This caused excessive time to complete the survey, thus, the online forms were abandoned for the other classes. With all data being collected in one session, keeping the time required to complete the surveys short helped keep students focused on their writing and not on the research being conducted. Also, clicking on the hyperlinks from the Word document on the floppy disk did not work. Students needed to copy and paste the link into a web browser to access the site, adding one more step, which caused more time.

Using online forms may be advanced, but it took too much time, and, even with the capabilities of the University, could not be done with all students in a classroom accessing the same site concurrently.

Voice Recognition Software

Voice recognition software, intended to be used for student and teacher interviews, was abandoned. The software required about 10 minutes of listening to a reader's voice before the software could understand what was said. Also, there needed to be minimal background noise or the software would continue to ask for verification data, which required rereading a passage of text, an additional five minutes. With time constraints of the research participants, the requirement of the software to individualize for each person, and the location of interviews, interviews were not done using the software.

Hardware

Computer errors. As the keystroke capture program indicated, at times, the computers would hang and software would not always work as it should. Errors occurred in the word processing applications. In spite of this, no one asked for help with a computer hardware or software process or complained about lack of knowledge to solve hardware or software issues. Students worked through any errors that occurred, generally by closing and restarting the application. Observations and interviews did not indicate that errors had occurred, but the keystroke capture program recorded problems and the solutions that students took to correct them. From the keystroke logs, it could be concluded that students had sufficient experience with computers and the error messages provided sufficient information that students could remedy the situation and return to writing. The computer problems did not cause a major disruption of writing. Although, some of the students who voiced dislike of writing with technology noted that software issues were troublesome to them; the problems did not cause students to stop work on the compositions, nor to ask for help.

IMPLICATIONS

The instructional model used by Computer-Integrated Composition teachers resulted in high achievement, reinforcing the teaching practices employed. On the other hand, results from the study imply a change to the Electronic Writing Proficiency model. Also, issues with using technology for research lead to implications for further studies using technology as a research tool.

Implications for the EWP Theoretical Model

Based on this study, the model requires revision. Findings confirmed the hypothesis that word processing skills and perceptions needed to be at a minimum level for students to have a high EWP.

Word processing skills and perceptions appeared to be important to the degree that they did not interfere with writing. Word processing skills are transcription skills. Like handwriting transcription skills in the developmental writer, the skills need to be automatic to the degree that they do not cause additional cognitive load or they will cause a decrease in the quality of the final draft (Bourdin & Fayol, 1994). Basic word processing skills required to write, edit, and revise an essay include knowing how to open, close, and save a document; enter, delete, and modify text; set font size and style; and set paragraph line spacing, indentation, and alignment. Students met these minimal requirements. Likewise, all students possessed the ability to keyboard. The basic skills needed, based on the results of the study, imply that having those skills are sufficient to be considered highly proficient for electronic writing with regard to word processing task knowledge.

The students in the study saw some benefit of writing on the computer, primarily with ease of use factors. Students said that the computer was a tool to support writing, but that they still have to think and develop content. There was no difference between students with mixed perceptions and high perceptions of using the computer for writing.

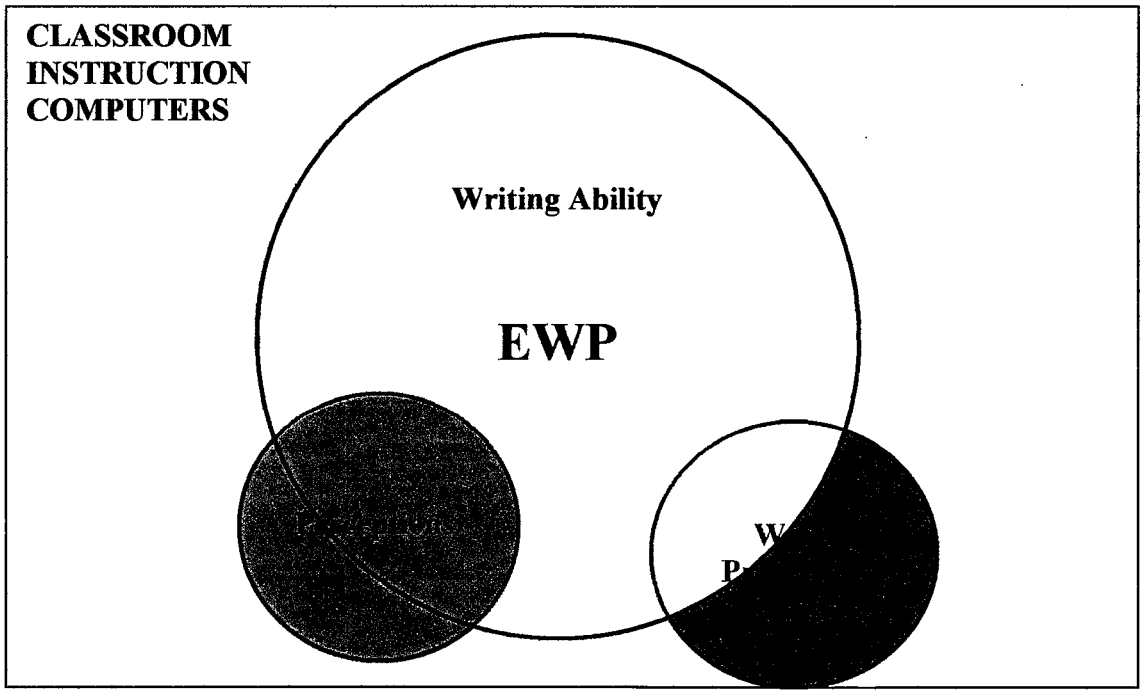

Figure 15: Revised Electronic Writing Proficiency (EWP) Theoretical Figure

Revising the definition of high electronic writing proficiency with regard to perceptions, all students in the study would qualify as highly proficient because they recognized some benefit to using a word processor. In addition, all were proficient, but not outstanding writers. Students only needed the skills required for the course or the ability to learn the skills quickly and not a strong negative attitude toward using computers for writing. As shown in Figure 15: Revised Electronic Writing Proficiency (EWP) Theoretical Figure, writing ability dominates the revised model. Word processing skills became less of a factor with only a few skills needed for high EWP. Likewise, perceptions became less of a factor with only negative perceptions not being included in the circle, EWP. The level of word processing skills and perceptions needed to create a well-written paper using the computer was lower than expected prior to the study. Also, students only needed to perceive some benefit of the technology for their personal way of writing and use that aspect when they composed with the word processor.

By the time students reached the university, they had acquired enough computer skills, knowledge of writing, and some positive perceptions to see how technology could help them write.

Implications for the Classroom

Teachers needed to teach the technology as well as writing. However, as demonstrated by the teachers in this study, teaching the technology did not require giving up time to teach writing; it was part of the demonstration on how to do a writing exercise. By using technology, students saw what others did well, made suggestions for others to improve papers, revised their own papers based on feedback from teachers and classmates, and discussed writing online. Students felt that they learned about writing from taking the course and that the technology helped to a point. In these classes, the technology supported the pedagogy; the technology did not drive the pedagogy.

IMPLICATIONS FOR RESEARCH USING TECHNOLOGY

Technology added a layer of problems in conducting the research. Testing the hardware and software were done prior to beginning the study; a pilot study was conducted using the exact technology, but these factors did not eliminate all problems that occurred during the study.

Technology must be used to evaluate the use of technology, a recursive action. Technical systems for data collection and the technology students use, institutional policies, or security concerns may conflict. A large amount of data could be collected and stored if a longitudinal study addressed all the components of the writing process. Thus, storage capacity and mechanical analysis methods would need to be addressed for an in-depth look at writing with computers.

In addition, technology could be a diverting factor for the researcher. At times, the technology could distract the researcher from concentrating on gathering data and

getting the information desired. In this study, older technologies, including paper and pencil, worked better for collecting some data than more sophisticated methods, even with the technology available at the high-tech university. Only by being flexible with the use of the technology, could the researcher maintain focus on the purpose of the research. At times, the hardware and software did not work as predicted or as tested and an adjustment had to be made during data collection to accomplish the goal.

Before technology is used, factors should be considered including time constraints, ease of use, and reliability. Does the technology speed up the process or does it take longer? Is the technology easy to use? Technology, at times, may not be reliable. Is there a backup? How easy is it to adapt to implement a backup plan? What alternatives are available? Evaluation of the answers to these questions will help determine the proper use of technology in research.

LIMITATIONS

As with any research, this study, which examined how electronic writing proficiency impacts writing, will have limitations. This study was limited to university students writing from a literature base. This study did not examine various genres of writing, nor did it address students outside of the university setting.

The current study also looked at one segment of the writing process taken from one class session. Since the assignment covered two weeks, the entire process and evolution of a document could not be tracked. The one-time look at the process may not reflect the entire writing process for all students. The technological means available could not capture the entire writing process for the assignment. Controls to capture an entire writing process, which is chaotic and complex, would create an abnormal writing situation. Discussions with friends and classmates to get feedback in and out of class, to write anywhere either by hand or on the computer, to think, and to look online for ideas and supporting evidence were all part of the recursive process and impossible to capture

in their entirety. For students, writing was personal; where to write (at home or in the computer lab), the amount of feedback requested and desired, to use the computer for all tasks or to use paper and pencil, or the amount of time required to write differed between students. No two processes were exactly alike and no two students used the same equipment in the same way.

All the students in the study could be considered good students which allowed little variance between them. There was no real measure of writing ability prior to the study, which may have accounted for some of the variance in the final grades, however, the final grades themselves varied little.

CONCLUSION

This study analyzed the data gathered from three composition classes to address the question, *How does the electronic writing proficiency (EWP) of university students in an introductory composition course that uses literature as a base affect student writing?* Writing instruction, using technology to support the pedagogy produced high results regardless of word processing task knowledge or perceptions of using the computer for writing. In addition, however, students who received higher grades used the technology differently than those who received lower grades. Further research is warranted in two areas: first, in authentic classroom situations, addressing how teachers can utilize technology to improve student learning and improve writing instruction and second, in examining the writing process when students use technology.

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APPENDIX A

INSTRUMENTS

WORD PROCESSING TASKS SURVEY

Check if you know how to do the following:

	I can do this.	This is new.
1. Open, close, and save a document		
2. Right align, left align and center text		
3. Change the margins to 1" on the right and left.		
4. Add bold or italic to text.		
5. Change the font size to 72.		
6. Apply a new font style.		
7. Indent the first line of each paragraph 1/2".		
8. Reorder paragraphs.		
9. Apply numbering or bullets.		
10. Insert a graphic.		
11. Find all occurrences of a word, such as "January" and replace them with another word, such as "February".	keys	
12. Insert special symbols, such as an em dash, "—".		
13. Add a bookmark.		
14. Add a cross reference.		
15. Insert a hyperlink.		
16. Check spelling and grammar.		
17. Use the thesaurus.		
18. Change the line spacing of the document from single to double.		
19. Use print preview.		
20. Copy formatting from one paragraph to another.		

PERCEPTIONS OF WRITING RESPONSE SURVEY

Choose the answer that most closely fits.

1. On the computer, I type my ideas quickly and expand upon them later. The computer helps me capture content for my paper.

Strongly Agree *Agree* *Disagree* *Strongly Disagree*

2. The computer helps me turn in a paper with correct spelling, grammar, capitalization, and punctuation.

Strongly Agree *Agree* *Disagree* *Strongly Disagree*

3. My text is neater so I can reread what I wrote.

Strongly Agree *Agree* *Disagree* *Strongly Disagree*

4. It takes me longer to write on a computer than to handwrite an assignment.

Strongly Agree *Agree* *Disagree* *Strongly Disagree*

5. I edit and revise my paper more quickly and with less effort when I use a computer.

Strongly Agree *Agree* *Disagree* *Strongly Disagree*

6. The computer helps me organize my paper. My paper flows better.

Strongly Agree *Agree* *Disagree* *Strongly Disagree*

7. I can express my ideas better when I use a computer to write than when I handwrite a document. My writing is more expressive.

Strongly Agree *Agree* *Disagree* *Strongly Disagree*

8. I like to write.

Strongly Agree *Agree* *Disagree* *Strongly Disagree*

9. I like to use a computer to write.

Strongly Agree *Agree* *Disagree* *Strongly Disagree*

10. My mind is clearer and more organized when I use a computer. The computer helps me concentrate on the content of my paper.

Strongly Agree *Agree* *Disagree* *Strongly Disagree*

11. Before I turn in my final draft, I reformat my paper, if necessary—adjust margins, double space text, change font sizes and styles, align text, set pagination.

Strongly Agree *Agree* *Disagree* *Strongly Disagree*

12. To find just the right word to use to communicate my message, I use the built-in thesaurus.

Strongly Agree *Agree* *Disagree* *Strongly Disagree*

13. I need to print a copy of my paper to edit it.

Strongly Agree *Agree* *Disagree* *Strongly Disagree*

14. I include more details in a paper when I use a computer.

Strongly Agree *Agree* *Disagree* *Strongly Disagree*

15. Are there any comments you would like to make regarding how a computer helps you to write?

KEYSTROKE CAPTURE SOFTWARE

WinWhatWhere Investigator®[80] captured student keystrokes as they used the computers in the CIC writing classroom. The software logged each keystroke and then automatically sent the collected data to the researcher's e-mail box.

Installation

At the beginning of each quarter, the LAN manager "cleaned" the computer by creating an image on one computer and using software to ghost that image to the others. All the machines begin with exactly the same configuration of hardware and software. A master copy of WinWhatWhere Investigator® was installed on one computer and ghosted to all others in the writing lab at the start of the research study. When the ghosted image did not include WinWhatWhere at the start of the second quarter of research, the software required individual installation on each computer.

The computers, named BA, BB, BC, ..., BX, sent log file data by computer name. Each student was linked to the computer name where they sat during data collection, for tracking purposes. Students stayed at one computer for the class period. The time stamps on the log files indicated class hour.

Keystroke Data

The Figure 16: WinWhatWhere Investigator® E-Mail Attachments shows the way the e-mail was sent from the lab computers. The opened attachment could be read with the WinWhatWhere program: The encrypted attachments could not be read without a licensed copy of the software.

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[80] WinWhatWhere® and WinWhatWhere Investigator® are registered trademarks of WinWhatWhere Corporation. WinWhatWhere Corporation gave permission for the researcher to use the software for the study.

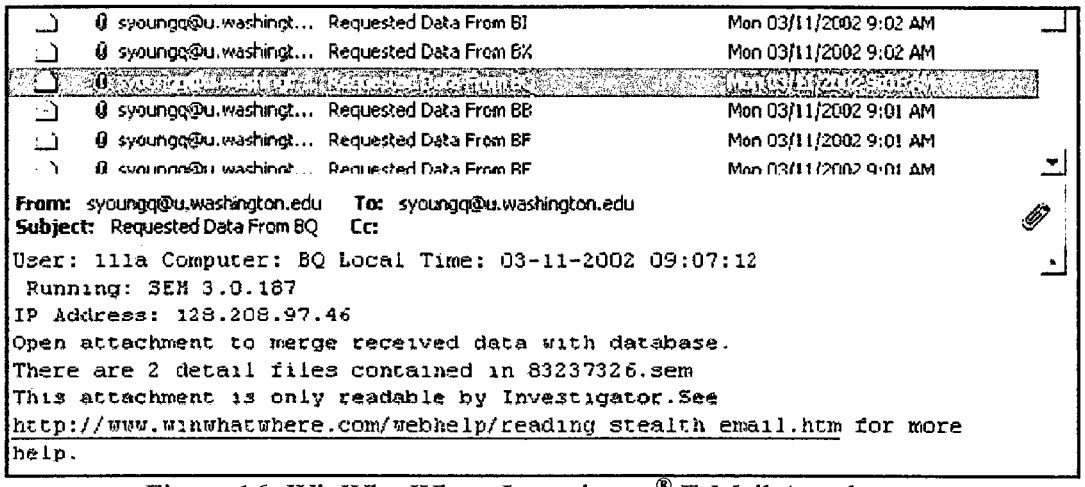

Figure 16: WinWhatWhere Investigator® E-Mail Attachments

Figure 17: WinWhatWhere Investigator® Formatted Data shows the information sent via attachments. The function keys, arrow keys, page up, page down, delete, backspace, etc. each had a unique translatable code that appeared in the file. For example, <32> was a space and <8> was a backspace). The keystrokes showed edits as students composed. Mouse clicks did not appear. If a student moved data with <CTRL+X> then <CTRL+V> to cut and paste, the data appears. However, if a student used the mouse to click on the cut button and then to click on the paste button to move text, those strokes not appear in the output.

Workstation	User	Date	Start	Elapsed	Exe	Caption	Keystrokes	Formatted	Raw
BF	111a	03/11/2002	8:53:39 AM	0:01:15	C:\PROGRAM FILES\MICROSOFT OFFICE\OFFICE\WINWORD.EXE	CCC Essay.wps.doc (Read-Only) - Microsoft Word	146	.the idea of the human race being altered by destin, altered by destiny, and inevitably doomed to come to a tragic end '	.the<<32>>id<<8>>dea<<32>>of<<32>>the<<32>>human<<32>>race<<32>>by<<8>>eing<<32>>altered|<<8>><<32>>by<<32>>destinal<<8>><<8>><<8>>ny<<8>>,<<32>>altered<<32>>by<<32>>destiny,<<32>>and<<32>>nevei t<<8>><<8>><<8>>itably<<32>>doomed<<32>>to<<32>>come<<32>>to<<32>>a<<32>>trac<<8>>gin<<8>>c<<32>>end.<<16>>'
BF	111a	03/11/2002	8:51:09 AM	0:00:08	C:\PROGRAM FILES\MICROSOFT OFFICE\OFFICE\WINWORD.EXE	CDD Essay.wps.doc - Microsoft Word	12	2nd try	<<32>>2nd<<32>><<8>><<8>>d<<32>>try
BF	111a	03/13/2002	3:24:25 PM	0:00:00	C:\PROGRAM FILES\MICROSOFT OFFICE\OFFICE\WINWORD.EXE	Rough Draft of xxx.doc - Microsoft Word	38	background color and dullness,,	background<<32>>colde<<8>>r<<32>>and<<32>>dullness<<32>><<8>>,<<46>>,<<8>>,

Figure 17: WinWhatWhere Investigator® Formatted Data

NORTHWEST REGIONAL LABORATORY WRITING RUBRIC

The Six Plus One Writing Assessment Rubric produced by the Northwest Regional Educational Laboratory was the basis for the writing assessment used in this study. The six trait writing model, developed by educators based on qualities of student writing that were common to well written drafts, has become the standard for writing assessment and is used by primary through college level teachers in every state for evaluation of student work (NWREL, 1999b).

Ideas and Content (Development)

The paper begins with a clear, narrow topic. The writer develops the theme with sufficient relevant details and anecdotes to answer audience questions and hold the reader's attention.

- The writer seems to be writing from knowledge or experience on a narrow, manageable topic.
- The writer expresses a well-reasoned point of view; ideas are original.
- Information is concise, focusing on a key issue or issues. Facts are thoroughly substantiated.
- Relevant details give the reader important information that goes beyond the obvious or predictable.
- The writer develops the theme and expresses creativity. The writer elaborates to convey coherent meaning in a purposeful way.
- The content and amount of information are well suited to the intended audience.
- Important reader's questions are anticipated and answered.

Organization

The organization enhances and showcases the central idea or storyline. The order, structure, or presentation of information is compelling and moves the reader through the text.

- The title is original and captures the central theme of the document.
- The introduction grabs the reader's attention and makes a connection to the main purpose.
- Main points stand out vividly; key information is easy to spot. Sequencing is logical and effective. Paragraphs begin with a topic sentence and include relevant information. Details seem to fit where they're placed.
- Pacing is well controlled; the writer knows when to slow down and elaborate and when to pick up the pace and move on.
- Thoughtful transitions clearly show how ideas connect. Organization flows smoothly. The writer sustains coherence and cohesion throughout the document.
- A satisfying conclusion leaves the reader with a sense of closure and resolution; the ending provides information the reader needs to know and remember.
- Pacing is fairly well controlled, though the writer sometimes spurts ahead too

Voice

The writer speaks directly to the reader in a way that is individualistic, expressive, and engaging. Clearly, the writer is involved in the text, is sensitive to the needs of an audience, and is writing to be read.

- The reader feels a strong interaction with the writer, sensing the person behind the words.

- The tone and voice give flavor to the message and seem appropriate for the purpose and audience. The writing makes the reader think about and react to the author's point of view.

- Narrative writing seems honest, personal, and written from the heart. Expository or persuasive writing reflects a strong commitment to the topic by showing why the reader needs to know this and why the reader should care.

Word Choice

Words convey the intended message in a precise, interesting, and natural way.

- Words are specific and accurate; it is easy to understand just what the writer means. The writer selects just the right word or phrase in just the right spot and manipulates words, phrases, and clauses for their shades of meaning and impact.

- Lively verbs energize the writing. Precise nouns, adverbs, and adjectives enhance meaning.

- The writer successfully involves the reader by the use of literary devices, such as, metaphor, simile, and onomatopoeia.

- Sparingly uses idioms, clichés, and jargon for effect.

- The language is natural and individualistic. Striking words and phrases often grab the reader's attention.

- Technical terms are used when appropriate and explained or clarified as necessary for the audience.

Sentence Fluency

The writing has an easy flow and rhythm when read aloud. Sentences are well built, with strong and varied structure that invites expressive oral reading.

- Sentences are constructed in a way that helps make meaning clear. The writer may choose to manipulate or abandon conventional text forms to achieve impact.
- Purposeful sentence beginnings show how each sentence relates to and builds upon the one before it. Beginnings show variety and energy.
- Sentences vary in length as well as structure. Fragments, if used, add style.
- The writer signals cause and effect, comparisons, alternatives, time, and order. The use of creative and appropriate connectives between sentences and thoughts help build a cohesive draft.
- The writing has cadence, as if the writer has thought about the sound of the words as well as the meaning; it invites oral reading.

Conventions

The writer demonstrates a good grasp of standard writing conventions—grammar, capitalization, punctuation, usage, spelling, paragraphing—and uses conventions effectively to enhance readability. Errors tend to be so few and so minor that the reader can easily overlook them unless hunting for them specifically.

- Paragraphing tends to be sound and to reinforce the organizational structure.
- Grammar and usage are correct and contribute to clarity and style.
- Punctuation, capitalization, and spelling are accurate.
- The writer controls conventions of writing but may make a deliberate choice to break them to enhance meaning.
- Only light editing would be required to polish the text for publication.

Presentation

The form and presentation of the text enhances the ability for the reader to understand and connect with the message. It is pleasing to the eye.

- The use of white space on the page allows the intended audience to easily focus on the text and message without distractions. The layout is attractive, effective, and appropriate.

- When appropriate to the purpose and audience, there is effective integration of text and illustrations—charts, graphs, maps, and tables. The visuals support and clarify important information or key points made in the text or help the reader interpret data or draw conclusions.

- The appropriate use of fonts and font sizes invites the reader into the text. Key ideas stand out thanks to the writer's effective use of typographic devices including boldface, italics, underlining, or variations in font style and size.

- The use of a title, side heads, page numbering, bullets, and evidence of correct use of a style sheet makes it easy for the reader to access the desired information and text. These markers allow the hierarchy of information to be clear to the reader.

This information was summarized from the rubric[81] presented by Northwest Regional Educational Laboratory.

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[81] Information from rubrics used by high school teachers was incorporated into the framework provided by NWREL. Wording and order of details within each trait was changed so that all ratings—1, 3, and 5—have corresponding points.

APPENDIX B
UNIVERSITY COMPUTING FACILITIES

The university provided "an extensive network that could be accessed on-campus, by wireless, or through the Internet" (Computing and Communications, 2002). Macintosh, Windows-based computers, and UNIX systems were networked on campus. There were general facilities available for all students and specialized facilities available such as the CIC computer writing lab.

GENERAL FACILITIES

A university wide intranet, used by faculty, staff, and students, was in place to help with research. Some areas were password protected, depending on the firewall maintained by the individual team or department using the technology.

Three general access labs and eight departmental computing labs were located on campus. One lab provided special resources including speech output, Braille, screen magnification, alternative input devices other than the keyboard and mouse, and voice recognition software. Other labs provided graphics capabilities, color printing, visual programming, 3-D modeling, video editing, scanning, and DVD creation capabilities.

Staff offered training and support each quarter including database programming, help with upgrade and purchasing decisions, and creating networks. Students and faculty could obtain consultation and advice in the design of studies and experiments; the creation of a web page; statistical and graphical analysis of data; choice, application, and reporting of statistical methods; and statistical review of research papers. Online documentation presented a first line of support, but other services were available, depending on the lab and the focus of the department.

Catalyst tools, which had been used since 1999 at the University of Washington,

included curriculum development technologies and online survey tools. WebQ, one of those tools was utilized to develop the online surveys for word processing and perceptions.

CIC WRITING LAB

The two computer writing labs at the University of Washington, which were used at the time of this study, each consisted of 24 networked workstations arranged in pods of three stations where students sat face-to-face (Figure 18: Computer Writing Lab configuration). The Dell Optiplex 110 Pentium IIIs computers with Windows 98, 256 MB RAM memory, and a 10 MB hard drive included earphones for sound. Students stored assignments as well as bulletin board discussions and comments in a password protected class directory on the LAN, which was accessible by members of the class. In the lab, one laser printer sat at the front of the classroom for student and teacher use; a LCD projector was connected to one computer for presentations and demonstrations.

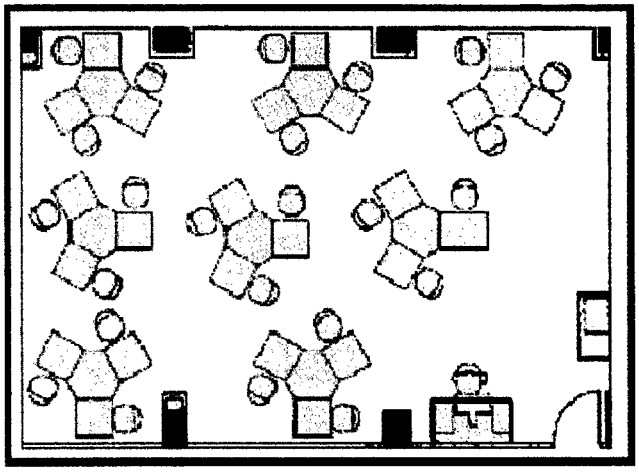

Figure 18: Computer Writing Lab Configuration

Although the schedule varied by quarter, students could use the computer writing lab when classes were not scheduled and an assistant was available, generally about 35 hours per week in the late afternoon, evening, and weekend. The lab assistant provided technical support to students, but did not provide help with writing.

The lab included software products for writing, viewing multimedia presentations, editing pictures, sending electronic mail, browsing the Internet, and instructional purposes—Microsoft Word 2000; BABEL, the Electronic Bulletin Board; CommonSpace; Netscape Composer; and Microsoft PowerPoint®.

Microsoft Word, a word processing program, allowed students to enter, change, move, and format text. Footnotes, endnotes, headers, footers, a table of contents, and graphics could be inserted. Word's spelling and grammar check functions allowed writers to note potential grammatical or spelling errors, whereas, the thesaurus assisted writers looking for a word to use in a sentence. Character, paragraph, and document formatting tools helped modify the layout of the final presentation. Furthermore, built-in Word options aided instruction.[82]

BABEL, The Electronic Bulletin Board (BB)[83] enabled interactive communication between students, an extension of a classroom discussion. All students talked simultaneously; students posted messages and responded to messages at the same time as other students. With BB, students had the opportunity to read over their comments before making them public. In addition, messages could be posted using a pseudonym, which allowed students an opportunity to participate without others identifying themselves. Bulletin Board supplemented oral conversations in the classroom.

CommonSpace, a simplified word processor, emphasized collaborative work on a document. As with other word processors, users could enter, revise, and modify text or import text from another word processor, but in CommonSpace, text appeared in the

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[82] Word options that were highlighted in the CIC Resource manual included the comment function, which students used to attach annotations to specific words, sentences, or paragraphs to provide peer feedback; the AutoSummarize command, which instructors used to demonstrate problems with the organization of a paper; outline view, which students used to see the organizational structure of the paper; and the track changes command, which students used for peer editing.

[83] Bulletin Board was designed and written by the English Department network administrator, Rob Weller.

left-hand column and reviewers responded to or edited text in a column to the right. A writer saw the text and commentaries side-by-side. By highlighting a section of the sources text, a reviewer could link comments to the original essay. Likewise, CommonSpace allowed links to the World Wide Web or other documents. Documents created or revised within CommonSpace could be exported to other word processing programs.

Netscape Composer facilitated World Wide Web presentation of student papers. Writers could insert graphics to illustrate and supplement the text. Options to customize color, layout, backgrounds, and font attributes contributed to the presentation format. With Composer's tools, students could give supporting evidence to their arguments by adding hyperlinks to other places in their document that illustrated a point or to another web site that supported their argument. Likewise, students could present individual ideas or arguments on separate pages and link those together to create their own web site.

Microsoft PowerPoint® enabled students to develop innovative presentations for their instructors and classmates. Being primarily a presentation tool, PowerPoint features stressed the graphical; charts, diagrams, drawings, tables, and pictures could readily be imported and manipulated within the program. Moreover, PowerPoint also included basic word processing functions for entering, modifying, and deleting text as well as a spelling checker.

In addition to the primary software programs used for writing and presentation in the CIC program, instructors could utilize e-mail and the Internet. E-mail allowed students opportunities to communicate between each other, to discuss writing, to ask questions, and to receive answers without having to wait until the next class period. At the discretion of the teacher, students could submit work via e-mail. Through the LAN and Netscape Navigator, CIC classes accessed the Internet. Instructors could choose to create a personal web site and post assignments, the class calendar, or resource references. Links could be provided to areas that aid writing—an online thesaurus or

dictionary, or the University of Washington library system. Furthermore, in class, teachers could demonstrate how to conduct research using the Internet with the computer attached to the LCD projector.

APPENDIX C
PILOT STUDIES

PILOT STUDIES

Two pilot studies were conducted: one with high school freshmen in a required language arts class and the second with college students in an introductory writing course. All had access to up-to-date technology. For writing, the nineteen freshmen in the pilot study used the latest version of Microsoft Word on Pentium PCs, purchased at the beginning of the school year for the computer lab. In the second pilot study, five university students, who attended the University of Washington, used the same computer writing lab as the students in the research study.

Pilot Study 1

Ninth grade students at a junior high school in an affluent neighborhood in a suburb of a major metropolitan area in the Northwest participated in the first pilot study. All the students in the two language arts classes of one experienced writing teacher completed a computer skills survey. Based on the ratings from the survey, twelve students in each class were randomly selected to participate in the study—four students with high technology skills, four with medium skills, and four with low skills. Nineteen students—six with self-reported low computer skills, seven with medium, and six with high—completed all aspects of the study.

Data were collected for a standard writing assignment used to assess the students' current writing skills and shape future writing lessons. Over four days, students completed all aspects of the essay in class; no one was permitted to work on the assignment outside of class. At the end of each class, students turned in their work. On the first day, students remained in the classroom and completed a planning sheet at their desks. On the second day, students used the computer lab to compose from their planning sheets and saved their drafts on a diskette. Back in the classroom on day three,

students used colored pencils and highlighters to note revisions and edits on a printout of their essay. On the last day of the assignment, students received their papers and diskettes once again and went to the computer lab to make the changes. Another ninth grade language arts teacher, who had extensive experience in teaching writing and familiarity with the school's standard rubric for this assignment, scored the final essays.

The researcher observed each selected student as he or she worked on the essay in the computer lab, noting computer skills students used as they composed, edited, and revised their texts. After students completed their writing, each was interviewed about their perceptions regarding using a word processor for writing.

From observation and the interviews, students indicated that instruction determined how they utilized the computers to write regardless of computer skills, perceptions about the writing process on computers, or how they made use of the technology for their personal writing. In the interviews, students confirmed that they used computers regularly for word processing. Students indicated that they used different word processing options such as color and graphics in their personal writing than they did for this assignment, but did not feel it was appropriate in their formal writing. Based on instruction they had received, the students indicated that they felt there were rules[84] to follow when producing formal documents, although no one elucidated rules for this assignment. The freshmen felt confined by their perceptions of the rules and only experimented outside the norms with the title of their papers.

In this pilot study, all students concentrated on their writing and quietly completed the assignment. Few questions arose regarding either computer hardware or software. Students experimented with title formats after they had completed revising and editing the essay. All accomplished the assigned task using the technology available in the

[84] In the interviews, students stated that formal writing should follow the formula that they had been taught. Text appeared double-spaced, in the default font, without graphics or illustrations, and in third person. In personal writing, students states that they may create a drawing to make a point, add a picture for interest or illustration, or use colorful, playful fonts.

school lab. Furthermore, all students knew where the keys were on the keyboard, although some could not keyboard as quickly as they could write by hand. Keyboarding slowed some students down and interfered with their writing. In addition, the technology forced all students to think about spelling and grammar. No student ignored the red and green squiggly lines in their text: In the interviews, students said that they felt compelled to eliminate them.

Students who self-reported computer skills in the lower half of the participant group demonstrated higher skills during the writing process than those students who self-reported higher scores. From observation, it appeared that self-reported computer skills did not always match skills students used in the writing process at school and that the ninth grade students did not accurately determine the level of their own computer expertise.

Students who appeared by observation to use more of the affordances of the technology received higher grades on their papers than students who used fewer word processing features, except those who merely used the technology to finish rapidly. Those who finished the essay quickly also used many of the word processor's built-in facilities to complete the task as fast as they did, but speed simply enabled them to avoid reviewing their papers carefully. This finding for those who used the computer to finish quickly was similar to the literature that found that students engaged in fewer meaning related revisions when they used the computer than when they had to rewrite essays by hand (Hawisher, 1987; Lutz, 1987). Consequently, these students, unlike others who used many of the technology features, did not get the highest scores on their final drafts. Moreover, it appeared that a student's perceptions about writing on a computer, especially knowledge about using the computer for revising, influenced the final product and the features of the technology they used to a greater extent than computer skills. Positive perceptions about writing with a word processor, including the ideas that the computer allowed them to capture their ideas, be more creative, reorganize their essays, be neater, and think differently about writing, encouraged the students to use

features of the word processor.

As a result of the pilot, several changes were made to the study. First, the computer skills survey was modified to focus on features of the word processor that students used in class, not on computer skills in general. The revised survey also included tasks students could use to compose an academic essay, but did not use during the initial pilot study. Knowledge of applications not related to word processing had no relationship to computer skills used for writing in the pilot study. Second, a keystroke capture program would record how students wrote, because students could not judge how they used a word processor, nor could observation capture the complexity of the writing process. Third, to capture student perceptions of writing with a word processor, a perceptions of writing survey was developed from the interviews conducted with the ninth grade students. Since students gave similar answers to questions about using a word processor, their answers were transformed into a Likert survey where students *Strongly Agreed, Agreed, Disagreed,* or *Strongly Disagreed* with a response. Fourth, a keyboarding survey would check for typing speed to ensure that entering information did not interfere with the composing process. Since past research has shown that when students keyboard less than 20 words per minute (Russell, 1999), it interferes with their writing, it was important to know if the students keyboarded at a minimum of 20 words per minute.

Pilot Study 2

The second pilot study tested the technological adaptations made as a result of the first pilot study. One composition class that used literature as a base in the Computer-Integrated Composition (CIC) program at the University of Washington participated in the second pilot. The class, like others in the CIC program, composed, revised, and commented on peer essays using the computers. Thirteen students in the class volunteered to be in the study, but only five completed all aspects.

Data were collected from one class in the middle of the quarter using a standard writing assignment. The researcher observed the group as they composed their papers, noting writing activities and collaboration. During the class, students provided peer feedback on another student's paper. As they wrote, WinWhatWhere Investigator® software captured their keystrokes and e-mailed the detail records to the researcher. The final drafts of the papers were graded by the instructor and the researcher. After all writing was completed, the teacher was interviewed.

Students completed three surveys. The word processing skills survey, modified from the first pilot study, asked students which of 20 features of a word processor they knew how to use and which ones were new. The 15 question Perceptions of Writing Survey, derived from the student interviews in the first pilot study, asked students if a word processor helped them with various aspects of writing, if they liked to write, and if they liked to write using a word processor. In addition, students were asked to comment on how a word processor helped or hindered their writing. The third survey on keyboarding speed, asked students to type a passage for two minutes to verify that keyboarding did not interfere with writing. All surveys were put online using WebQ, part of the Catalyst toolbox, at the University of Washington.

Each student received a floppy diskette that contained a Word document describing the three surveys and provided hyperlinks to the online version of the survey; students also received a printout of the surveys and of the Word document. Students were asked to complete the surveys outside of class. The hyperlinks did not always take students to the Catalyst web site on the Internet when clicked. Students had to copy and paste the URLs in the document into the address line of a browser window to go to the site. Even after sending reminders to all students who volunteered for the study, most elected not to complete the surveys. To correct these problems the next quarter, students were given a short synopsis of the study and surveys were completed in class.

Unlike the first pilot study, there was no apparent issue with keyboarding speed; even those students, who thought they were slow, were fast enough to ensure that the computer did not interfere with the writing process. None thought keyboarding speed interfered with writing. During the quarter, the teacher did not observe any students as having problems entering text or that keyboarding speed caused issues with writing nor did the researcher. Even the one student who complained about being a slow typist still believed that she typed faster than she wrote by hand. All students who took the keyboarding survey typed at least 20 words per minute. As with the first pilot study, students indicated some benefits of using computers for writing, but did not find all aspects helpful.

The keystroke capture program sent data to the researcher to be analyzed for how students wrote using the word processor. However, since students focused on providing peer feedback the entire class period, no one edited or revised their own papers. Even though providing feedback was an important exercise for these students, the exercise did not provide much data with regard to answering the question of this study, *What is the impact of electronic writing proficiency on student writing?* On the other hand, the exercise reflected classroom instruction. As with the first pilot study, students followed teacher direction. Students commented on global issues, not only word level edits or conventions. Their comments on organization, content, and clarity of an argument suggested that instruction stressed larger changes. Suggestions included:

- Improving clarity and grammar: "Perhaps break into two or use some other kind of punctuation."
- Modifying the thesis and introduction to the paper: "Your opening seems a bit vague."
- Adding details for unity and cohesion: "You talk about virtues, but you don't relate them to the two stories until the body of your paper."

- Providing more supporting evidence: "Use quotes to back up your argument."

- Reorganizing the essay: "Introduce the texts and characters you are discussing earlier."

Student comments focused on global issues as stressed by the teaching assistant. Student directions had included: Look for "what you really want to argue, what is interesting and valuable to you in the reading." Avoid opinion, obvious or difficult claims, and write on an arguable claim (Teacher syllabus).

As a result of this study, two changes were made. First, the surveys would be completed in class. The amount of time needed to complete the surveys would be minimized to moderate interference with the normal classroom writing agenda and maintain an authentic student writing activity. Second, the writing activity to be observed would be one that included revising one's own paper.

Observations from the Pilot Studies

In both pilot studies, the classes were quiet even though students had to get up to retrieve printouts because the one printer was located at the front of the classroom. Each class followed directions. No off-task behavior was observed.

In both preliminary studies, few students talked to one another as they worked on their documents. Students had their own computer and followed the instructor's directions. All students appeared to work on the assigned task, to understand the assignment, what needed to be done, and how to respond to one another. Students did not ask questions about using the technology. In addition, all students used a touch-typing method to enter text from the keyboard.

Instrument Development Summary

The original word processing skills survey asked about knowledge of different software packages, including spreadsheets, databases, and operating systems. From the data analysis, there was no relationship between computer skills and functions that students used in the word processor for writing the essay. Therefore, based on the functions that students used or could use for an essay, such as page numbers in the header or footer, the survey was modified.

From the analysis of the interviews in the first pilot, the perceptions survey was developed. Comments made by students regarding perceptions were made into a Likert response survey.

APPENDIX D
ASSIGNMENTS AND RUBRICS

The class assignments and rubrics in this section were taken directly from student materials provided by the teaching assistants.

LITERARY ANALYSIS CLASS: ASSIGNMENT

Read "Axolotl" "The Night Face Up" and give a brief description of each story. Are the main characters in each story alike in some way? How are they different? Read "House Taken Over". Answer these questions: What Force is taking over the house? What makes you say so? Read "At Your Service" What is going on in "At Your Service"? What do we know about Bebe, Nina, and LouLou? What is the Rosa's relation to Bebe? Why do they enlist Mme. Francinet's help in a charade? Who is the mysterious figure who comes in and disrupts the proceedings?

LITERARY ANALYSIS: RUBRIC

Topic and Purpose

- Is the argument focused, and the focus appropriate to the length of the piece?
- Is there a clear topic and purpose? When you're finished reading you should have a clear idea of what the subject of this paper is, and what the writer's "take" on that subject is.
- Does the writer stay on topic? Is the treatment of that topic—the writer's "take" on the topic—consistent throughout the paper? Does the writer keep to all of the claims made at the beginning of the piece?
- Is the topic/argument the writer has chosen appropriate to the assignment? Has the writer met all the requirements of the assignment?

Information

- Is there enough in the way of evidence/details/support for the claims the writer makes? Do you find yourself wanting more defense of the assertions the writer makes?

- Are the details provided necessary; do they pass the "so what" test?

- Is the information accurate, or consistent with verifiable sources? What effects do the sources cited have on the way you view the writer's argument? Are they recognizable as authorities on the subject in question? Do they inspire confidence in you, as a reader?

- Is there any obviously erroneous information presented which would undermine the writer's argument?

Organization

- Is the piece unified? How do you know it is unified—what common threads are woven throughout the essay? Are there parts of the paper you think the writer might need to weave in a little more tightly?

- Is there a clear progression of ideas in the essay? Do you, as the reader, feel that the writer is "leading" or "navigating" you through his/her ideas in the way which most efficiently furthers his/her purpose?

- Are there smooth transitions between ideas? Do they articulate the relationship between the ideas involved? Do they further the writer's purpose?

- Are there any "little lost dogs" wandering around the essay (ideas which are disconnected from the main argument but are so good and interesting that you feel sorry for them and want to help them find their way back into the essay)? Sometimes these can be worked in, sometimes you just have to let them go.

Argument

- Is the paper's focus original and interesting?
- Are the assumptions which "hold up" the argument appropriate for the audience, and explained enough (but not too much)?
- Is there enough in the way of evidence/details/support for the claims the writer makes? Do you find yourself wanting more defense of the assertions the writer makes? (I know this is already in the list but it's important—look twice.)
- Does the analysis of quotes, details, anecdotal evidence, and other support seem logical and well-developed?
- Are the methods of analysis consistent throughout the paper? (Are quotes from a "sketchy" source, for instance, treated as ok in one part of the paper, and as unreliable in another?)
- Does all the argument lead to some interesting idea—a focused conclusion, an informed recommendation, or a thoughtful question?

Rhetoric

- Think about which statements in the paper you would classify as claims. What kinds of knowledge and thinking are involved in "holding up" the claims? Are they appropriate for the claims and the larger purpose of the paper?
- Is the tone appropriate to the paper's purpose, and consistent?
- Is the voice appropriate to the paper's purpose, and consistent?

Conventions

- Do mechanical errors (syntax, punctuation, spelling, and the like) interfere with

your reading and understanding of the text?

- Do mechanical errors interfere with the authoritative ethos of the writer? (Would you buy an idea from this person?)
- Are the citations formatted in MLA style?

CULTURAL REFLECTION CLASS: ASSIGNMENT

This is a much shorter essay than last time 4-5 pages at most. Think of it as a final exercise where you can demonstrate your writing skills. Each topic choice has this in common: you must write about the contact points between different cultures in one particular city or region in America, examining the history of that culture's occupation of the area and the ways in which the cultures in that area have or have not cooperated in navigating American life.

You may wish to choose a particular incident to ground your essay, as the length is short. That is, an essay on the L.A. riots, and not just on Los Angeles, an essay on the Tawana Brawley incident in New York, and not just on New York in general. Your choices:

- An essay on the L.A. riots, its causes and its effects.
- An essay on the cultural conditions described in either Spike Lee's *Do the Right Thing* or John Sayles' *Lone Star*.
- An essay on a city or region of your choice, which you must clear with me by the middle part of next week.

CULTURAL REFLECTION CLASS: RUBRIC

Topic and Purpose

- Is the argument focused, and the focus appropriate to the length of the piece?

- Is there a clear topic and purpose? When you're finished reading you should have a clear idea of what the subject of this paper is, and what the writer's "take" on that subject is.

- Does the writer stay on topic? Is the treatment of that topic—the writer's "take" on the topic—consistent throughout the paper? Does the writer keep to all of the claims made at the beginning of the piece?

- Is the topic/argument the writer has chosen appropriate to the assignment? Has the writer met all the requirements of the assignment?[85]

Information

- Is there enough in the way of evidence/details/support for the claims the writer makes? Do you find yourself wanting more defense of the assertions the writer makes?

- Are the details provided necessary; do they pass the "so what" test?

- Is the information accurate, or consistent with verifiable sources? What effects do the sources cited have on the way you view the writer's argument? Are they recognizable as authorities on the subject in question? Do they inspire confidence in you, as a reader?

- Is there any obviously erroneous information presented which would undermine the writer's argument?

Organization

- Is the piece unified? How do you know it is unified—what common threads are

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[85] The teacher also noted in the interview (Teacher interview, March 2002) that she asked, "Does the writer move beyond the class discussion in the ideas presented and the argument made?"

woven throughout the essay? Are there parts of the paper you think the writer might need to weave in a little more tightly?

- Is there a clear progression of ideas in the essay? Do you, as the reader, feel that the writer is "leading" or "navigating" you through his/her ideas in the way which most efficiently furthers his/her purpose?

- Are there smooth transitions between ideas? Do they articulate the relationship between the ideas involved? Do they further the writer's purpose?

- Are there any "little lost dogs" wandering around the essay (ideas which are disconnected from the main argument but are so good and interesting that you feel sorry for them and want to help them find their way back into the essay)? Sometimes these can be worked in, sometimes you just have to let them go.

Argument

- Is the paper's focus original and interesting?

- Are the assumptions which "hold up" the argument appropriate for the audience, and explained enough (but not too much)?

- Is there enough in the way of evidence/details/support for the claims the writer makes? Do you find yourself wanting more defense of the assertions the writer makes? (I know this is already in the list but it's important—look twice.)

- Does the analysis of quotes, details, anecdotal evidence, and other support seem logical and well-developed?

- Are the methods of analysis consistent throughout the paper? (Are quotes from a "sketchy" source, for instance, treated as ok in one part of the paper, and as unreliable in another?)

- Does all the argument lead to some interesting idea—a focused conclusion, an informed recommendation, or a thoughtful question?

Rhetoric

- Think about which statements in the paper you would classify as claims. What kinds of knowledge and thinking are involved in "holding up" the claims? Are they appropriate for the claims and the larger purpose of the paper?
- Is the tone appropriate to the paper's purpose, and consistent?
- Is the voice appropriate to the paper's purpose, and consistent?

Conventions

- Do mechanical errors (syntax, punctuation, spelling, and the like) interfere with your reading and understanding of the text?
- Do mechanical errors interfere with the authoritative ethos of the writer? (Would you buy an idea from this person?)
- Are the citations formatted in MLA style?

WEB-BASED PROJECT CLASS: ASSIGNMENT

As we have discussed in class, editions of literary works—books, films, and web sites—tend to foreground particular themes. For instance, the *Norton Critical Edition of Great Expectations* emphasizes the importance of travel within the story through its cover illustration of a man at a crossroads and through the inclusion of multiple maps. Additionally, the 1995 film edition of *Pride and Prejudice* emphasizes the importance of landscape by opening with a view of the countryside.

For your final project, you will create an interpretive web edition that foregrounds the role of a theme of your choice in *Pride and Prejudice* and/or *Great Expectations*.

Possible themes include, by are not limited to, the following: revenge, marriage, upward mobility, education, guilt, unrequited love, madness, religion, independence, money, gossip, fashion, traveling, imprisonment, elopement, et cetera. Your web edition will include two chapters from *Pride and Prejudice*, two chapters from *Great Expectation*, or one chapter from each work. Select chapters that emphasize your chosen theme.

Format

Your web site needs to include the following components. See the "Sample Web Design" handout for ideas on how to structure your site. NOTE: Either the annotative links or the supplementary material needs to contain your critical commentary on the function of the theme in specific passages of the chapters on your site. This is a required element of the web site.

Critical Introduction

The critical introduction should focus on the significance of the theme you have chosen within the entire novel, or novels, you include chapters from on the site.

Think of the introduction as a critical paper (750-1000 words)—it should have an argument. The argument will be about the significance and function of your theme. Why is your theme important? What does it tell you about the novel, or novels, that you are investigating?

Your introduction should introduce your chapters. In particular, you should emphasize why they are so important to the theme. However, your introduction does not need to go into a close reading of the chapters, since that will happen elsewhere in the site.

About This Site

Include a paragraph in this portion of the site introducing the contents of the site—the materials that will appear in supplementary information and in the links. This is a place where you can indicate why you have chosen these particular materials. You should

also provide the viewer with any information that would be useful for navigating the site.

Introduce yourself and/or this class in order to give the site a context for someone who might come across it on the Internet.

Chapters

You need to include two chapters from *Pride and Prejudice* and/or *Great Expectations* on your site. You can choose chapters from two different parts in one novel or choose one chapter from each novel. You will copy the chapters you select from on-line editions.

Annotations

Your *Norton Critical Edition* annotates its chapters in a manner that helps readers understand unfamiliar words and cultural practices. You will need to annotate the chapters on your site in a manner that provides information about your theme. For a web edition, annotations will take the form of internal or external links, rather than footnotes. You will need to create links from specific words and phrases in the chapters. You can link passages in the chapters to your critical commentary, to passages from other places in the story, to quotes from scholars, to images, to other web sites, and/or to supplementary information within your own site. Be creative.

Suggestion: Choose ONE type of information to include in footnotes. For instance, you could have all of your annotations contain your critical commentary—your close reading of the phrase or passage and connections that you make to other points in the novel. Another possibility would be to include only historical information, only material related to films, or only references to scholarly articles in your annotations. (These are all just possibilities. Your site does not need to include all of these materials.)

Be selective: only create links to and from the portions of the chapters that connect to

your theme.

Supplementary Information

You will also want to provide the reader with supplementary information to allow him or her to understand the theme in more depth. Supplementary materials might include historical details, information from scholarly reviews, connections to film editions, links to web sites related to the topic, and other such materials. You can link this information to the chapter via annotations or you can provide it in separate pages. Most likely you will want to use a combination of both. The context you create does not have to focus on the nineteenth century. You can look at information from other points in time as well.

Suggestion: Choose TWO types of supplementary materials to include on your site. Your supplementary material should not reproduce what you have chosen to include in your footnotes. Instead, it should offer additional information. For instance, if your annotations do not include your critical commentary or close reading of the chapters you have chosen, you can offer such a close reading in your supplementary materials. On the other hand you could include one page of historical information and one page about films. There are many other possibilities. Be creative.

Bibliography

Include a complete bibliography of all the resources you utilized to construct your site. Be sure to credit the source for the chapter texts and the sources of any images that you include on the site. Link any URLs and library call numbers to the appropriate sites, so that others can retrace your research.

WEB-BASED PROJECT CLASS: RUBRIC

Specifics

For your critical introduction, this criterion measures how well you notice what is going

on in the text. A strong introduction will draw its reader's attention to a sufficient number of details to fully develop its claim. At the same time, it will focus on the details that are the most relevant to its central claim.

- Does the introduction use examples from throughout the novel, or novels, to discuss the theme?
- Is each quote introduced and properly formatted?
- Is there a sufficient amount of detail to support the argument?

For your web site as a whole, this criterion measures the relevance and extent of your annotations and supplementary materials.

- Does the writer identify all of the passages in the chapters that reference the chosen theme?
- How thorough is the information in the supplementary materials? Is there any place where you would like to have more information?

Exploration

For your critical introduction, this criterion measures how fully and how convincingly you explore the significance of the details you notice. A strong introduction will not only explain what you see happening at a particular point in the text, but will also show how the observation corresponds with your overall claim.

- Does the writer discuss each quote?
- Does the writer connect specific observations to the overall theme?
- Are there any places that you have questions or would like more explanation?

For your web site as a whole, this criterion measures the thoroughness of your

examination of the details you notice and the extent of the connections you draw between details throughout the site.

- Does the writer discuss all of the passages in the chapters that reference the chosen theme (either through annotations or supplementary materials)?
- Does the writer connect the supplementary materials to the theme?
- Are there any places where you have questions or could use more explanation?

Integration

For your critical introduction, this criterion measures the imagination, scope, and interest of the claim you make. A strong introduction will explore the idea with which it begins. It will not settle for making a small point; instead, it will take that idea to its limit, seeing its complications. It will capture the attention of the reader, explaining why he or she should care about the details being explored in the introduction and the web site.

- What is the claim? Is the claim arguable?
- Does the introduction hold your interest? Why or why not?
- Does the argument make you think of the text(s) in a new way?
- Does all of the material in the critical introduction connect to the overall claim?

For your web site as a whole, this criterion measures the overall thematic unity of the materials you present.

- Are all the materials on the web site connected by a common theme?
- Does the writer connect the supplementary materials to the theme?

- Does all of the material on the site hold your interest? Why or why not?
- Does the material on the site make you think of the text(s) in a new way?

Structure

For your critical introduction, this criterion measures the organization, coherence, and logic of your introduction. A strong introduction will make a clear claim and will keep its attention on that claim's logic, excluding what is irrelevant. It will tell its reader where the introduction and the edition is going and why.

- Does the critical introduction have a clear and easy to follow structure?
- Is each paragraph unified around one idea?
- Are there clear transitions between paragraphs?

For your web site as a whole, this criterion also measures the organization, coherence, and logic of the materials you present. At the same time, it assesses the ease of navigating between materials within the site.

- Is the web site as a whole have a clear and easy to follow structure?
- Does the link structure make sense? Are there any places you get lost or any links that do not work?
- Does each page have a clear and easy to follow layout?

Style

For your critical introduction, this criterion measures the effectiveness of the punctuation, spelling, and grammar within your introduction. A strong introduction will use a style appropriate to the assignment. Also, it will demonstrate a sophisticated use of language.

- Identify any places where the writer makes errors in punctuation or grammar.
- Are any of the sentences difficult to follow?
- Does the writer employ a variety of sentence structures?
- Does the writing style capture your attention? Why or why not?

For your web site as a whole, this criterion not only assesses the style of your language, but also the visual design of your site.

- Do you like the look of the web site? Why or why not?
- Is the material easy to read? Are colors too bright or too dim?
- Is anything on the site visually distracting?

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I will rate your success in each category on a scale of 1 to 10.
The following skill levels correspond with these numbers.
1-5 Insufficient skills in this category

6 Introductory, or first level, work: does not show a clear understanding of the category.

7 Some understanding of this category.

8 Partial success within this category, but not yet showing control.

9 Functional success within this category, with only minor problems.

10 Success within this category.

VITA

SANDRA A. YOUNGQUIST

University of Washington

2003

EXPERIENCE SUMMARY

As the lead curriculum developer, managed the development of instructional materials for teaching technology skills to children and adults. As an application systems analyst, evaluated and implemented client requested enhancements to various information systems.

EXPERIENCE HIGHLIGHTS

FOURTH R, INC., KIRKLAND, WA

DIRECTOR OF EDUCATION

- Design, develop, and implement training materials to teach computer skills. Develop and document procedures to integrate various learning and teaching resources. Distributed internationally through Fourth R learning centers.
- Review, proofread, improve clarity and readability, and edit electronic curriculum materials and marketing materials.
- Review, update, enhance, and edit train-the-trainer curriculum and assessment.
- Train franchisees on conducting classes, learning theory, using Fourth R curriculum resources, and basic marketing techniques advocated by the marketing group. Taught computer classes to students 5-16. Trained other developers in creation of training materials to follow corporate standards.
- Identify and advocate for improvements of courseware and new areas of courseware development.
- Vendor liaison for electronic curriculum resources.

TECHNICAL SUPPORT

- Maintain computers; debug machine problems and coordinate resolution.
- Maintain corporate website using FrontPage and modifying HTML code.
- Developed procedures and the user interface for distributing resources electronically to Fourth R learning centers worldwide; manage the biannual distribution process.
- Developed the documentation standards and produced the documentation for the technical support position.

- Employment dates at Fourth R: October 1994 to present

U S WEST, BELLEVUE, WA

SYSTEMS ANALYST

- As a technical group lead, translated client requirements into information systems terminology and wrote code specifications for programmer implementation. Coordinated the implementation of changes into the customer records system
- Analyzed legacy systems, devised alternatives for increased flexibility and cost reduction, helped design new systems for billing and posting, and created a transition plan.
- Designed, coded, and tested batch and online modules for client requested enhancements to the customer information system, the billing system, and for reports from those systems.
- Designed and modified hierarchical and relational databases.
- Teamed with other group members to correct production problems in a timely manner and to verify the accuracy of the corrections.
- As chairperson and team member of the technical advancement evaluation board for a term, helped develop the standards for advancement on the technical scale. Wrote the document for distribution.
- Technologies included Easytrieve+, COBOL, DB2, IMS, Assembler, and Microsoft Office. Additional training in C, UNIX system administration, Troubleshooting PCs, Consensus Facilitation, and SQL.

TECHNICAL SUPPORT

- Recommended, budgeted, ordered, and coordinated installation of hardware and software; provided one-on-one training for new users for four directors and their staffs in Bellevue and Portland.
- Coordinated hardware and software problem resolution, including diagnosing error conditions.
- Employment dates at US West: February 1981 to September 1994

OTHER EXPERIENCE

- Mentored students in the Computer Science lab as a student consultant at Western Washington University, Bellingham, WA.
- Helped program and test CAI program for basic arithmetic, primarily authored by a professor as a student programmer at Western Washington University, Bellingham, WA.
- Taught pre-algebra, algebra, and geometry at Schaumburg High School, Schaumburg, IL.
- Taught eighth grade general mathematics at Bullen Junior High School, Kenosha, WI.

EDUCATION

- Ph.D. 2003 University of Washington, Seattle, WA
  Curriculum and Instruction
  Educational Technology Specialization
- M.Ed. 1995 University of Washington, Seattle, WA
  Secondary Education
  Concentration in Writing
- B.S. 1980 Western Washington University, Bellingham, WA
  Computer Science
  Concentration in Accounting
- B.A. 1969 Marycrest University, Davenport, IA
  Mathematics
  Minor in English

CERTIFICATES

Continuing Teacher Certificate, 4-12
Endorsements: Computer Science, Mathematics
State of Washington

PROFESSIONAL MEMBERSHIPS

International Society for Technology in Education

American Educational Research Association

National Council of Teachers of English

CURRENT VOLUNTEER ACTIVITIES

Technology Advisory Committee, Lake Washington School District, 1998-present