THE IMPACT OF E-MAIL USE ON FOURTH GRADERS' WRITING SKILLS

by

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Presented to the Faculty of the Graduate School of

The University of Texas at Arlington in Partial Fulfillment

of the Requirements

for the Degree of

DOCTOR OF PHILOSOPHY

THE UNIVERSITY OF TEXAS AT ARLINGTON

December 1998

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ACKNOWLEDGMENTS

While this dissertation bears my name, its completion would not have been possible without the assistance of a number of people. Susan Herring, my supervising professor, has been a tremendous help throughout the last several years. She has guided my development not only in this project but as a professional linguist. Don Burquest, Shin Ja Hwang, John Paolillo, and Sylvia Vardell, the members of my committee, have each contributed to the final product. Rick Yount and Nancy Rowe provided valuable assistance in making sure my statistical analysis was accurate and informative.

Without the dedication and persistence of Susan Lerew, the instructional designer for Boyd Elementary, the e-mail project would not have been completed. Jennifer Jones, the coordinator of the project at the control school, was also instrumental in providing data for the project. My thanks further go to the 1997-98 fourth grade teachers and students at Boyd Elementary and Stewarts Creek Elementary.

Personally, I am grateful to my family and friends who have encouraged me during this process. My husband David has demonstrated unfailing support in numerous ways which I am convinced, if measured statistically, would be significantly greater than the contribution of any other person. Others who have encouraged me are: Kenneth and Mabel Greb, Danny and Linda Vaughan, Norman and Marjorie Nix, Peter and Jodie Nix, Philip and Rosemary Berner, Robin Lombard, Kathleen Tacelosky, Welcome and Debbie Edwards, and Art and Jodi Treherne. Finally, I owe gratitude to Jesus Christ, upon whom I have relied throughout this process for power, love, and a sound mind, and without whom the future goals for my life would be meaningless.

November 30, 1998

ABSTRACT

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Publication No._____

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The University of Texas at Arlington, 1998

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The growing interest in computer use at home and in the workplace has led to the incorporation of computer skills into school curricula. Numerous claims assert the benefit of computers, but questions remain concerning the nature of that benefit. The increasingly widespread use of telecommunications raises further questions regarding the effect of computer-mediated communication on language development. Unfortunately, few rigorous studies have been conducted to provide evidence of the actual effect of e-mail on children's writing skills.

The data for this study are handwritten compositions, e-mail messages, and surveys/interviews collected from two schools, matched for demographic and academic variables. The experimental school used e-mail as a part of their curriculum, while the control school did not. The data were collected from fourth grade students and their teachers during 1998. All of the handwritten and some of the e-mail texts were responses

to persuasive writing prompts, based on Texas Assessment of Academic Skills criteria. Discourse analysis methods were used to analyze these texts for language-focused features in the areas of amount of text, grammatical complexity, control of the mechanics of language, organization, argumentation, audience awareness, oral and informal features, and a composite score for the text. Statistical tests were then conducted to identify areas of significant difference between the schools.

Two comparisons form the basis of the study. In one, an e-mail composition from the experimental school was compared to a handwritten composition from the control school. Results reveal that the experimental group performed better in the areas of audience awareness and argumentation. In the second comparison, handwritten essays from both schools were compared following three months of e-mail use at the experimental school. Results show that the experimental group demonstrated better writing overall and in the areas of audience awareness, organization, and text length.

These results indicate that e-mail use has a positive impact on the writing skills of fourth grade students. The benefits produced by e-mail use are attributed to the influence of interaction with an authentic audience and the educational and technological contexts for composition.

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CHAPTER 1

INTRODUCTION

1.0 Purpose of the study

The incorporation of computer skills into school curricula is increasing at all levels of education, largely due to the growing interest in computer use at home and especially in the workplace. Many adults are regularly confronted with the task of learning to use new computer technology. Predictions concerning the poor marketability of job seekers who have few computer skills, and personal observation of this reality, have driven these adults to demand computer instruction for their children. Universities were the first educational institutions forced to respond to this call (Bailey and Cotlar 1994), but the ripple effect has now reached the kindergarten level in many school districts.

Often, the effects of the rapid influx of computer technology fall far short of the envisioned potential. This is in part because "the sort of judgment that would be exercised as a matter of course when any other new element entered a social situation is usually suspended when the addition is a piece of technology" (Bromley 1998:21). Certain administrators, eager for the schools in their care to be viewed as being on the cutting edge, are limited only by budget constraints in their purchase of technology. Some may naively believe that the biggest and best computer systems will ultimately lead to parental satisfaction and high academic ratings for their schools. It is in this context that computers are forced on teachers who are too often ill-prepared to implement the systems in their teaching. Stories abound about computers awarded to classroom teachers with hopes of improving standardized test scores, yet the new machines served only to fill the corner and collect dust (LeBlanc 1994). Many teachers are unable to use computers themselves,

others are reluctant to change from a long-standing curriculum, and still others do not regard the perceived benefit of using computers in their teaching as worth the time required to develop applicable lessons. In the wake of such experiences, some education scholars contend that technology itself is not the answer but is only a tool that may be used to aid instruction (Dale and Traun 1998); therefore, if computers are to be effective in education, teachers must be trained to use the hardware and software and then trained in how the technology can best be used to enhance their teaching (Bitter and Yohe 1989; LeBlanc 1994).

The dominant view asserts that computers are helpful to "most individuals and all of society" (Barton 1994), but questions remain regarding the nature of that benefit. Particularly in the area of writing, perspectives span the continuum from computer technology being a detriment to a benefit. For example, many are willing to accept that the use of word processing can improve writing due to the ease of correction; however, some contend that access to spell checkers and other aids will inhibit learning.

The increasingly widespread use of telecommunications raises further issues. Interaction with others via computer-mediated communication (CMC) has been found by some to increase motivation for learning and to provide access to experts on current topics of study (Schrum 1988; Negroponte 1995). Students may be more attentive, because the use of e-mail in school seems to combine work and play (Daisley 1994). At the same time, others have found that exposure to students from another culture can actually initiate the early stages of culture shock and result in a more negative view of the other culture (Meagher and Castaños 1996). In addition, parents' fears, driven by media reports, of their children being exposed to inappropriate material have led schools to design extensive permission forms which detail expected behavior and require the signatures of both the parent and student before Internet access is allowed.

With conflicting reports on the benefits of CMC in general, many teachers further question the effect of the medium on language and language development. They witness the carelessness of many adult writers in spelling and capitalization in electronic messages they receive, and wonder how such interaction would impact their students' language development. Since CMC use first began to spread from governmental agencies and universities to the general public, some researchers have warned that it would have a negative impact on writing. Baron (1984) predicted a decline in writing skill, which would result from focusing on the message rather than the recipient. This decline would be evidenced by more attacks on the addressee, fewer register shifts, and a decrease in description and individual style. She concluded that CMC is effective for transmitting logical, objective information but not social, subjective data, and that it would lead to homogeneity in all writing. Ferrara, Brunner, and Whittemore (1991) investigated the language of real-time CMC and suggested that written conventions might eventually be affected by emerging CMC norms, such as failure to practice obligatory capitalization. Contrary to these predictions, Herring (1997) found that, while there were changes in the more social aspects of language usage (e.g., politeness and formality), there was no significant difference in syntactic complexity, degree of variability, or commission of errors over an eleven year period of regular CMC use by computer professionals on the Arpanet. Among children, some studies report an increase in length of texts when students use CMC (Newman 1986; Dale and Traun 1998). Others report improvements in the writing itself, especially in higher-order skills such as organizing, developing, and clarifying (Cohen and Riel 1989; Bowen 1994).

Unfortunately, few rigorous studies have been conducted to provide evidence of the actual effect of e-mail on children's writing skills. Moreover, of the studies which have been done, most analyze only the e-mail messages themselves and not the transfer effect, if any, to handwritten material. Clearly, if children are to gain the greatest benefit from

computer technology, it must first be determined whether the programs of instruction are producing the assumed results.

The present study is an empirical examination of the writing skills of fourth grade children involved in an e-mail exchange program with children at another school in the same district. The students' compositions were compared with those of children under an otherwise similar curriculum who did not use e-mail. The results, based on statistical analyses of a variety of discourse phenomena, show that the use of e-mail has a significant positive impact on the writing skills of the fourth graders in several of the areas examined.

1.1 Statement of the problem

The problem of this study is to determine whether the use of e-mail has a significant impact on the writing skills of the fourth grade participants. In order to analyze possible effects of the e-mail, it is necessary to analyze writing from two groups, only one of which uses e-mail in the curriculum, and to analyze writing composed in the different media. To study the effect of the medium, one set of texts written for e-mail is compared to one written by hand. To determine whether features observed in e-mail use transfer to paper and pencil writing, handwritten texts composed at each school after the e-mail treatment are compared.

In order to evaluate writing skills, it is necessary to examine features which are most representative of the writing characteristics expected of good writers. According to the Texas Education Agency (TEA), evidence of audience awareness, organization, language control, and development of the central idea are essential to well-written essays. Additional categories most likely to be affected by e-mail use, according to previous research, are base measures and orality. Each feature analyzed in this study belongs to one of these six categories. The base measures are necessary to consider amount of text and grammatical complexity. Language control provides a measure of correctness regarding

mechanics and syntax. The organization category examines whether the composition includes basic parts of a text, and argumentation indicates how well the ideas are developed. Audience awareness measures those features which demonstrate an obvious awareness or ignorance of the target audience. Oral/informal features include elements generally expected in spoken rather than written discourse.

1.2 Research questions and hypotheses

Given the criteria in section 1.1, the study seeks to answer the following questions for fourth grade students:

1. Does e-mail use have an impact on the amount of text produced?
2. Does e-mail use have an impact on the complexity of the text produced?
3. Does e-mail use have an impact on control of the mechanics of language?
4. Does e-mail use have an impact on organization?
5. Does e-mail use have an impact on argumentation?
6. Does e-mail use have an impact on audience awareness?
7. Does e-mail use have an impact on use of oral and informal features?
8. Does e-mail use have an impact on overall writing ability (e.g., as measured by a combination of the features in the seven preceding questions)?

Each of these questions is addressed for the comparison of e-mail and handwritten essays and for the comparison of handwritten essays taken after the e-mail treatment.

The null hypotheses for both comparison of e-mail essays to handwritten essays and comparison of handwritten essays at the e-mail school to handwritten essays at the control school in this study are that:

1. There is no significant difference in the amount of text written by fourth grade participants who use e-mail as a part of their school curriculum and those who do not.

2. There is no significant difference in the complexity of texts written by fourth grade participants who use e-mail as a part of their school curriculum and those who do not.
3. There is no significant difference in the control of the mechanics of language in texts written by fourth grade participants who use e-mail as a part of their school curriculum and those who do not.
4. There is no significant difference in the organization demonstrated in texts written by fourth grade participants who use e-mail as a part of their school curriculum and those who do not.
5. There is no significant difference in the argumentation demonstrated in texts written by fourth grade participants who use e-mail as a part of their school curriculum and those who do not.
6. There is no significant difference in the audience awareness demonstrated in texts written by fourth grade participants who use e-mail as a part of their school curriculum and those who do not.
7. There is no significant difference in the oral and informal features demonstrated in texts written by fourth grade participants who use e-mail as a part of their school curriculum and those who do not.
8. There is no significant difference in the overall writing ability (e.g., as measured by a combination of the features in the seven preceding questions) in texts written by fourth grade participants who use e-mail as a part of their school curriculum and those who do not.

If, however, any significant differences are found in the above areas, the null hypothesis will be rejected, and e-mail use will be shown to have an effect on fourth graders' writing. For any instance in which the null hypothesis is rejected, it will be determined which school demonstrated better performance.

1.3 Research design

In order to address the research questions, the researcher devised a study based on a nonequivalent control group design, in which the fourth grade students at Boyd Elementary, Allen, Texas served as the experimental group and the fourth grade students at Stewarts Creek Elementary, The Colony, Texas served as the control group. These schools are comparable based on a number of demographic and academic variables.

The study includes three data sources: in-class writing, e-mail, and interviews/ surveys. Because students' skills in the categories of analysis would be most evident in persuasive writing (Eaton 1989-90), all essays were based on writing prompts for persuasive compositions. In-class handwritten essays were collected from each school both before and after the e-mail treatment. In addition, during the course of the treatment, one set of in-class writings was collected from the control group.

The e-mail treatment consisted of a series of exchanges between the fourth grade students at Boyd and those at Story Elementary, another school in the same district. Students were matched with a "keypal" at the other school and were involved in a variety of communication activities. During the course of the treatment, one set of e-mail writings was collected from the experimental group.

Following composition of the final essay collected for the study, teachers and students involved in the project were questioned concerning demographic information as well as attitudes toward and use of computers, e-mail, the project, and writing in general. Teachers were interviewed individually, and students were asked to complete a survey designed by the researcher.

Analysis of the essays was accomplished using discourse analysis of texts and statistical testing. The essays were coded for several language-focused elements within the categories identified above. Statistical analyses included a multiple regression analysis, t-tests, and analyses of covariance.

1.4 Organization of the study

The remainder of this dissertation is organized as follows. Chapter 2 provides a review of the literature in the areas of computer use in elementary and secondary education, CMC scholarship, instruction in writing as a process, and applicable methods of discourse analysis. Chapter 3 elaborates the statement of the problem and describes the schools used in the study and the method of selection. A description of the data collection and analysis are given along with an explanation for the particular methods and tools used in the process. Chapter 4 presents the results of the analysis and interprets these results. Finally, chapter 5 furnishes a summary of the study, specifically as the findings relate to the research questions set forth in chapter 1, offers implications for linguists, CMC researchers, and educators concerning the inclusion of e-mail in elementary school curricula, and suggests areas of further research.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

This chapter provides, in four sections, a review of the literature most relevant to the concerns of this dissertation. Section 2.1 surveys research on computer use in elementary and secondary education regarding who uses computers, how they are used, why they are used in that manner, and the effects of their use. Studies in CMC scholarship are reviewed in section 2.2, with a discussion of linguistic studies of both synchronous and asynchronous CMC, and of claims concerning the effects of CMC on writing. Instruction in writing, especially from a process approach, is discussed in section 2.3. Section 2.4 closes the chapter with a review of discourse analysis methods which are applicable to the present study.

2.1 Computer use in elementary and secondary education

2.1.1 Who uses computers

Studies show that computers are used in education by every age, gender, and socio-economic status; yet, the number of users within each category varies widely from school to school. One of the first concerns to arise when computers entered the educational scene was the issue of access. It was argued that if the new technology was advantageous for learning, all children should be given equal opportunity to reap the benefits. In reality, it is the schools with more money that have obtained the equipment. While 90% of all children in the United States, kindergarten through twelfth grades, attended a school with at least one instructional computer in 1987 (Becker 1987), there is

a vast difference between sharing a computer with a few hundred other children and being allotted a certain amount of time per week as an individual user. More recently, in a report to the National Association of Elementary School Principals, Executive Director Samuel Sava (1997) stated that the student-to-computer ratio has decreased to 10:1, but affirmed the need to provide access to more students.

Rocheleau (1995) analyzed patterns of computer use based on the National Science Foundation's five-year Longitudinal Study of American Youth, which surveyed both students and parents to identify factors associated with students' attitudes toward science and mathematics. The data showed that the extent of computer use increased proportionally with socio-economic status and academic performance. Negroponte (1995), based on observations of computer use in various contexts worldwide, concludes that computer use is not related to social, racial, or economic factors, but rather to generational factors (cf., Kraut, Scherlis, Mukhopadhyay, Manning, and Kiesler 1996 for greater Internet use among younger generations in a longitudinal study of home electronic services provided to demographically diverse families). Negroponte (1995) and Kraut et al. (1996) support the notion that people of varying backgrounds use computers when they are given access; therefore, since heavier use of computers was related to home computer ownership in Rocheleau's (1995) study, using computers in school would alleviate some of the inequity.

The amount of computer time children are given seems to vary according to age in many cases; however, these amounts are controlled by scheduling rather than student choice, so their relevance to Negroponte's assertion is uncertain. Becker (1987) analyzed findings of the 1985 National Survey of Instructional Uses of School Computers ordered by the United States Department of Education. The survey involved 2331 schools from both the public and private sectors and encompassed both elementary and secondary levels. Concerning in-class computer use, Becker reports that the average elementary

school student uses a computer only thirty-five minutes per week. Middle school students have approximately one hour per week, and high school students have just under two hours. While these numbers have most likely risen in the last decade, if computers are shown to benefit young children in learning tasks, more extensive use will aid in this process. The lack of more recent data highlights the need for further study of computer use in elementary and secondary schools.

Males have traditionally been considered to be more interested in computers than their female counterparts, although statistics seem to indicate this trend is changing. In the Department of Education survey, boys and girls were found to use computers similarly in class, but boys were more likely to use them outside of school hours (Becker 1987); however, Rocheleau (1995) concluded that the difference between the number of male and female users was declining in 1992, the last year of his longitudinal study data. McGrath, Thurston, McLellan, Stone, and Tischhauser (1992) report that girls demonstrate more interest in computers than do boys at all levels of grades four through eight. Their findings are based on a survey of student attitudes following a teacher training course in computer education and gender equity. The results show no significant difference in the experimental (students whose teachers had received the training) and control groups' attitudes concerning the gender appropriateness of using computers for various tasks. Gender differences revealed that the girls liked both paper and pencil writing and general computer use significantly more than boys did.

Gender differences are also revealed in the context of computer-mediated communication. In an effort to facilitate student learning through the sharing of ideas on topics of student interest, Evard (1996) introduced several classes of fourth and fifth grade students to a computer-based newsgroup. The students used the medium to solicit technical advice from their peers on classroom projects such as creating an educational video game for a younger audience. Analysis of the posted messages showed that girls

contributed a relatively higher percentage of the messages. In a case study of adolescent girls, designed to illuminate the purposes and expectations of young females who post electronic messages, Kaplan and Farrell (1994) report that the girls maintain participation on a local electronic bulletin board specifically for purposes of "communication and connection." Kaplan and Farrell suggest that greater use of educational computers in the language arts, in addition to use in math and science, would leave girls with a stronger interest in using computers. Although computer use has traditionally been associated with the masculine gender, these studies reveal that females now demonstrate interest in computer and CMC use as well. Changes in the attitudes of teachers, a profession still dominated by women in most areas, and girl students toward using computers should allow for more equal access between the genders concerning available computers.

Inequities appear to remain in computer use between lower and higher ability students. Both Becker (1987) and Rocheleau (1995) found that students with higher grades made more use of computers. This leads to the question of not only whether or not computers are used, but how.

2.1.2 How computers are used

The range of answers in response to the question of how computers are used in elementary and secondary schools is vast; this section attempts to identify some general trends. Novak and Knowles (1991) conducted a qualitative case study of six beginning teachers who were located in three districts and all teaching in grades two through five. Their research was designed to show the instructional computer uses employed by teachers, the reasons those uses were chosen, and the effects of those uses on student learning. Results of their analysis show that, even among schools which have moved from using computers only in math and science to using them in the language arts as well, too often teachers relegate computer technology to the position of glorified workbooks.

Computer time spent in drill and practice is much less effective for learning than activities which promote higher order thinking skills, such as problem solving or writing (cf., Jacobson 1994). The potential for computer use in elementary classroom instruction has risen with the increase in technological capabilities. For students to gain the greatest benefit from the technology available to them, schools must explore uses of the computers beyond drill and practice.

Traditionally, if anyone used computers for activities other than tutorial work, it was only those students with greater intellectual ability (Becker 1987); however, as instructors have become more familiar with computers, some innovative teachers have been using word processing and CMC for all their students, regardless of intellectual ability. DeGroff (1990) analyzes the impact of computer use on six beliefs commonly held by those who teach writing as a process. These beliefs are that writing instruction is most effective in the context of social interaction, meaningful texts, authentic purposes and audiences, process approaches, author choice, and risk taking. She concludes that word processing can contribute in all six areas. Computers are ideally suited to process writing (see section 2.3). The ease of revision promotes experimentation with words and text order. Jacobson documents a number of ways teachers are using computers to challenge their students "to think and perform at higher cognitive levels" (1994:53). These methods include research and presentation of findings, writing, illustrating, publishing, and having their own stories read back to them by the computer.

The most popular form of CMC at all grade levels is e-mail (Peha 1995). Peha writes that this medium provides the means for sending work to others for evaluation or response, collaboration on worldwide group projects, and access to remote data sources and experts. Peha's findings are based on interviews of school personnel in the Pittsburgh, Pennsylvania area and a survey of educators subscribed to educational newsgroups and e-mail distribution lists. As students become involved in more aspects of computer use, their

intellectual abilities, including developing literacy, and computer skills grow. As teachers become involved in computer use, they gain ideas from their peers concerning implementation of computer technology in educational settings.

Media coverage tends to focus on schools involved in what journalists view as revolutionary education. In 1994, an article in *Business Week* described the burgeoning market in "edutainment" software (Armstrong 1994). Armstrong concluded that the interactivity of the programs, along with the overlap they provide in subject material, would potentially transform the computer into the "high-tech learning tool it was always expected to be." More recently, *Time* magazine printed an article on the growing use of laptop computers in some schools and the plans of others to eliminate textbooks in favor of portable computers (Ratnesar 1998). Students are able to take the computers from class to class and even home for use in homework and field research. Schools have reported success in terms of the quality of student work with laptops from sixth through twelfth grades. Students stand to benefit as schools explore various options for teaching essential elements and extend the children's use of computers in the process.

2.1.3 Why these computer uses are selected

Many teachers feel limited in their computer use by constraints such as a lack of computers. Novak and Knowles' (1991) case study shows that the performance of a word processing task by all students in an elementary class can require two weeks. Sava (1997) notes in his report to elementary school principals that, in the United States, there are only half as many computers available to students as recommended by the U.S. Department of Education. For the potential benefits of computer use to be realized in students' progress, adequate access is essential.

Some teachers are placing children in pairs or small groups, in which the children co-author compositions and experience benefits in the process from the interaction itself.

Assigning more than one child per computer at a given time often stems from a scarcity of equipment; thus many teachers began this practice before the benefits of partner or group work at the computer were documented. While the instructional practice of assigning multiple simultaneous users appears to be related to access, the use of computers primarily for drill and practice or for higher order thinking skills may depend on teacher training.

Whether computers are used for drill and practice or higher order thinking skills appears to be related more to teacher training than to any other single variable. LeBlanc (1994) makes a philosophical attempt to reconcile literacy goals with computer use and finds that some teachers are reluctant to change traditional forms of pedagogy, especially if they are themselves unfamiliar with computers. A new piece of equipment may not be appreciated but may be more readily accepted if it can be employed in the same tasks previously performed. Such attitudes yield predominantly drill and practice uses of the computer. Most teachers have no model from their own education to follow in educational computer use; thus, as new teachers begin their careers, they report concentrating on the necessities of academics, rather than "extras," such as computers (Novak and Knowles 1991). The situation is further complicated in Texas by the pressure teachers feel concerning their students' performance on the Texas Assessment of Academic Skills (TAAS). Early patterns of instruction often influence teachers' strategies for the remainder of their careers.

In Moore's (1991) study, students in a graduate education class were paired with fifth graders at a local elementary school for e-mail exchange. Following introductory messages, the pairs discussed their understanding of a particular book, focusing on information concerning the plot, characters, and setting. Moore's results show that giving teachers hands-on experience using technology which had been integrated into the curriculum strongly influenced their desire to use it in their own classrooms (cf., Kraut et al. 1996 for greater CMC use among experienced home computer users). Levin and

Thurston (1996) discuss findings from several research projects on how "electronic learning networks" can be used for meaningful classroom instruction (e.g., access to resources worldwide, audience effect). They emphasize that training in the possibilities of telecommunications is vital if teachers are to use the medium as a means to an end rather than an end in itself.

Haller (Graves and Haller 1994), who taught in a private college preparatory school with military roots, encountered resistance from both staff and administration in implementing a computer-supported writing center. After three years of teacher training, he concluded that acceptance of computers as more than elaborate typewriters is slow in a traditional setting. In a public high school, Graves found that their nationally recognized, computer-supported writing program deteriorated when administrative support declined (see section 2.1.4.1 for the positive effects of the program). The primary use of computers is closely related to teacher training, and teacher training is closely related to administrative support. Research indicates that the lack of either can doom the best computer writing initiatives.

Based on the results of his 1989 national survey, Becker (1993) examined the conditions related to successful implementation of computers in classrooms, and identified five factors associated with what he termed "exemplary" computer use: a social network among computer-using teachers within a school, regular use of computers for assignments other than drill and practice, organized staff development, concern from the leadership for equity of access to computers, and smaller classes resulting in better student-to-computer ratios. He noted that these characteristics were more prevalent in schools which had a full-time computer coordinator. Suggestions of additional lesson preparation, for a medium with which many teachers are unfamiliar, are resented by those whose schedules are already full. A computer coordinator can locate or design computer uses that promote

higher order thinking, enabling students to gain the advantages of available technology while teachers learn new strategies in addition to carrying out required tasks.

2.1.4 Effects of computer use

Disagreements persist about the effect of computers on children's actual skills, especially in the area of literacy acquisition. In an early study of computer use in educational settings, Becker (1987) reports little difference in student abilities as a result of computer use, yet the primary use of computers was admittedly for lower order thinking processes at the schools on which his findings are based. He writes, "Despite the dominance of drill and practice in the lower grades, computers have not markedly affected most student learning and practice in language arts and arithmetic" (162). While some attribute lack of improvement to limited computer access and inconsistency in software use, others argue that it is the drill and practice pedagogy itself which fails to promote literacy acquisition. Teachers, believing that their students are learning from these electronic workbook programs and having fun in the process, often fail to realize that many of the programs are instructionally weak, only tangentially related to the curriculum, and strongest in providing practice in skills already mastered by most students (Novak and Knowles 1991). In contrast, there are documented positive effects of both word processing and CMC.

2.1.4.1 Word processing effects

Numerous studies have illustrated the benefits of being able to alter compositions easily. Bruce, Michaels, and Watson-Gegeo (1985) analyzed the writing of sixth grade students in Quill, a writing software program designed for children. They found that students were more likely to revise their work when the threat of recopying was removed (cf., Moore 1989). DeGroff (1990), after evaluating the effect of computers on teaching writing as a process, notes that, even after changes, a student's final product is readable,

with no messy corrections or poor handwriting. The release from the need to focus on mechanics, which can be corrected later, allows students to focus more on the content of their writing. Mehan (1989) placed computers in four elementary school classrooms and analyzed changes in organization of the classroom, interactions between the teachers and students, and curriculum. He concluded that teachers fit computers into existing time and space organizations. They used the new technology to reach both previously established and previously unattainable educational goals. One result was that the children's shift in focus from mechanics to content led to improved control over literacy processes, both in reading and writing.

Word processing capabilities also allow students to manipulate language by experimenting with different choices of spelling, word, sentence construction, and text organization. Moore (1989) studied fourth and fifth grade classes in which word processing was integrated into the developmental writing program already in use. She found that the opportunity to experiment with inserting, deleting, and rearranging text resulted in a higher quality of writing for students who used word processing than for those who did not. Graves (Graves and Haller 1994) concurs that the use of word processing increases writing skill. By the end of the first year of a computer-centered, writing across the curriculum program, holistic assessment showed that his high school students abilities had improved, especially in the areas of development, organization, and clarity of writing. These effects not only tend to help students' grades, but help them in learning to write.

Due to the improved appearance and quality of the work children are producing after revision, more teachers are publishing their students' work. Publication may take a number of forms (e.g., books for use in class, newsletters for family and friends). The addition of an authentic audience for their writings has had a great impact on children's work (DeGroff 1990). The Texas Education Agency acknowledges the importance of a

real audience in their TAAS essay scoring guide: "Writing is a process in which one individual attempts to communicate to another, who responds in some way to the message being conveyed" (1997:1). Without an authentic audience, there is no response. Hubbard (1985) observed and interviewed two classes of second graders, only one of which regularly published their writings. She found that students who publish have a clearer understanding of authorship and view themselves as authors. These children reported that their publications gave them a means of communicating their ideas to those in other times and places as well as to classmates. Hubbard recommends beginning with peers and building confidence before moving to a wider audience.

2.1.4.2 CMC effects

Many praise the benefits of computer-mediated communication as paving the way for greater student skill development. Some of the features of word processing, such as ease of revision, exist in CMC with the further advantage of informality, allowing students more freedom than in word processing to focus on content rather than form. Dale and Traun (1998) matched high school juniors and seniors with university English education majors for a collaborative e-mail project. The high school students sent messages discussing each chapter of an assigned book, and their partners responded. The same format was used for securing feedback from university students on high school students' literary research papers. Compared to an earlier paper and pencil version of the project, e-mail improved both the logistics and quality of exchanges. The juniors and seniors wrote more and were more focused in their reading and writing, as a result of thought-provoking questions from their partners. Dale and Traun also found that the ease of revision and informality of the medium allowed students to focus on the content rather than the form of their messages. In an analysis of telecommunications methods used in education and the implications for learning, Schrum (1988) concludes that CMC use in the classroom offers

many benefits, among which are enhanced motivation, the development of research skills, access to experts, opportunities to share data and test conclusions, and opportunities to discuss major news events from different cultural perspectives. She emphasizes the contribution of the exchanges to higher level literacy skills.

Interaction with others via CMC provides an authentic communicative context and therefore a meaningful learning environment. Cohen and Riel (1989) conducted a study in which they compared two sets of texts written by seventh graders in Israel. Both texts concerned the same topic. One text was a midterm exam, composed for teacher evaluation, and the other text was composed to share ideas with a distant peer audience. The latter composition was handwritten for later transmission via e-mail. Handwritten essays were used in an attempt to determine whether writing improvements found in previous research were due to composition on computers, or to the effect of a distant audience. The results show that essays written for peers scored significantly higher, with the strongest effects in the areas of content (substance and development), organization (fluency and clarity), and language use (complexity and agreement). There was no significant difference in the amount of text. Cohen and Riel blame slow development of social and cognitive skills necessary to write for specific audiences on the decontextual approach to writing in classrooms.

Reading and writing to provide information regarding shared problems results in a more sophisticated use of language. Bowen (1994) analyzes telecommunication networks used for publication of student writing, joint student projects, and professional development of teachers. She concludes that various CMC forms increase motivation and provide purposeful contact between students who would otherwise have no contact. As a result, students develop a sophisticated use of language when they use their writing skills to make information available to others and solve shared problems. She bases her conclusions on studies of the Intercultural Learning Network, which links students in

several countries for projects such as news coverage from different perspectives. Meagher and Castaños (1996) corroborate results showing audience effect with their findings of increased language proficiency and commitment to high-level content in a computer-mediated cultural exchange program between high school students in Mexico and the United States.

Most students are taught to write for the sake of teacher evaluation, not for communicative purposes. Attempts to create context, usually by having writers imagine a particular audience, are often ineffective, especially in the early grade levels. The Texas Education Agency (1997) admits this dilemma and attempts to compensate by limiting the audiences specified on the fourth grade TAAS exam to those with whom the students are highly familiar (e.g., teacher, principal).

Several studies have found that students write more in their electronic mail messages than they write with paper and pencil. Through observation of her elementary school class, Newman (1986) discovered increased length in students' messages to her. She attributes the longer texts to the responses they received from her and the short reply time. In addition to more text, Newman observes that the students' messages increased in fluency. Dale and Traun (1998) found a similar result concerning increased length in high school students' messages as they were involved in an exchange with university graduate students.

Computer networks provide audiences at any desired geographical distance and expose children to other cultures (Cohen and Riel 1989; Mehan 1989). A computer-mediated cultural exchange program between high school students in Mexico and the United States demonstrated that the program facilitated perception of cultural values to the point that students went into culture shock (Meagher and Castaños 1996). The exchange promoted the students' understanding of both the other culture and, through self-reflection, their own.

Joint problem solving is another educational application of CMC. An example is a project designed to investigate possible solutions to water shortage (Levin, Riel, Miyake, and Cohen 1987). Students in Mexico, Japan, Israel, and several locations in the United States were linked via the Inter-Cultural Network (an earlier version of the Intercultural Learning Network). Each participating class investigated how their community deals with water shortage, and then reported to the other groups via e-mail. Some students made suggestions for other communities' approaches to the problem and received responses regarding reasons those methods are not employed. All students were able to participate, regardless of knowledge or skill level, providing whatever input they perceived to be relevant.

Levin and Thurston (1996) contend that joint problem solving requires fewer computers than word processing and thus may be beneficial to more schools. Students are able to research certain aspects of a problem from their perspective and report on them to others at small or great geographical distances. The writers of those messages, in turn, gain the same sort of information from their counterparts in other locations. In problem solving, CMC provides information which is both more timely and more cost efficient (cf., Dale and Traun 1998). Authentic data extend students' understanding as they work, for instance, with math in the context of global climates or economy (cf., Bull, Geyer, Arkin, and Appert 1995). For example, one experiment was designed to determine the earth's circumference (Levin, Rogers, Waugh, and Smith 1989). Students in various locations worldwide measured shadows according to specifications and submitted the data to other project participants. Classes were then able to take the raw data and calculate the earth's circumference. Their results were surprisingly close to those of professional scientists.

Some wonder whether the benefits evident in many texts produced via CMC (e.g., increased revision, length, and overall quality) will transfer to other contexts. Cohen and Riel (1989) argue that the more similar the contexts, the more likely is successful transfer.

This emphasizes the need for authentic audiences to whom the students' work is addressed. At least one study, Newman (1986), reports that the fluency her students exhibited in CMC did in fact transfer to journals and other compositions. She writes that "other writing efforts reveal an ease of expression and a coherence which has convinced [her] that electronic mail is an important learning and writing tool" (737).

Writing for a specific audience results not only in purposeful contact, but in increased motivation as well (cf., Bowen 1994). Observations of his eighth grade English students led Noden (1995) to report that students were willing even to forfeit lunch in order to spend more time sending and receiving messages in cyberspace. The students of a colleague were so excited about reading and writing that they would stand in line for a chance to access the computers. Students gain practice reading and writing in the context of what Paisley (1982) identifies as a game-like quality of computers, which has been enhanced in recent years to hold students' interest through edutainment (Armstrong 1994), or on the Internet, which Noden (1995) refers to as "the ultimate reading-writing workshop." The motivation provided by computers alone was evidenced in Belyaeva and Knox's (1988) analysis of communicative, cognitive, and affective behavior in three groups of international children living in Moscow. They observed the children, ages four through six, using computers to develop reading and math skills. They found that computers are so effective in capturing attention that the children retained high motivation even in difficult tasks and after the novelty had worn off. Their results further show that children seek interaction with each other during computer use and sometimes turn to peer "experts" when they need assistance. The most effective partner work occurred between children who were near the same level of development. These findings raise the question of social effects which result from computer use.

2.1.4.3 Social effects

In addition to the effects of word processing and computer-mediated communication, working on computers initiates social interaction which itself affects the outcome of computer experience. The interaction may be with global peers, classroom peers, teachers, or other experts. Based on observation research, child psychiatrists Bremer and Rauch (1998) assert that these interactions improve social skills, self-esteem, and organization, especially for students with shy personalities and learning disabilities. Some educators urge the eradication of barriers which currently separate classrooms from the rest of society through use of CMC (cf., Levin et al. 1987). Following analysis of CMC uses and avenues, Graves (1995) advocates using CMC to "take" her eighth grade students outside the classroom. In the computer-mediated context, "literacy emerge[s] through transactions between readers and writers" (Moore 1989).

Interaction among classroom peers seems to be just as vital. In fact, Mehan (1989) asserts that it is the social organization which emerges from computer use, and not the technology itself, that results in improved writing skills (see section 2.2.2). The use of partners or small groups for computer time has been found to be effective by many teachers in helping children consider revision at both mechanical and textual levels (Dickinson 1986; Moore 1989). In a study of a first-second grade class with a new computer, Dickinson (1986) found that students spontaneously initiated collaborative efforts in composing texts at the computer. Interactions focused on students' planning, self-monitoring by the student typing, and the non-typing student's responses to what was being written. Students discussed spelling, punctuation, spacing, text meaning, and style. The collaborative sessions led to frequent and sophisticated corrections. These same students demonstrated little interaction during handwritten composition, even when encouraged to collaborate. Moore's (1989) study of fourth and fifth grade word processing revealed that partners reminded the student typing about mechanics. Moreover,

sharing stories with peer editors helped students identify problems, consider revisions, and proof final versions.

Children gravitate toward one another during computer use, seeking interaction even when they are asked to work individually (Belyaeva and Knox 1988). Bruce et al. (1985) discovered changes in social interaction patterns as a result of computer use. Students demonstrated interest in the writing of others as they mingled, waiting for computer access. At times, this interaction affected the students' final products. In one case, students were asked to write a review of a school performance. After reading a classmate's review of the lighting conditions, one student changed her own assessment of the lighting from "bright enough" to "kind of dull." Although student interest in their peers' writing is often evident in a non-computer setting, the ease of revision allowed by computers results in more changes based on interaction (cf., DeGroff 1990). Moreover, the computer context differs from the non-computer context in the capability of reviewing other students' work stored on the computer, and in the use of features such as Quill's Mailbag to send messages to other students within the classroom. In effect, this feature functions as a simplified form of e-mail.

Students sometimes serve as experts in their own classrooms, although teachers are needed to maintain order and provide direction (cf., Belyaeva and Knox 1988). Peha's (1995) interview responses show that students were more likely to consult their peers than their teacher. Interestingly, this mirrored the response of teachers, who sought advice from their peers before consulting the support staff, in learning to use computers. Bruce et al. (1985) conclude that the success of open-ended programs involving the use of CMC in education requires participation and cooperation from both students and teachers.

According to Costanzo's (1994) observations and synthesis of related research, computers divert attention and authority away from the teacher, leading students to focus on the text itself. This change makes some teachers uneasy as they consider the prospect

of a role as more coach or mentor. In Graves' experience, integrating the computer into the writing process "allowed, even forced [them] sometimes, to use a more student-centered, collaborative approach to learning" (Graves and Haller 1994:146). Levin and Thurston (1996) reach the same conclusion in their analysis of findings from several studies.

Early claims that writing at the computer would decrease individual communication between teacher and student have proven untrue (Dickinson 1986; Graves 1995). Dickinson's (1986) study revealed no difference in the time spent in student/teacher interaction, and Graves' (1995) study showed increased communication between individual students and their teachers in the context of cooperative learning and portfolio evaluation.

Moreover, as noted in section 2.1.2, the world of CMC offers students access to experts outside their classrooms. Some teachers have taken advantage of this possibility through ongoing projects between children and graduate education students (Moore 1991; Dale and Traun 1998). Moore's (1991) analysis revealed that fifth grade participants reflected the graduate education students' use of examples, detail, and vocabulary. Interaction with the assigned reading text and, simultaneously, with their partners, increased both the quantity and quality of the children's writing. The graduate students saw the benefits of using questioning and modeling in instruction, and began to realize ways e-mail could be integrated into a reading/writing curriculum. In addition to the improvements in high school students' critical thinking and writing, Dale and Traun (1998) found that the university students' responses shifted from a focus on the writing itself (e.g., "nice idea," "good") to the literature they were discussing. They learned to ask thought-provoking questions which stimulated more mature reading and writing from their high school partners. Both the Moore (1991) and Dale and Traun (1998) studies show

improvements not only in the children's writing and critical thinking, but in the university students' ability to promote the same.

While not all of the factors related to educational computer use and its effects which are discussed in section 2.1 can be evaluated in the present study, some are particularly relevant. According to previous research, the level of support from both the teachers and administration of the experimental school regarding the use of computers in general and e-mail in particular, should affect the viability of the project. In addition, all fourth grade students at Boyd will need to have equal access to e-mail in the classroom setting, regardless of gender or intellectual abilities, in order to minimize extraneous influences on the results. With respect to the language-focused findings of previous research, will Boyd students shift their attention from mechanics to content? If so, will their mechanical accuracy suffer? Will writing skill among the e-mail students increase in development, organization, fluency, and/or complexity? Will the presence of an authentic audience within a real communicative context have an impact on the e-mail discourse? Will students write longer texts? If any of these improvements are demonstrated in actual e-mail texts, will the effects transfer to subsequent handwritten discourse? Will the return to an imagined audience after communicating with an authentic one affect students' writing? These questions are among those addressed by the research questions of the present study.

2.2 CMC scholarship

2.2.1 Linguistic studies

Linguistic studies of computer-mediated communication focus on evaluating the language of the messages. CMC is a relatively new topic of study in the field of linguistics (Herring 1996a). As such, researchers have found it necessary either to adapt methods of analysis in existence, or invent new ones. Some of the methods which researchers have

chosen include conversational analysis and text analysis. Mimicking the spread of the medium itself, studies of CMC began with adult usage and are gradually moving from the university level back into the secondary and elementary realms. Consequently, linguistic studies concerning children's CMC are few. The selection of studies discussed here covers a range of participant ages and is classified according to whether the study involves synchronous or asynchronous CMC.

2.2.1.1 Synchronous CMC

Synchronous CMC consists of computer-mediated interaction which occurs in real time, with temporal limitations similar to spoken discourse. An interest in comparing CMC to spoken and written discourse has triggered a number of studies. Condon and Čech (1996) compared face-to-face and synchronous computer-mediated decision making and concluded that CMC is more efficient, but face-to-face interaction yields more detailed plans. Their results showed that CMC users omit unnecessary linguistic material; however, they make more use of requests, both for information and action, and metalanguage, to organize the structure of the discussion.

Ko (1996) compared exchanges on Daedalus InterChange, a real-time chat protocol used in university settings, with spoken and written text, and found the CMC more closely resembled the spoken data. His analysis showed the CMC to be interpersonally involved, syntactically fragmented, and minimal in providing information and elaboration. Ko suggested that such factors could render the medium unsuitable for in-depth discussions but useful for encouraging widespread participation.

An analysis of Internet Relay Chat (IRC) conducted by Werry (1996) revealed numerous forms of reduction and omission. The sequence of conversation was jumbled and topic shifted rapidly. The high level of informality led Werry to emphasize the orality of this real-time communication.

Herring and Nix (1997), in a comparison of social and pedagogical IRC, found differences in topic coherence depending on the purpose of communication. Pedagogical chat proceeded in a highly logical fashion, typified by a teacher question and student response. Social chat, on the other hand, was disjointed in its progression, jumping between topics or pursuing vaguely related tangents.

2.2.1.2 Asynchronous CMC

Unlike synchronous CMC, asynchronous CMC is not subject to the constraints of real time interaction, since sender and receiver need not be logged on at the same time. Messages can be edited, and there is generally a time lapse of a few hours to a few days between the initiating message and the response. Typical forms of asynchronous CMC are personal e-mail and postings to discussion lists or bulletin board systems. In a comparison of e-mail messages and written memoranda at an Australian university, Cho (forthcoming) identifies the need to balance linguistic economy with social and phatic contact between participants. She found that the e-mail used shorter words and sentences, more abbreviation, and more omission of words. While some abbreviated forms seemed to be employed for their economy of keystrokes (e.g., sentence-initial lower case letters), other forms were used despite the requirement of additional keystrokes (e.g., capitalization for emphasis). She concluded that linguistic economy and informality in the CMC were used to evoke a less formal "conversational" style than would be expected or accepted in business memoranda.

Collot and Belmore (1996) analyzed messages posted to a Canadian bulletin board system using Biber's (1988) multidimensional analysis, comparing their results with those for a variety of spoken and written genres. They found that "electronic language" most closely resembles public interviews and letters (personal or professional). According to

their results, CMC is more involved than informational, more non-narrative than narrative, more situation-dependent than explicit, and more abstract than concrete.

In a study of computer conferencing in a British university setting, Yates (1996) used a Hallidayan model to evaluate textual, interpersonal, and ideational functions of the discourse of CMC relative to spoken and written data. He concluded that the CMC was more similar to writing in lexical density and overall pronoun use, more similar to speech in reference to first and second person, and stronger than either speech or writing in use of modal auxiliaries.

Zyngier and de Moura (1997) conducted a study of fifth grade Brazilian students' e-mail to examine linguistic and psychological elements (e.g., development of higher-order mental processes, interactional setting). Through segmentation of the text into communicative events and analysis based thereon, they conclude that the data demonstrate features associated with orality. Zyngier and de Moura also assert that the potential of electronic messages in an educational setting lies in cognitive development, as students are involved in solving problems and negotiating meaning in an informal context.

Herring (1996b) used macrosegmentation to analyze e-mail messages posted to two academic mailing lists, one consisting of predominantly male postings and the other predominantly female. She concluded that both genders submit messages for the same purpose, but structure their messages differently. Females generally aligned themselves with their audience, while males set themselves in opposition.

Nix (forthcoming) found that both gender and native language influenced the politeness strategies of children sending requests for an electronic penpal. Girls were friendlier than boys, but boys were more conventionally polite in their request strategies than girls. Native language politeness norms also appeared to influence the children's politeness choices in English.

There are similarities in the findings of many of these studies. General patterns seem to identify CMC as exhibiting properties of spoken discourse; this is true for asynchronous as well as synchronous CMC. Employment of reduced forms and inexplicitness lends an informal quality associated with orality. How will these factors, found in analysis of computer-mediated discourse, influence Boyd students' writing? Will Boyd students demonstrate reduction, omission, a greater number of oral features, and/or lack of elaboration? In section 2.2.2, the implications of these and other CMC features are considered for their influence on writing.

2.2.2 Claims of effect on writing

Debates continue among CMC researchers concerning "technological determinism" and language use. Proponents of one side claim that the medium itself is responsible for different language use patterns than are found in spoken or written data (Baron 1984; Ferrara et al. 1991; cf., Williams 1977), while proponents of the other side set forth the necessity of considering social and cultural circumstances of use (e.g., Lea, O'Shea, Fung, and Spears 1992; Rice and Love 1987). Cherny (1995) focuses on CMC context and concludes that computer-mediated language functions as a linguistic register, varying among and within types of CMC. She notes that most advocates of technological determinism generalize their findings to all CMC, or at least to that which is asynchronous/synchronous. She joins Markus (1994) in claiming that CMC participants are "rational actors" whose discourse features result from communicative choices, not impositions of the medium. If the claims of technological determinism are true, this study should show that the discourse features of fourth grade students' e-mail are similar across all users, including those within the student group and those found among adults (e.g., more reduction and omission than in written discourse).

Some argue that the use of CMC will eventually affect one's writing skill, and that just as the positive effects listed in section 2.1.4.2 are believed to transfer, so do the less desirable traits. As early as 1984, Baron wrote of one mode of communication influencing the linguistic shape of another and warned of dire consequences for written English following the spread of CMC. Baron analyzed how the medium of communication affects both what and how ideas are expressed. She predicted that while logical sequencing might improve, stylistic variation would likely decline, leading to a monotonous homogeneity among writers. Keisler, Siegel, and McGuire's (1984) study of CMC analyzed social and psychological aspects of using the medium for work-related tasks. Based on experimental conditions, they found that CMC alters organizational hierarchy, leads to a mixing of work and personal communication, tends toward an extreme of either polarization or intimacy, affects group decision making by making the process slower but more democratic, and promotes a focus on the message rather than the addressee. Consistent with Baron's assertion that the medium is ill-suited to social interaction, Keisler et al. concluded that CMC leads to depersonalization, and that the lack of feedback could make messages difficult to comprehend.

Ferrara, Brunner, and Whittemore's (1991) analysis seemed to support some of these fears. After examining syntactic and stylistic features of what they termed Interactive Written Discourse (a synchronous form of CMC as used in an experimental setting), the authors referred to a similarity between CMC and note taking. While they acknowledged that the constraints of real-time interaction and register probably explained many of the reductions and omissions, they suggested that a few features (e.g., sentence initial lower case letters) were gradually emerging as norms and might eventually influence written conventions as a whole.

Herring's (1997) study, however, tells a different story. In a study encompassing eleven years of continuous data, she examined a sample of archived messages posted by

computer science professionals to an early computer-mediated discussion group on the Arpanet (the predecessor of the Internet). Her analysis included measures of syntactic complexity, formality, politeness, and variance. While Herring admitted that CMC meets the social conditions for language change, her findings for authentic (i.e., non-experimental) data do not bear out many of the earlier claims for language change. Rather than sentences becoming shorter and more fragmented over time, syntactic complexity remained relatively high. Errors tended to decrease, rather than increase. Participants exhibited less formality and affirmation of others over time, becoming more blunt and sometimes openly critical, although the overall tone remained civil. Moreover, the style did not become homogeneous, but rather demonstrated great variability during all periods of analysis.

If language does not degenerate in a medium which is itself alleged to promote such an effect, why should it be expected that writing skill in handwritten texts would necessarily decrease as a consequence of using CMC? With respect to this research question, how can one determine if the use of CMC has caused a decrease in the quality of subsequent handwritten material? Can the same methods used to study the discourse of CMC be applied to handwritten texts? These questions, among others, led to the categories of analysis identified in the research questions posed in chapter 1, and aided in determining which of the currently existing methods of analysis were relevant in this case. While there are numerous approaches to CMC analysis (see section 2.4), the present study focuses only on those concerned with language structure and formality.

2.3 Instruction in writing as a process

The approach to writing instruction adopted in this study is that of a process approach. Graves (1983) notes that the elements of the writing process can be described, but that the order is unpredictable. Rehearsal is the stage in which topics push themselves

to the surface and produce better writing when they are not dictated by the teacher. Composing covers the point from which the first letters are written to completion of the last draft. Graves writes of the need to focus on content, since "the child who can take control of his information will soon take control of mechanical conventions" (238). He discusses problem solving stages and the growing ability to look at the piece from a different perspective. He also emphasizes publishing, because writing is essentially a public act and will later provide evidence of a child's progress. This step also leads to a natural focus on more surface conventions.

Calkins (1986) refers to the need to understand the "craft of writing" in order to assist writers in employing strategies. She identifies the stages of rehearsal, drafting, revision, and editing. Rehearsal is the formation of ideas or collection of raw materials. Drafting reflects the tentative nature of initial efforts to move the ideas onto paper. Revision is seeing the work again and making changes as meaning develops. Because the major changes were made during revision, editing is easier and serves to clarify and finalize the piece. Writers move back and forth between the stages, spending varying amounts of time. Steps do not proceed in linear fashion but are overlapping and recursive. To be effective writers, students must learn to interact with their own writing through conferences with teachers and peers. Teachers must allot extended blocks of time over a period of days for children to move through these steps.

Tompkins (1994) notes that the writing process shifts focus from the product to the thoughts and behaviors of students as they write. She identifies five stages in the cyclical process of writing: prewriting (identifying a topic, purpose, and audience), drafting (writing for content), revising (making substantive changes based on teacher and peer feedback), editing (correcting mechanical errors found in proofreading), and publishing (sharing in an appropriate form). Writers, from elementary to adult, have been found to monitor themselves and move between stages accordingly. Tompkins asserts four

precepts for the writing process. These precepts are that elementary students can write, develop a repertoire of writing strategies, separate revising and editing, and use a problem-solving approach.

Graves (1983) is recognized by educators for establishing many of the foundations of process writing. While other education researchers identify various stages or steps in the process, all agree that writers of any age or developmental level make their way through the process by moving back and forth between often overlapping stages of formulating ideas, getting those ideas onto paper, making changes at increasingly more detailed levels, and sharing the information with others. They emphasize the importance of audience input at each stage. Process writing affects demonstration of control over the mechanics of language, organization, argumentation, and audience awareness. These categories form the basis of analysis in this study.

The writing process takes time. TAAS examination methods force students through as many stages as students will go in one sitting. Although many teachers argue that the TAAS essay is an unfair representation of students' abilities, TEA standards are the current method for evaluating better writing in this context. A rigorous analysis thereof provides linguists with information regarding fourth grade writing in a controlled context.

2.4 Applicable methods of discourse analysis

Since CMC bears similarities to both spoken and written discourse, a large variety of possibilities exists for analysis. This study is concerned with a selected group of e-mail messages and with the effect they and other e-mail writings have on subsequent handwritten compositions. Because the focus is not on the e-mail interactions per se, many of the discourse analysis methods previously used in analyzing CMC are inappropriate (e.g., exchange structure (Herring and Nix 1997)). Likewise, procedures for comparing

CMC to spoken and written discourse (e.g., multidimensional analysis (Collot and Belmore 1996)) or analyzing computer-mediated text. alone (e.g., macrosegmentation (Herring 1996b)) are not in and of themselves sufficient to answer the research questions of this study.

The present study draws elements of discourse analytical methods from a number of sources. Based on the assertion that e-mail messages may be treated as monologue texts (Herring 1996b), the e-mail essays are evaluated according to the same criteria as the handwritten essays. For analysis of the data, this study uses methods of text analysis including but not limited to macrosegmentation (Longacre 1992), topic coherence (Hobbs 1990; Herring and Nix 1997), and lexicogrammatical analysis (Halliday 1992).

Macrosegments (Longacre 1992) are functional constituents which contribute to global organization of the text. In some cases, they are distinguished by text formatting, formulaic discourse markers, or shifts, such as in person or tense; however, macrosegments require only notional coherence for identification. This concept is useful in evaluating the structural organization of a text as well as development of its central idea.

The concept of topic coherence (Hobbs 1990; Herring and Nix 1997) yields further elements in the categories of organization and argumentation. Hobbs (1990) designed a system for analyzing topic coherence based on whether, relative to preceding moves, a move was on topic or shifted the topic through a parallel move, explanation, or metatalk. Herring and Nix (1997) expanded this concept to include breaks in coherence and a measure of distance for each of the other move types. The notion of coherence is essential in organization and argumentation.

Halliday's (1992) lexicogrammatical analysis examines several features: theme, information structure, mood and modality, transitivity, clause complexes, lexical cohesion, and nominalization and grammatical metaphor. Some concepts taken from these features were adapted for the study of other discourse elements in the present study.

Certain features of analysis from portions of the research discussed in section 2.2 are relevant to the present study. Yates' (1996) concept of ideational aspects, evidenced by modal auxiliaries in his data, was applied as a measure of the explicitness of the author's opinion in the introductory and concluding elements of argumentation. The body of the message in Herring (1996b), especially expression of views, requests for and provisions of information, apologies, and appeals, was included in either the argumentation or audience awareness section. Some of the discursive properties of IRC (Werry 1996), including abbreviations and prosodic cues, were counted as oral features in the present corpus. Cho's (forthcoming) basic grammatical statistics of words per message, sentences per message, and words per sentence were used as base measures. In addition, selected linguistic variables from her study which were included in this study as language control measures are use of lowercase in place of capital letters, omission of essential punctuation, and several other omission features. Abbreviation/clipping, contraction, and repetition of letters, punctuation, or capitalization for emphasis were counted as oral features. Some of Herring's (1997) elements of syntactic complexity were used in calculating the base measure of grammatical complexity, a few elements of syntactic simplicity were included in language control, and certain measures of informality (e.g., colloquial language) were used in oral and informal feature analysis. Nonetheless, even this combination of elements from various studies did not allow for a completely satisfactory analysis of the data.

To complete the model, the researcher used information from the Texas Education Agency (1995) to formulate additional categories and elements of analysis. TEA's objectives and measurement specifications address 1) relevance to a given purpose and audience, 2) organization, 3) elements of English language control at the word and sentence levels, and 4) development of the central idea.

In order to be useful in an educational setting, the analysis must reflect evaluative measures recognized by the institutions which the results would most affect. The current standard for scoring compositions according to TEA (1997) is "focused holistic scoring" by which the whole composition is evaluated according to established criteria. Although numerous educators vehemently disagree with the TAAS method for writing evaluation, and little research has been conducted to evaluate the TEA criteria, at present it is the method by which they must abide. TEA (1995) provides for an understanding of the established criteria. This document sets forth objectives (see section 3.4.3 for a list of the objectives), supported by the corresponding rationales and instructional targets, which are to be met by fourth grade writing. This information, along with the descriptions of successful responses for each text type, or mode of writing as referred to by educators (e.g., narrative, persuasive), and an appendix specifically addressing language control, provided the researcher with a basis for devising a coding system for the various categories and elements.

In summary, previous research has examined use of computers in educational settings, the language of computer-mediated communication, and/or the applicability of discourse analysis methods to CMC; however, little research has yet been done that considers the intersection of these three topics of analysis. The present study aims to address this gap.

CHAPTER 3

DATA AND METHODOLOGY

3.0 Introduction

This chapter consists of four major sections which clarify the statement of the problem, and describe population and sampling, procedures for collecting the data, and procedures for analyzing the data. In order to collect appropriate data for reaching conclusions concerning certain problems, it is first necessary to articulate the problem of the study precisely. Therefore, section 3.1 refines the statement of the problem, and subsequent sections specify in detail how those problems are addressed. Section 3.2 describes the population and sampling method, including the selection process for the experimental, control, and e-mail exchange schools. The selection of essays used in the analysis is also explained. The procedure for collecting the data is detailed in section 3.3. This procedure includes permission to conduct the study, prompts for the essays, e-mail interaction, student survey, teacher interview, limitations, and assumptions of the study. Section 3.4 describes each of the steps in analyzing the data: storing the coding in electronic form, coding the categories and elements (with definitions and examples), calculating overall scores, and performing various statistical analyses.

3.1 Statement of the problem

The specific problem of this study is to determine the difference in writing ability between an experimental group of fourth grade students who used e-mail as part of their curriculum, and an otherwise similar control group who did not. The fourth grade students at Boyd Elementary served as the experimental group and fourth grade students at Stewarts Creek Elementary served as the control group. Differences in writing ability were

measured overall, for six specified categories, and for specified individual elements within the categories. The categories are:

(1) base measures (number of words, number of sentences, number of words per sentence, and grammatical complexity)

(2) language control (capitalization errors, punctuation errors, spelling errors, incomplete sentences, and grammar errors both not affecting and affecting meaning)

(3) organization (presence of introduction, support, conclusion, and breaks in logical progression)

(4) argumentation (effectiveness of introduction and conclusion, number of reasons given that are relevant, irrelevant, and detracting to the topic, number of reasons given that are relevant, irrelevant, and detracting to the audience, and elaboration)

(5) audience awareness (use of greetings, personal "you," inclusive "we," questions, requests for action, imperatives, assumptions of correct audience, violations of audience, requests for approval, apologies, thanks, compliments, and requests for the other's opinion)

(6) oral and informal features (use of interjections, prosody, contractions, abbreviations, Arabic numerals, slang or colloquial speech, repetition of words, tag questions, and quotes).

These categories were selected because they follow from the methods of discourse analysis, especially the TEA criteria, discussed in section 2.4.

A further goal of this study is to determine the relationship between writing ability of fourth grade students at Boyd Elementary and Stewarts Creek Elementary, and a specified set of predictor variables among the students and/or their teachers. These variables are the students' frequency of writing at home, the students' frequency of computer use at home, the students' frequency of e-mail use at home, the students' frequency of computer use at school, the teachers' number of years spent teaching, the

teachers' number of years spent teaching fourth grade, the number of hours spent on in-class writing per week, and the number of weeks spent on persuasive writing per year.

3.2 Population and sampling

The population for this study is fourth grade students at Boyd Elementary and Stewarts Creek Elementary. In order to conduct the study, it was necessary to obtain an experimental group which would use e-mail and a control group which would not. Because the subjects were elementary school students, it was not feasible to divide existing classes such that some class members were in the experimental group and others were in the control group. A nonequivalent control group design allowed the students to be studied in existing classes, so that all fourth grade students in the same class and school followed the same curriculum.

The fourth grade level was selected based on the essential elements developed by the Texas Education Agency. Children in fourth grade are expected not only to use basic skills correctly, such as capitalization and punctuation, but to employ higher-level writing skills, such as writing with a purpose and sense of audience. These same skills are those which would be expected to develop in the course of an e-mail exchange program, since the children would be seeking to communicate with an audience who will respond to their messages. Fourth grade is also the first year in which students taking the Texas Assessment of Academic Skills are required to submit a written composition. By using students in this grade for the study, comparisons could be made of each participant school's past performance on that particular portion of the exam. These comparisons allowed the researcher to identify a school to serve as the control group which was comparable to the e-mail group in writing ability demonstrated on the TAAS exam over the previous two years' scores.

3.2.1 Selection of schools

3.2.1.1 Boyd Elementary

Boyd Elementary was particularly suited to the project due to its recent acquisition of e-mail capability. Boyd, in the Allen Independent School District (ISD), is equipped with at least one computer per classroom and thirty computers in the computer lab with telecommunication capability. Since the students at Boyd Elementary began using e-mail late in the spring of 1997, most were at least somewhat familiar with the mechanics and would have been able to send messages with ease early in the fall semester if the e-mail program had remained the same.

The e-mail exchange program was in some ways merely an extension of what teachers in Allen elementary schools were already doing. Each grade level is increasingly involved in using computer applications such as word processing, spreadsheets, and data presentation. These skills will be important as the children progress through school and eventually into the workforce; however, telecommunication skills are also coming to be viewed as a necessity. The students had also been participating in joint computer projects. For example, at Boyd Elementary, children worked together to develop PowerPoint presentations and even a web page which they entered in a nationwide peer review contest. Because the students had worked with those in other classes and grade levels within their school, the next logical step was to cooperate with those in a different location.

3.2.1.2 Story Elementary

Story Elementary, also in the Allen ISD, was chosen as the exchange school for the e-mail project. This selection was made by Boyd's instructional designer in cooperation with the researcher. It was decided to restrict keypal relationships to other fourth grade students in the same district for control purposes in the experiment and to alleviate some fears of the students' parents. Because the students would follow largely

the same curriculum, students in the same district would be more likely to provide comparable peer input rather than input which was either greatly superior or inferior to the work of children at Boyd. Story Elementary was selected based on the willingness of the instructional designer to commit to the project.

3.2.1.3 Stewarts Creek Elementary

In order to carry out the study, it was necessary to locate another school similar to Boyd in demographic and curricular composition, with the exception of e-mail use. The Texas Education Agency maintains a website which contains a vast amount of data regarding Texas districts, schools, educators, and students. The "Campus Comparison Groups" feature allows one to select a target school and generates the thirty-nine most similar schools in Texas based on grades of instruction, percentages of Hispanic, African American, and white students, percentage of mobile students (those transferring in and out from the previous year), percentage of economically disadvantaged students, and percentage of limited English proficiency students enrolled (see table 1). Using Boyd Elementary as the target school, the field of thirty-nine schools was limited to eighteen based on geographic proximity to Boyd and accessibility to the researcher.

Table 1. Demographic Statistics for 1995-96 by Category and School

	Boyd	Stewarts Creek
Hispanic enrolled	9.0%	10.3%
African American enrolled	6.9	5.6
White enrolled	82.1	81.5
Mobile	21.0	12.6
Economically disadvantaged	14.8	13.8
Limited English proficiency	0.0	0.7

The Academic Excellence Indicator System, also at the TEA website, provides access to detailed information on each campus. Obtaining the records for each of the

eighteen schools allowed the investigator to compare the percentage of students at each campus who passed both the overall TAAS exam and the writing portion in particular. Scores were available for the previous two academic years at the time participating schools were identified and were used to compare the eighteen remaining schools. Seven schools were identified as being most like Boyd and were ranked for similarity. The principal of the campus which ranked first agreed to the project, but the administration subsequently denied permission to conduct the study. The second most similar school, Stewarts Creek Elementary, and their administration readily agreed to participate (see table 2).

Table 2. Percentage of Students Passing TAAS Overall and Writing Portion by School and Year

	1995	1996
Overall		
Boyd	63.9%	56.3%
Stewarts Creek	74.0	76.2
Writing		
Boyd	88.3%	78.3%
Stewarts Creek	94.7	82.0

3.2.2 Selection of essays

While the population for the study includes all fourth grade students at Boyd and Stewarts Creek, not all students participated in all sections of the study. Due to the necessity of using the same sample of students for comparison at different points in the study, only the data from those students who participated in both of the essays being compared were used. In addition, five students at Boyd did not return consent forms, so their essays were not included in the analysis. Table 3 shows the participation of students in each school for each of the testing periods and the number which were used for comparison. The first column identifies the essay number or essay sets compared in the

analysis phase of the project. The remaining columns indicate the number of student essays included in the particular essay or comparison, organized by school and finally by total number. These students were under the instruction of one of four fourth grade teachers at each of the schools.

Table 3. Participation of Students by School and Essay

	Boyd	Stewarts Creek	Total
Essay			
2	77	79	156
3	77	70	147
4	72	76	148
Comparisons			
2 and 3	69	58	127
2 and 4	63	61	124

3.3 Procedure for collecting the data

3.3.1 Permission to conduct the study

Due to the fact that the study involved children, numerous avenues were pursued until all necessary permission was granted. Concerning the participation of those in the Allen ISD, permission to carry out the study was obtained from the fourth grade teachers, instructional designer, and principal at Boyd Elementary, the instructional designer and principal at Story Elementary, the technology facilitator for Allen ISD, and the superintendent of schools for Allen ISD. In Lewisville ISD, of which Stewarts Creek is a part, permission was obtained from the teachers, grade level coordinator, and principal at Stewarts Creek Elementary, the executive director of elementary curriculum for Lewisville ISD, the executive director of personnel for Lewisville ISD, and the superintendent of schools for Lewisville ISD. The project was also reviewed and approved by the Human Research Review Committee at The University of Texas at Arlington.

The student participants and their parents or guardians were also asked to give consent for the students taking part in the project. Fourth graders at Boyd received a consent form along with a cover letter from the school describing the study and encouraging support thereof (appendix A). As previously noted, all but five of the Boyd students returned the signed consent forms. Students at Stewarts Creek received a slightly modified version of the consent form (appendix B), and all students returned the documents signed by both them and their parent or guardian.

3.3.2 Essay prompts

The study was designed so that handwritten essays would be taken from both the experimental and control groups at four different points in the school year. The first was to be taken near the beginning of the school year and used as a measure of initial comparability between the children at the two schools. The second essay was scheduled for January, not long after the winter break. During March, the third essay would be administered like the others, with the exception that the Boyd students would type their essays on computer and send them via e-mail to their keypals at Story. Near the end of the school year, in May, a final handwritten essay would be taken at both schools.

It was decided that all four essays should represent the same type of writing for ease of comparison, and that persuasive writing would more readily reflect the children's abilities in organization, argumentation, and audience awareness than any of the other possibilities identified by TEA for use on the TAAS exam. TAAS writing prompts are designed for one of three purposes: expressive (narrative prompt), informative (how-to or classification prompt), and persuasive (persuasive prompt). Each of these prompt types was examined for its usefulness in evaluating the six coding categories identified in section 3.1 (see table 4).

Table 4. Usefulness of Prompt Type by Coding Category

	Narrative	How-to	Classification	Persuasive
Base measures	X	X	X	X
Language control	X	X	X	X
Organization			X	X
Argumentation				X
Audience awareness		X		X
Orality	X			

Base measures and control of the mechanics of language are equally analyzable in any of the prompt types. The chronological organization of a narrative or how-to prompt requires a lower level of skill than that needed for classifying or persuading. With the possible exception of justifying classification categories, only persuasive writing requires argumentation. How-to and persuasive essays more accurately reflect audience awareness, because students must more directly base the information they provide on assumed background knowledge of their reader. Of the four prompt types, a narrative is most likely to demonstrate oral and informal features. As shown in table 4, the best prompt type for use in this study is persuasive. Moreover, Eaton argues that "persuasive writing is considered by most professionals to use the highest level of thinking skills of any of the types of writing tested on the *TAAS* test" (1989-90:unit 5, page 1).

All prompts for the essays were taken from Mammen (1996). This book of exercises is intended to give fourth grade students practice for the writing portion of the TAAS, and all material contained therein is designed to meet the requirements of that exam. The four prompts (appendix C) were selected in consultation with Susan Lerew, instructional designer at Boyd and coordinator of the project for that campus.

The writing prompts were administered largely in the same manner as the writing portion of the TAAS in order to maintain uniformity across classes and schools. There is no time limit placed on the writing portion of the TAAS, so the exception to TAAS specifications was that students were limited to forty-five minutes of writing time. This

control was established to ensure further comparability of the essays. Only one exception was made to the forty-five minute time limit. Because fourth graders type more slowly than they write by hand, students at the e-mail school were allowed one hour for the prompt which was typed on the computer and e-mailed. During the allotted time period, students were allowed to do any pre-writing they wished but were not required to do so. The instructional designer administered the prompts to all the individual classes at Boyd, but each teacher administered the prompts to her own class at Stewarts Creek.

The dates the prompts were actually given were not as consistent with the time frames requested and preferred for the project. Boyd Elementary collected essay 1 during the week of August 18, their second full week of class for the 1997-98 school year; however, Stewarts Creek did not give the prompt until October. The second prompt was administered at both schools during the week of January 12, shortly after returning from the winter break. Prompt three was given at Boyd during the last week of March and not at Stewarts Creek until the first week of May. The final essay was written during the second week of May at both campuses, shortly before school was dismissed for the year.

3.3.3 E-mail interaction

As of May 1997, Boyd was led to believe that each fourth grade student at their campus would have a separate e-mail account rather than the standard grade-group account. In early August, they learned that they would still have only grade-level e-mail accounts but were told that all students in a class would have the capability of sending their messages at the same time. This was to be possible using the newly installed Groupwise e-mail package; however, by the end of August, the e-mail was still not functioning. More upgrades were necessary, including more memory for the lab computers and a new server. By mid-October, e-mail was working within the school building at Boyd, and they thought the system was ready for the project.

Problems sending e-mail between Boyd and Story continued through November and December. It was decided to continue to use group mail boxes for security purposes, but this made the process of logging on and sending very slow, if not impossible. The children had to log on in small groups so as not to overload the server. This process occupied twenty of their thirty minutes in the lab. Sending messages was no better. On the first try, all students in each class attempted to send their messages at the same time, and only sixteen of the eighty-two composed actually reached their Story keypals. Finally, in early December, the fourth grades at each campus were given four accounts rather than the one grade-level account they had been attempting to use. Even this did not solve the difficulties, however.

At the insistence of Boyd's instructional designer, the network administrator and others continued to seek a solution. It was determined that following the winter break, they would use the Web Access feature of Groupwise to send all messages simultaneously. This solution also failed. In early January, as the children once again tried to send messages to their Story keypals, there were no difficulties in logging on, but Netscape timed out as the children typed their messages. Each message had to be copied and pasted into a new message in order to be sent.

Early February saw the addition of more accounts so that the total available for each school involved in the project was thirty. This allowed each student in a class to be working concurrently from a different account. Although still not flawless, this system worked better than any of those tried previously. On February 13, Boyd students at last opened introductory messages from Story and were instructed to reply with two sentences about themselves and the beginning of a round robin story.

Late in February, the instructional designers at Boyd and Story agreed that the Boyd students would limit their e-mail to every other Friday. This would allow students who were absent at either school to catch up on the e-mail, messages which had not gone

through to be resent, and a better match of time between the two schools. All students at Boyd have two computer lab times of one-half hour each per week. The fourth graders were allotted an additional half hour slot specifically to be used for the e-mail project. Children at Story were only allowed half the time in the computer lab that Boyd students received. Because they had other requirements to fulfill within that time, students at Story were very limited in the time they were able to spend on e-mail.

When students entered the computer lab for their e-mail section, they logged on using whatever procedure was currently being tested. They were then given instructions about the content of their message for that day. Over the course of the semester, the students sent introductory statements, contributed to a round robin story at least twice, composed and responded to a persuasive essay, and tried to recreate a picture from a written description. The children were required to have an adult proofread their messages before they sent them in order to check for "school appropriate content." The researcher was able to observe several sessions of e-mail use and attempted use among the students at Boyd and to access the e-mail messages via the Internet with user names and passwords obtained from Boyd. Although all e-mail messages were collected, a full analysis of such is beyond the scope of this study.

3.3.4 Student survey

During the final week of the school year, when all essays and the e-mail project had been completed, the fourth grade students were asked to complete a survey. This instrument was developed by the investigator to learn more about the participants' attitudes and practices concerning writing in general, use of computers, and the e-mail project. The survey was also designed to gather relevant demographic data. Students at Boyd (appendix D) and Stewarts Creek (appendix E) received the same survey, with the

exception that questions concerning the actual e-mail project were deleted from those copies given to the control group.

3.3.5 Teacher interview

The teachers of each of the classes involved in the project were interviewed after all other aspects of the study were completed. These interviews were conducted individually by the researcher and were tape-recorded in order to gather more information in a brief time period. The questions concerned writing and computers (appendix F). Writing questions sought to determine philosophy, methods of instruction, and time devoted to writing, with particular emphasis on persuasive writing. Further questions investigated each teacher's attitude toward computers, how much and in what ways technology is used in the curriculum, the training received by teachers and students, and the teachers' opinions concerning the impact of computers on writing. Teachers also provided relevant demographic data.

3.3.6 Limitations

That the four prompts were all different could result in instrumentation invalidity. Measures to guard against this include the use of prompts which were all tested according to the same standard (Mammen 1996), and the use of a control group. If the use of different instruments caused an effect, the effect should have been the same on the control and experimental groups, still allowing for comparison.

Differential selection results from the non-random choice of experimental and control subjects. The danger that experimental results are due to pre-treatment differences is controlled in this study by using analyses of covariance.

3.3.7 Assumptions

The students and teachers are assumed to have given accurate information in their responses to survey and interview questions. The researcher assumes that participants were honest in their answers and correct in their estimates of time.

In addition, it is assumed that inter-rater reliability would be high for the coding of the essays, had multiple raters been employed. To promote the likelihood of a correct assumption in this regard, the coded features were identified in objectively quantifiable terms.

3.4 Procedure for analyzing the data

3.4.1 Electronic storage of coding

Once the essays were collected, the researcher coded them for specified features. It was necessary to store the codings in a program that would do several things: permit ease of access, sort by various features, perform simple mathematical calculations, and facilitate statistical analysis. The Excel spreadsheet program was chosen for this purpose. Each essay set was assigned to a workbook, and each school's data for that essay were entered on a separate worksheet within the workbook. Codings based on the essays of all students with proper consent were entered for each of the specified elements.

3.4.2 Coding categories and elements

This section describes the procedures for coding the various elements and calculating the composite scores. The example calculations are all based on the essay 4 from Boyd shown in appendix G.

3.4.2.1 Essay identification

Each essay was identified by prompt number, date, account, school, and class. The prompt number designates whether the data were from essay 1, 2, 3, or 4. The date identifies when the writing was done, if known. The account consists of the student's

name or computer login. School signifies whether the essay is from Boyd or Stewarts Creek. Although the school distinction was unnecessary at this level, because each campus had a separate worksheet, it maintained the distinction when the data were later combined. Teachers' names were used to indicate classes.

3.4.2.2 Base measures

Each essay was coded for base measures, including: number of words, number of sentences, number of words per sentence, and grammatical complexity. The number of words is a simple count. Sentences were also counted, with run-on sentences being counted as two (or more) separate sentences (example 1):

Example 1
I'm an just asking if we could do this just this ones we have worked so hard can we plase go we have planed this seanse last year. [B4sw]

This example, written as one sentence, was counted as four. The number of words per sentence was calculated by dividing the number of words by the number of sentences to find an average. Instances of grammatical complexity were identified as combinations of clauses in other than a coordinate relationship (e.g., involving relative clauses and adverbial clauses; example 2):

Example 2
When you watch to much t.v. you'll never get enough exercise. [B3sc]

Since their occurrence is likely to be affected by text length, cases of grammatical complexity were expressed in frequency per one hundred sentences. This figure was calculated by dividing the observed number of grammatically complex sentences by the number of sentences and then multiplying by one hundred.

3.4.2.3 Language control

Language control was measured largely according to the elements specified by TEA for evaluating control of the English language on the TAAS, only in greater detail. Errors were counted in capitalization, punctuation, spelling, completion of sentences, and grammar. Because a longer text increases the possibility of errors, each of these figures was adjusted for frequency per hundred words, or per hundred sentences in the case of the number of incomplete sentences. Similar to the process for adjusting grammatical complexity counts, this was accomplished by dividing the number of errors for the particular language control element by the number of words, or sentences, and multiplying by one hundred.

While a variationist perspective would argue for counting complementary features and calculating the number of errors relative to the number of correct uses of that feature (e.g., number of errors in capitalization per number of correct uses of capitalization), only the errors were counted in this study. The latter approach was chosen based on the linguistic precedent of Biber (1988), whose computer-automated tagging system identified only instances of a given feature and not its complement. The counting system used in the present study is also supported by holistic writing evaluation practiced in educational contexts, particularly the TEA's TAAS evaluation criteria. Under these circumstances, evaluators are not concerned with correct uses of a feature but only with the mistakes demonstrated in children's writing.

For the purposes of this study, the exact same mistake in punctuation or spelling was counted only once. If, however, a second misspelling differed from the first misspelling, these were counted as separate errors. The concession for identical mistakes in punctuation and spelling was made due to their consistency, and prevented the skewing of error results based on the same mistake. Run-on sentences were counted as punctuation errors (see example 1). Grammar errors were classified according to whether or not they

seriously compromised intelligibility (examples 3-4). The bolded portion of example 3 shows a grammar error which does not affect the reader's ability to discern the intended meaning, while the error in example 4 does affect the meaning.

Example 3
I want to go hikeing with my **friend** Jayme, bethany, and Alice... [B4kf]

Example 4
T.V. can also mar your eyesight and can damage your eyes very badly, **and if to much T.V. just a tittle T.V. but to much.** [SC3jd]

An aggregate score for language control was calculated by adding the adjusted figures (i.e., frequencies per hundred words) for errors in capitalization, punctuation, spelling, grammar which does not compromise meaning, and two times the numbers for both incomplete sentences and grammar which does compromise meaning (figure 1). The elements were weighted to reflect the seriousness of the infraction. TEA (1997) states that, because the compositions do not represent "polished" responses, only errors which impair meaning will affect the score. Incomplete sentences and grammar errors which compromise the meaning of the sentence are far more serious than errors in the other features (e.g., capitalization), and were therefore multiplied by 2 before being added to the total. The result was one number for each essay representing language control, with lower numbers indicating fewer errors.

The example essay 4 (see appendix G) for Boyd is a 202-word essay which contains one error in capitalization, five in punctuation, none in spelling, no incomplete sentences, and no grammar errors which either do or do not compromise the meaning. This composition would receive a language control score as calculated in figure 1.

number of capitalization errors	(1÷202)(100)	= 0.5
+ number of punctuation errors	+ (5÷202)(100)	= 2.5
+ number of spelling errors	+ (0÷202)(100)	= 0.0
+ 2(number of incomplete sentences)	+2(0÷202)(100)	= 0.0
+ number of grammar errors which do not compromise meaning	+ (0÷202)(100)	= 0.0
+ 2(number of grammar errors which do compromise meaning)	+2(0÷202)(100)	= 0.0
score for language control		= 3.0

Figure 1. Example Calculation of Score for Language Control.

3.4.2.4 Organization

Seven of the eight teachers involved in the study indicated that they teach their students to follow the same basic outline for writing a persuasive essay. This pattern, which consists of an introduction, a middle section offering reasons (at least three) in support of the chosen position, and a conclusion, was used to judge the organization of the essays. In addition, breaks in logical progression (e.g., lack of local topic coherence; example 5) were noted:

Example 5
I would want to go bike ridding because it is safer. And my parents would rather let me going biking enyhow. **And if you fall the rope is tite.** I have no clue how to hike. [SC4j]

This example includes the initial sentences of the essay. The bolded sentence is not topically connected to any of the preceding text. The organization section did not seek to determine how well the specified elements were accomplished (see section 3.4.2.5 for this type of analysis), but only whether they were included in the essay under consideration.

A composite score for the category of organization was figured based on the presence or absence of the features coded for that category. Essays were awarded five points for including each of three features: an introduction, at least three supporting reasons, and a conclusion. The number of supporting reasons was set according to teachers' responses in the interviews. Most teachers stated that they expect a minimum of

three reasons to support a position in a persuasive composition. The essays received five additional points if no breaks in logical progression were found. Thus any given composition could score a maximum of twenty for organization. In the example essay 4 (see appendix G), the student includes an introduction, four supporting reasons, a conclusion, and no breaks in logical progression. This essay would receive an organization score as illustrated in figure 2.

	introduction	present	5 = 5
+	minimum of three reasons	4 reasons	+5 = 5
+	conclusion	present	+5 = 5
+	no breaks in logical progression	no breaks	+5 = 5
	score for organization		=20

Figure 2. Example Calculation of Score for Organization.

3.4.2.5 Argumentation

Argumentation serves as a measure of how well each of the organizational moves is accomplished. While in some cultures (e.g., Japanese (Watanabe 1993)) the ideal is to present multiple positions which may be taken in an argument in an effort to demonstrate the complexity of the situation, the model used for evaluation in this study is based on the cultural norm for American argumentation. Students were explicitly taught that for a persuasive essay, they must choose a side, state their opinion, and present supporting evidence.

The introduction and conclusion were both scored on a scale of zero to four according to the following guidelines:

0 none

1 detracts from purpose (example 6)

2 remains neutral concerning purpose (example 7)

3 implies purpose (example 8)

4 states purpose (example 9)

In example 6, the prompt asked children to choose between doing their homework as soon as they get home from school or later in the evening. By selecting neither, this excerpt from the conclusion actually detracts from the purpose of the essay:

Example 6
And most inportantly homework means do your work at home, instead at school, or at home in the morning. [B2jc]

The writer of example 7 closes the composition with one positive and one negative reason for saving homework until later, in effect canceling each other and yielding a neutral conclusion:

Example 7
These are the last things I'm going to tell you about. A good thing is you can eat a big snack right away. A bad thing is you might have to go somewhere later in the evening. I hope you've enjoyed reading my paper [SC2b]

In response to a different prompt, example 8 implies that families do not watch too much television by noting that television is good, while example 9 clearly states the author's view:

Example 8
Some people think wach T.V. is bad for familys and some people think it is good for familys.I thinkT.V.isgood doun't you? [B3tm]

Example 9
Some kids like to wach t.v. and other familys dont I think people wach to much t.v. I hop you injoyd my papper. [SC3tp]

Another column in the spreadsheet contained a coding for statements of opinion which were not included in the introduction. These were coded on the same scale as introductions and conclusions.

The middle section was coded by counting the reasons which were relevant to the topic (example 10), irrelevant to the topic, detracting from the topic (example 11), relevant to the audience (example 12), irrelevant to the audience (example 13), and detracting to the audience (example 14):

Example 10
I want to go hiking because its eucationel. It helps you learn which trees are which. It helps you learn what are dangerous plant and what aren't. [SC4wh]

In an essay concerning reasons to go hiking, one student (example 11) detracts from the topic by including activities which would not be considered part of a typical hike:

Example 11
I will learn how to hunt...I will learn how to plant. [SC4jk]

The use of the equipment listed in example 12 would certainly be relevant in convincing a parent, the target audience, to grant permission to go bicycle riding:

Example 12
I'll wear a helmet, knee pads, elbow pads, and water on the bottom of the bike in case I get thirsty. I'll be safer than safe, really. No need to fret. [B4sa]

In an effort to persuade a parent to allow the child to go hiking, the likelihood of the child learning to make knives on such a trip is so slim that example 13 would be irrelevant:

Example 13
I might learn to make knifes so we won't have to get any expensive Super Chef knifes. [B4co]

In contrast, example 14 would be more effective in moving the parent to deny permission. Among a list of items one might see on a hike, the writer lists artifacts, big rocks, and mountain lions. The excerpt included here is the paragraph describing the mountain lions:

Example 14
I like mountain lions because they got long teeth and they run fast. They can eat your eyeballs if you are near one. You can get seriously hurt. [B4vm]

While this argument might generate interest, it would be less than effective in persuading a parent to allow the requested hike.

One final element in the category of argumentation is elaboration. The need for elaboration is strongly emphasized by teachers and is scored on the following scale:

0 none—essays written in outline form only or paragraph form with no elaboration

1 minimal—essays with little elaboration scattered through the essay (example 15)

2 moderate—essays with some elaboration of all points

3 extensive—essays with ample elaboration on each point (example 16)

Example 15
I think doing your homework right after school is better. If you do that you'll have the rest of the day to play. It's better because you won't have to worry about doing your homework later on.
Also you will have enough time to do your homework and play. You won't be so tired so soon. I think it is a better time to do your homework. [B2jf]

Example 15 includes the entire essay and demonstrates minimal elaboration. In contrast, the essay from which example 16 was taken consists of an introduction, three paragraphs, each describing a particular supporting reason for the stance taken in the introduction, and a conclusion. The excerpt concerns the desire to play as a reason for the author's waiting until later to do his homework, and offers a relatively thorough description of his play time:

Example 16
Most the time when I get home I manely go play. Some times I climb trees or rock climb. My most favorite thing to play is hibe-n-go-seek with my freinds. I usely go roller blading with a freind but his blades are mest up. [B2md]

It is through connecting several pieces of information, such as those in example 16, to a reason that elaboration is achieved in this context (Fuller and Newman 1996).

The aggregate score for argumentation was calculated by weighting and combining the various elements. Because the introduction and conclusion exert a strong influence on the reader's initial and final impressions of the argument, the scores for these features were multiplied by two. The actual number of reasons was weighted so that those which were detracting to either the topic or audience were multiplied by two. Elaboration, also considered essential (TEA 1997), was multiplied by two as well. The weighted results for the features were added or subtracted depending on their impact on the argument.

Example essay 4 in the appendix, which explicitly states the writer's position in the introduction, implies it in the conclusion and includes extensive elaboration, would be given scores for those features according to the scales listed in this section. The composition further contains four supporting reasons, all of which relate to the topic and audience. Calculations for the argumentation score are illustrated in figure 3.

2(introduction score)	2(4)	= 8
+ 2(conclusion score)	+2(3)	= 6
+ number of reasons relevant to the topic	+ 4	= 4
− number of reasons irrelevant to the topic	− 0	= 0
− 2(number of reasons detracting to the topic)	−2(0)	= 0
+ number of reasons relevant to the audience	+ 4	= 4
− number of reasons irrelevant to the audience	− 0	= 0
− 2(number of reasons detracting to the audience)	−2(0)	= 0
+ 2(elaboration score)	+2(3)	= 6
score for argumentation		=28

Figure 3. Example Calculation of Score for Argumentation.

3.4.2.6 Audience awareness

Certain elements which indicate awareness of the specified audience were also counted. These include use of greetings, personal "you" (example 17), inclusive "we,"

questions, requests for action (example 18), imperatives, assumptions of correct audience (example 19), requests for approval or agreement (example 20), apologies, thanks (example 21), compliments (example 21), and requests for the other's opinion. Violations of audience (example 22) were counted for cases in which the writer was either unaware of the target audience or chose to ignore it.

Examples 17 and 18 illustrate the personal "you" and a request for action, respectively:

Example 17
You always want me to go play outside on my bike. If **you** let me ride my bike it would be really easy for me to do. [SC4jg]

Example 18
Please type me back. [B3dh]

Because the target audience for example 19 is the friend of a fourth grade student, it is highly appropriate to assume that the reader engages in such activities as playing outside, riding bicycles, and studying spelling:

Example 19
My believe that families should not watch T.V, because it's not healthy for your brain and not healthy for you. You can read a book, play outside, study, draw, write., You can ride your bike, do multiplacation, division, like if you have a test of spelling. Study your spelling words or in your spelling book. [SC3t]

The writer of example 20 all but begs for the approval of the reader, while example 21 illustrates both an offer of thanks and a compliment:

Example 20
Did I convins you are you inprest. If I imprest you tell me whan you emall me bake . By tayp you later. Do you agrey with me by for the last time to day. [B2nd]

Example 21
Thank you for lissing to my story. You are a very smart person. [SC3ah]

In contrast, in an essay that is supposed to convince the author's teacher that it is better to do homework immediately after one gets home from school, example 22 demonstrates audience violations through statements about the teacher playing with toys and incurring the wrath of her parents:

Example 22
You will be able to play with your toys. Your parents might get mad if you don't do your homework right when you get home. Your better off obeaing your parents. [SC2jk]

In the full context of the composition, the second person pronouns clearly refer to the reader, the student's teacher, as opposed to a generic other.

A composite score for audience awareness is determined by adjusting each feature for frequency per hundred words and summing the results for use of greetings, personal "you," inclusive "we," questions, requests for action, imperatives, requests for approval, apologies, thanks, compliments, and requests for the reader's opinion. Two features, assumptions of correct audience and violations of audience, are weighted by a factor of two. This multiplication is necessary to indicate the strength of the features. References which specifically apply to the audience or violations thereof would be more conspicuous to the reader than the other elements. The result for assumptions of correct audience is added to the previous sum, while that for violations is subtracted. The results for the example 202-word essay are shown in figure 4.

	greetings	(2÷202)(100)	= 1.0
+	personal "you"	+ (3÷202)(100)	= 1.5
+	inclusive "we"	+ (1÷202)(100)	= 0.5
+	questions	+ (1÷202)(100)	= 0.5
+	requests for action	+ (1÷202)(100)	= 0.5
+	imperatives	+ (0÷202)(100)	= 0.0
+	requests for approval	+ (1÷202)(100)	= 0.5
+	apologies	+ (0÷202)(100)	= 0.0
+	thanks	+ (0÷202)(100)	= 0.0
+	compliments	+ (0÷202)(100)	= 0.0
+	requests for opinion	+ (0÷202)(100)	= 0.0
+	2(assumptions of correct audience)	+2(9÷202)(100)	= 8.9
−	2(violations of audience)	−2(0÷202)(100)	= 0.0
	score for audience awareness		=13.4

Figure 4. Example Calculation of Score for Audience Awareness.

3.4.2.7 Oral and informal features

The oral and informal features coded were use of interjections, prosody, contractions, abbreviations, Arabic numerals, slang or colloquial speech, repetition of words, tag questions, and quotes. Example 23 demonstrates the use of prosody with the extension, capitalization, and exclamation of "I love TV" (warranting a count of three for prosody), two contractions, an abbreviation of the word "television," Arabic numerals, and two instances of slang or colloquial speech in describing all day, every day of the week (24 7) and the deterioration of mental capabilities (rot):

Example 23
I can watch T.V. 24 7 and it wont rot my brain
because I don't have one.
IIIIIIIIIIIII LLLLLLLLLLOOOOOOOOOOVVVVVVVVVVEEEEEEEEE
T.V.!!!!!!!!!! So watch it every day untile you die. [B3dh]

The same oral elements as were coded in compositions as a whole, with the exception of quotes themselves, were coded separately within quotes.

Prosody was exhibited through orthographic or typographic expressions such as in example 23. Contractions, abbreviations, and Arabic numerals are generally proscribed in

written material and would therefore be indicative of a more informal style generally associated with oral expression. Due to the variation in use and non-use of contractions and slang or colloquial language for the same word combination or expression within a given essay, each individual use of a contraction or slang/colloquial language was counted. Distinct abbreviations, however, were counted only once, because the essays showed a consistency of use once an abbreviation was employed. The result for each feature was then adjusted for text length by figuring the frequency per hundred words as previously described.

A composite score for oral and informal features was calculated by summing the adjusted scores for each feature. All elements were equally weighted. The results for the example essay are shown in figure 5.

	interjections	(1÷202)(100)	= 0.5
+	prosody	+ (1÷202)(100)	= 0.5
+	contractions	+ (6÷202)(100)	= 3.0
+	abbreviations	+ (0÷202)(100)	= 0.0
+	Arabic numerals	+ (1÷202)(100)	= 0.5
+	slang/colloquial speech	+ (4÷202)(100)	= 2.0
+	repetition of words	+ (0÷202)(100)	= 0.0
+	tag questions	+ (0÷202)(100)	= 0.0
+	quotes	+ (0÷202)(100)	= 0.0
	score for oral and informal features		= 6.5

Figure 5. Example Calculation of Score for Oral and Informal Features.

3.4.3 Overall scores by objective and essay

Because TAAS performance is a dominant concern among educators, a set of composite results was calculated to reflect the specific objectives measured by the written composition section of the TAAS evaluation. The intention was that the results would provide an objective measure of students' writing abilities in the areas deemed most important by the TEA and the State Board of Education. These objectives are:

(1) The student will respond appropriately in a written composition to the purpose/audience specified in a given topic.
(2) The student will organize ideas in a written composition on a given topic.
(3) The student will demonstrate control of the English language in a written composition on a given topic.
(4) The student will generate a written composition that develops/supports/ elaborates the central idea stated in a given topic (TEA 1995).

Composite scores for each of these objectives were calculated using the codings of relevant features. The objectives are related to the coded features as described in the remainder of this section.

3.4.3.1 Objective 1

Objective 1 combines purpose and audience, so computation of this aggregate score drew on elements from both the argumentation and audience categories. The purpose, in this case statement of argumentative position, is generally included in the introduction; however, the children sometimes clearly state their opinion later in the essay. For this reason, the most clear statement of their writing purpose preceding the conclusion, the higher of the two codings for introduction and statement of opinion, served as the score for the introduction. Another element taken from the argumentation codings was number of reasons irrelevant to the audience. Because the reasons relevant to the audience and detracting to the audience were included as part of the assumptions of correct audience and violations of audience respectively, the latter two were used in the purpose/audience calculation. The conclusion score from argumentation was also included in the calculation for objective 1. The overall figure was determined by adding the introduction/statement of opinion and conclusion scores, adding two times the assumptions of correct audience, subtracting the number of reasons irrelevant to the audience, and subtracting two times the number of violations of the target audience (see figure 6). Because the length of the text can affect the number of irrelevant reasons as well as the assumptions and violations of correct audience, these figures were adjusted for text length before calculating the overall purpose/audience figure.

Multiplication was used to weight the various elements more appropriately. Assumptions of correct audience are strong indications that the student is addressing the appropriate audience; therefore, instances of this feature were multiplied by two to give them more weight before being added to the total. Based on similar reasoning, audience violations demonstrate an equally negative indication, so violations of the target audience were also multiplied by two. Irrelevant reasons detract somewhat from the purpose, but not to the extent of violations. The adjusted number of irrelevant reasons was, therefore, simply subtracted from the total. Likewise, introductions and conclusions are important in the composition of an essay but do not overtly add or detract to the extent of correct assumptions or violations. The scores for these features were added to the total. The result was an overall measure of skill in meeting objective 1, with higher numbers indicating better response to the purpose and audience.

For example, since the author of Boyd essay 4 stated her point in the introduction and implied it in the conclusion, and included nine assumptions of correct audience, no reasons which were irrelevant to the audience, and no violations of the target audience, the score for objective 1 was calculated as in figure 6.

introduction/statement of opinion score	4	= 4.0
+ conclusion score	+ 3	= 3.0
+ 2(number of assumptions of correct audience)	+2(9÷202)(100)	= 8.9
− number of reasons irrelevant to the audience	− (0÷202)(100)	= 0.0
− 2(number of violations of the target audience)	−2(0÷202)(100)	= 0.0
score for objective 1, purpose/audience		=15.9

Figure 6. Example Calculation of Score for Objective 1.

3.4.3.2 Objective 2

The aggregate score for organization of ideas was calculated to measure the student's ability to meet objective 2. The presence of an introduction or conclusion

resulted in a rating of "four" for the respective element, while absence of the same yielded a "zero" for purposes of weighting. The number of reasons given constituted the score for the middle section, and the instances of breaks in logical progression were summed. The number "four" was chosen to weight the introduction and conclusion, because most of the teachers request at least three reasons in the supporting section. Their responses to the interview questions indicate that an introduction and conclusion are critical, while the number of supporting reasons is not as important. A rating of "four" gives the introduction and conclusion slightly more weight than a supporting section with three reasons. The score for organization of ideas was obtained by adding the numbers for introduction, number of reasons, and conclusion and subtracting two times the number of breaks in logical progression, due to their noticeable impairment of a sense of organization.

For the example essay, which includes an introduction, four supporting reasons, a conclusion, and no breaks in logical progression, the score is illustrated in figure 7.

presence of introduction	4	= 4
+ total number of reasons	+ 4	= 4
+ presence of conclusion	+ 4	= 4
– 2(number of breaks in logical progression)	–2(0)	= 0
score for objective 2, organization		=12

Figure 7. Example Calculation of Score for Objective 2.

3.4.3.3 Objective 3

The third objective of a written TAAS composition is to demonstrate control over the English language. TEA's (1995) rationale indicates the need for control at the word, sentence, and composition levels. The elements coded in the language control category were designed to correlate with the specifics mentioned by TEA; thus the calculation for

an objective 3 score matches that for the aggregate language control score (see section 3.4.2.3).

3.4.3.4 Objective 4

Objective 4 focuses on development, support, and elaboration of the central idea. The elements used for this calculation were taken from the argumentation category (see figure 8). The score for elaboration was multiplied by two and added to two times the number of reasons relevant to the topic. The number of reasons irrelevant to the topic and two times the number of reasons detracting to the topic were both subtracted from the previous sum.

Again, multiplication was used to weight the various factors. Elaboration is considered crucial to development of a composition by TEA (1997), so the score for this element was multiplied by two. The degree of relevance was used to weight the reasons. Reasons which detract from the topic are more detrimental to support of the argument than those which are irrelevant; therefore, the number of detracting reasons was multiplied by two. Relevant reasons are the basis of support for the argument, so their number was also multiplied by two. Addition showed contribution to the development while subtraction revealed lack of development, or worse, the breakdown thereof. These computations resulted in a figure indicative of the writer's ability to develop a topic, objective 4.

For the example composition, which demonstrated extensive elaboration, four reasons which were relevant to the topic, none which were irrelevant, and none which was detracting, the composite score for objective 4 was calculated as shown in figure 8.

2(elaboration score)	2(3)	= 6
+ 2(number of reasons relevant to the topic)	+2(4)	= 8
– (number of reasons irrelevant to the topic)	– 0	= 0
– 2(number of reasons detracting to the topic)	–2(0)	= 0
score for objective 4, development of the central idea		=14

Figure 8. Example Calculation of Score for Objective 4.

3.4.3.5 Overall scores

The researcher further designed calculations to compute overall scores for each essay. After all, it is not the individual components that are the primary concern in evaluating a composition, but the effect of the whole as the various elements work together, hopefully to form a well-written essay. Two overall scores were figured for each composition, one based on the categories identified in the research questions, and one based on the TEA objectives.

3.4.3.5.1 Overall score based on categories

The overall score based on categories was computed using the aggregate scores for language control, organization, argumentation, audience awareness, and oral and informal features. The five categories were equally weighted in the calculations. The researcher first identified the highest score on any one essay for each category. These figures are given in table 5.

Table 5. Highest Score Achieved on Essays by Category

Category	Highest score
Language control	81[a]
Organization	20
Argumentation	28
Audience awareness	37
Oral and informal features	19[a]

[a]For this category, a higher score represents poorer performance.

Figure 9 illustrates calculation of the overall score for the example essay used in figures 1-5. Each categorical score for a given essay was divided by these respective numbers and multiplied by twenty. This generated a score for each objective on a scale with a maximum of twenty; thus, the contribution of performance in each category was equally weighted. These scores were then summed, with the exception that the language control score and the oral and informal features score were subtracted from twenty and then added to the others. This had the effect of making higher language control scores represent compositions with fewer errors, and higher oral and informal scores represent essays with less informality. Although TAAS evaluation criteria do not seem to down-grade essays for use of oral features, the tradition of discouraging informality in written compositions persists in most classrooms. For any essay, the maximum overall score of 100 would represent the best essay, among the data for this study, as defined by the five categories. The results for the individual categories in the example essay (figure 9) show that the student demonstrated good language control, organization, and argumentation, and relatively poor audience awareness. The overall score indicates that, according to the criteria described, the composition represents fairly good writing.

20−20(language control score÷81)	20−20(3.0÷81)	=19.3
+ 20(organization÷20)	+20(20.0÷20)	=20.0
+ 20(argumentation÷28)	+20(28.0÷28)	=20.0
+ 20(audience awareness÷37)	+20(13.4÷37)	= 7.2
+ 20−20(oral and informal features ÷19)	+20−20(6.5÷19)	=13.2
overall score for essay categories		=79.7

Figure 9. Example Calculation of Overall Category Score.

3.4.3.5.2 Overall score based on TEA objectives

In the overall score figured according to TEA standards, all four objectives were assumed to be equally important and were therefore equally weighted in the calculations. Similar to the overall score based on categories, the highest score on any one essay for each objective was identified and is shown in table 6.

Table 6. Highest Score Achieved on Essays by Objective

Objective	Highest score
Purpose/audience	39
Organization of ideas	15
Language control	81[a]
Development of central idea	18

[a]For this category, a higher score represents poorer performance.

Calculations based on the example essay used in section 3.4.3 (objectives 1-4) are given in figure 10. The same basic format was used for computing both overall scores. Using the data in table 6, scores for each objective were figured on a scale with a maximum of twenty, so that the objectives were equally weighted. The language control score was subtracted from twenty before being added to the others. The sum of the scores for the four objectives had a maximum value of 80, which would represent the best essay, among the data for this study, as defined by the four objectives. The results for the individual objectives in the example essay (figure 10) indicate that of the four objectives the composition showed the best skill in language control, followed by organization of ideas, and development of the central idea. Although the student demonstrated poorer performance in writing to the appropriate purpose and audience, the overall score for this essay is one of the higher scores based on TEA criteria.

20(purpose/audience score÷39)	20(15.9÷39)	= 8.2
+ 20(idea organization score÷15)	+20(12÷15)	=16.0
+ 20–20(language control score÷81)	+20–20(3.0÷81)	=19.3
+ 20(idea development score÷18)	+20(14÷18)	=15.6
overall score for essay based on TEA objectives		=59.1

Figure 10. Example Calculation of Overall TEA Objective Score.

These indices are useful for approximating holistic scoring methods. By examining each feature within the categories and objectives, the researcher can determine specific areas expected to improve as a result of e-mail use.

3.4.4 Statistical analyses

Section 3.4.4.1 discusses the multiple regression analysis which was performed to determine which student- and teacher-related variables were predictor variables for post-treatment scores. Section 3.4.4.2 is a description of the procedure in which the post-treatment scores were tested using either t-tests or analyses of covariance (ANCOVA), depending on the comparability of pre-treatment scores (see figure 11).

3.4.4.1 Relationships among variables

It was necessary to determine whether variables other than the e-mail treatment influenced the experimental results. The variables from the student surveys and teacher interviews which were tested for their possible influence were: frequency of students' writing at home, frequency of students' computer use at home, frequency of students' e-mail use at home, frequency of students' computer use at school, number of hours students spent writing in class per week, number of weeks students spent on persuasive writing per year, number of years the teacher had been teaching, and number of years the teacher had been teaching fourth grade. Other variables potentially affecting study results (e.g., teacher attitudes and abilities related to computer use) were measured qualitatively and are analyzed in section 4.4.

Using the Statistical Package for the Social Sciences (SPSS), a multiple regression analysis was conducted to determine which of the student- and teacher-related variables were significant predictors of writing ability. The multiple regression analysis was performed using the overall scores from essay 4 as the dependent variable, because the student- and teacher-related effects would be strongest at the end of the school year. Any variable which proved to be a significant predictor of writing ability would be used as a covariate in the analyses of covariance. These precautions would further ensure that any significant differences revealed in the ANCOVAs could be attributed to e-mail use. As will be seen in chapter 4, none of the variables tested proved to be a predictor variable.

3.4.4.2 Differences between groups

Statistical tests were performed on both essay 3 and essay 4. The former test was designed to ascertain whether there were significant differences between the writing ability demonstrated in a persuasive essay written by hand and turned in to the teacher, and one typed on the computer and sent via e-mail to a member of the target audience. The tests on essay 4 were intended to identify any significant differences between the handwritten essays of students at the control and experimental schools following the e-mail treatment. The statistical test used for a given variable, t-test or ANCOVA, was determined according to the flowchart in figure 11. These tests were carried out at the overall, categorical, and elemental levels of coding, as well as for an overall score based on the TEA objectives and composite scores for the individual TEA objectives.

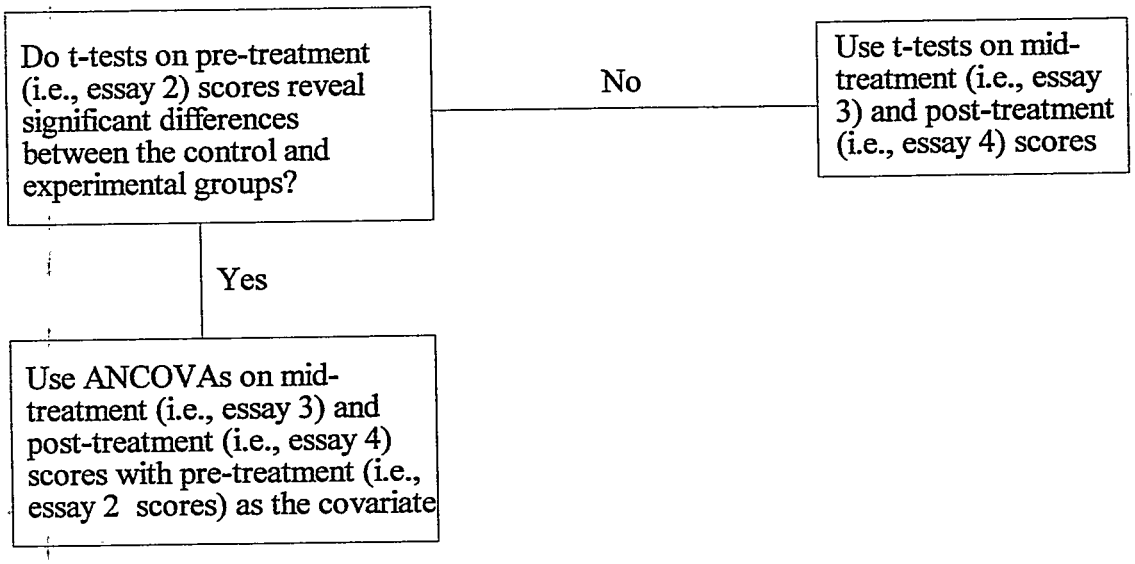

Figure 11. Flowchart of Statistical Analyses.

The null hypothesis was used for each test. Conflicting evidence identified in previous research prevented use of a directional hypothesis for some variables. Due to CMC being a relatively new area of research, it was considered that the current study might produce results contrary to previous research, so the researcher chose to use the null hypothesis for all variables. In addition, this strategy afforded a more conservative approach to the data, requiring a larger absolute value for the t statistics to reach the level of significance than the use of directional hypotheses would require.

In order to perform the statistical analyses on the essay scores, it was first necessary to determine whether the control and experimental schools were initially comparable in their performance. Due to the difficulties with the e-mail system at Boyd Elementary as described in section 3.3.3, the e-mail treatment did not actually begin until mid-February. The option to retain essay 1 as the pre-treatment representation of students' writing seemed unacceptable, since that essay was written four to five months before e-mail use began. Essay 2 was written in January and thus depicted the students' writing performance just prior to e-mail use by the experimental group more accurately. The

researcher therefore concluded that essay 2 was more representative of the students' pre-treatment writing ability than essay 1, and essay 1 was ignored for analytical purposes.

In order to check for comparability between the two schools, t-tests were run on essay 2 to determine if there were any differences between the two groups at the overall, categorical, and elemental levels.[1] These tests were performed using SPSS independent sample t-tests.[2] If no significant difference was identified between the schools for essay 2, a t-test was used for that element or composite score in testing for differences between schools on essay 3 and essay 4. If the t-test on essay 2 revealed a significant difference between the schools, analysis of covariance was used to test essay 3 or essay 4, offering the ability to adjust later scores for pre-treatment differences.

An example t-test table (table 7) will serve to illustrate the results of the t-test analysis:

Table 7. Example Table Based on T-test for Requests for Approval in Essay 3

	Mn2	Mn3	N	Std dev 3
B	0.05	0.43	69	0.60
SC	0.07	0.13	58	0.31
	Essay2	Essay3		
df	123	105		
t Statistic	-0.641	3.634		
p (two-tail)	0.522	0.000[a]		

[a]A value of .000 in a statistical table indicates that the value for that constituent is <.001.

[1] A different sample of students was used for the t-tests conducted on essay 2 for comparison with essay 3 than for t-tests conducted on essay 2 for comparison with essay 4. Because the ANCOVA tests required that only students who participated in both essays under comparison be included in the sample, in order for essay 2 scores to be used as a covariate for essay 3 or 4 scores, the same control was employed for t-tests. This step required the omission of some students from the sample but was necessary in order to maintain the same population sample for all comparisons regarding a particular essay.

[2] The decision concerning whether or not to assume equal variances for the t-test was made using Levene's test for equality of variances.

The values given in table 7 illustrate the findings for requests for approval within the category of audience awareness in essay 3. The upper portion of the table gives values for both Boyd (B) and Stewarts Creek (SC) with respect to the means for essay 2 (Mn2) and essay 3 (Mn3), the number of essays included in the analysis (N), and the standard deviations for essay 3 (Std dev 3). The lower portion of the table shows the degrees of freedom (df), t statistic, and p-value for both essays 2 and 3. Following the non-directional null hypothesis (i.e., the assumption that there is no difference between the schools), a two-tailed t-test was used. If the p-value is less than 0.05, there is a significant difference between the schools.

Concerning the interpretation of table 7, the p-value for essay 2 shows no significant difference between the schools in their requests for approval (essay 2 $p>.05$); therefore, a t-test is used to test for a difference with respect to the same variable in essay 3. The results for essay 3 show that the p-value is significant (essay 3 $p<.05$), and the two schools significantly differ in their requests for approval on essay 3. Because Boyd students (0.43) have a higher mean than Stewarts Creek students (0.13) for this variable on essay 3, they are shown to use significantly more requests for approval than the control group.

Analysis of covariance is useful in experimental conditions under which the random assignment of subjects is either not possible or not allowed. In this study, it was not possible to randomly assign students from the population to the control and experimental groups, since classes were kept intact. Consequently, pre-treatment differences in performance scores between the schools would affect the post-treatment scores. For example, if students at School A performed well on a pre-test and students at School B performed poorly, a significantly better performance by School A than School B on a post-test would not be surprising. The question would be whether the difference on the post-test was due to treatment received by School A or due to the initial differences. A

covariate in this example would adjust the scores of the post-test based on the pre-test scores prior to comparison of post-test scores between schools.

By using a covariate in the present analysis, some of the variance caused by variables other than e-mail is eliminated, resulting in a more powerful statistical test. In other words, the mid- and post-treatment scores being compared between Boyd and Stewarts Creek were adjusted based on a specified covariate. This adjustment yielded more accurate results as to whether there was a significant difference between the two groups and increased the likelihood that any significant differences found were due to use of e-mail by the experimental group.

The covariate used in this study was the relevant variable scores in essay 2. This covariate was used in the study of each respective variable for which an ANCOVA was performed (e.g., the covariate used for essay 3 purpose/audience scores was essay 2 purpose/audience scores). The codings from essay 2 were used, because earlier t-tests revealed significant differences between the two schools with respect to that variable (see figure 11). Using these scores as a covariate had the effect of controlling for pre-treatment differences between the groups.

In order to use ANCOVA tests on essay 3 scores, only students who participated in both essay 2 and 3 could be used in the sample for this analysis, so that the score for a given student in essay 2 could be used as a covariate for that same student's score in essay 3. Some of the students who participated in the study had to be omitted from the sample, because they did not participate in both essays under consideration (see table 3). This resulted in the omission of 29 students from the sample involving essays 2 and 3. The same control was necessary for analyzing essay 4 scores. In order to use ANCOVA tests for essay 4, only students who wrote compositions for both essay 2 and 4 were included in this sample. This restriction allowed essay 2 scores to be used as the covariate for essay 4 scores, and necessitated the omission of 32 students from the sample involving essays 2

and 4. Different samples were thus identified for the analysis involving essays 2 and 3 and the analysis involving essays 2 and 4, so that a student did not have to participate in the composition of all three essays to be included in the study.

An example table (table 8) will serve to demonstrate the results provided by an ANCOVA analysis:

Table 8. Example Table Based on ANCOVA for Purpose/Audience in Essay 3

	Mn2	Mn3	AdMn	N			
B	11.37	13.38	13.18	69			
SC	9.40	10.16	10.39	58			
		SS	df	MS	F	p	B
Cov	S2	234.50	1	234.50	11.44	.001	.271
Effect	Sch	236.57	1	236.57	11.54	.001	
Model		471.07	2	235.54	11.49	.000	
Resid		2542.37	124	20.50			
Total		3013.44	126	23.92			

The values in table 8 are based on the results for the TEA objective of purpose/audience in essay 3. The upper portion of the table shows the mean purpose/audience scores for the essays being compared, in this case essays 2 (Mn2) and 3 (Mn3), at Boyd (B) and Stewarts Creek (SC). In addition, the adjusted mean for each school shows the mean for essay 4 scores after incorporating adjustments for the covariate (AdMn). The "N" column indicates the number of essays included in the analysis. The lower portion of table 8 is the ANCOVA table for purpose/audience in essay 3, incorporating adjustments to the scores for the covariate (Cov). The second column provides a label for the covariate, in this case purpose/audience scores in essay 2 (S2). The covariate values indicate the extent to which the covariate influences the dependent variable (i.e., scores for essays 3 or 4). The main effect (Effect), the school (Sch), indicates the values of purpose/audience analysis including the covariate adjustments, and provides the primary statistic showing a significant difference or lack thereof between the schools. A significant value for the main

effect (effect $p \leq .05$) shows that e-mail use produces a significant difference between the two schools with respect to the variable under analysis, in this case purpose/audience. If the model p-value is significant (model $p \leq .05$), this particular analysis is based on a good model. The residual (Resid) indicates the values for measures within the schools. The table also reports total values for the sum of squares (SS), degrees of freedom (df) and mean squares (MS). The sum of squares is the sum of the squared deviations, degrees of freedom is based on the number of covariates and number of students used in the model, and the mean squares are variances. The ANOVA, performed by the statistical package after the scores are adjusted for the covariate, produces an F-ratio value (F), which is compared to critical values to determine the probability (p) of obtaining an F-ratio score as high as the value of "F." The p-values, as discussed, provide information concerning the influence of pre-treatment performance, the existence of a significant difference between the schools for the variable under analysis, and the appropriateness of the model. The B-value (B) is a standardized regression coefficient and, when squared, shows the proportion of variance in the dependent variable (i.e., scores for essay 3 or 4) accounted for by the covariate (i.e., scores for essay 2). A low B-value indicates that the covariate, although significantly different between the schools in essay 2 as demonstrated by a t-test, accounts for a small proportion of the difference between the schools for essay 3 or 4.

In table 8, $B=0.271$, so $B^2=0.073$. Thus, essay 2 purpose/audience scores only account for 7.3% of the variance between schools for this variable in essay 3. Table 8 also shows that both the main effect and model p-values are significant ($p<.05$). This model is determined to be appropriate for examining purpose/audience in essay 3. The significant p-value for the effect ($p<.05$) reveals that the schools significantly differ in performance with respect to purpose/audience in essay 3.

Once it is determined that a significant difference exists between the schools, it must be determined which of the schools demonstrated significantly better performance. If

the p-value for the effect is significant ($p \leq .05$), one must compare the adjusted means for the essay under comparison (i.e., essay 3 or essay 4). The school with the larger of the adjusted means is shown to have significantly better performance for that variable.[3] In table 8, the effect is significant ($p < .05$), so a significant difference exists between the schools with respect to purpose/audience in essay 3. The higher adjusted mean for Boyd (13.18) than for Stewarts Creek (10.39) indicates that the e-mail group demonstrated significantly better performance in purpose/audience on their essay 3 compositions.

3.5 Summary

This chapter has articulated the methodology employed in the study, especially regarding the selection of participating schools, data collection and coding, and statistical analyses of the codings. The results of these procedures are presented in chapter 4.

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[3] Exceptions to this principle of interpretation are the results for the language control category and each of its elements (capitalization errors, punctuation errors, spelling errors, incomplete sentences, and grammar errors both not affecting and affecting meaning), in which case a larger mean represents a greater number of errors. A higher adjusted mean in this case demonstrates more errors, and therefore poorer performance. Other exceptions are results for the number of breaks in logical progression, number of reasons irrelevant to either the topic or the audience, and number of reasons detracting to either the topic or the audience.

CHAPTER 4

RESULTS AND INTERPRETATION

4.0 Introduction

This chapter presents the results and interpretation of analysis concerning the three data sources: e-mail, handwritten essays, and surveys/interviews. Sections 4.1-4.2 present the statistical findings tests for relationships among variables (multiple regression analysis) and differences between groups (t-tests and ANCOVAs), respectively. The discussion of the results regarding differences between groups is divided into two parts, comparison of e-mail essays at Boyd to handwritten essays at Stewarts Creek (essay 3), and comparison of handwritten essays from both schools (essay 4). Responses to the student survey are evaluated in section 4.3, and teacher interviews are discussed in section 4.4. Survey and interview results are compared to the statistical findings to identify any relationships between writing or computer attitudes and practice to writing performance. In section 4.5, other e-mail messages produced during the exchange are examined for features relevant to the research questions of this study.

4.1 Relationships among variables results

Eight student- and teacher-related variables were tested using a multiple regression analysis to determine which variables are related to students' writing abilities. The variables considered were: frequency of students' writing at home, frequency of students' computer use at home, frequency of students' e-mail use at home, frequency of students' computer use at school, number of hours students spent writing in class per week, number of weeks students spent on persuasive writing per year, number of years the teacher had been teaching, and number of years the teacher had been teaching fourth grade. In

conducting the regression, scores from essay 4 were chosen as the dependent variable, because the effects of any of these variables would be strongest at the end of the school year. Results show that the model only accounts for 7.6% of the variability in the data (adjusted R^2=.076). Based on the controls of the experiment, it is assumed that the remaining variability is largely due to the effects of e-mail use. Of the eight variables tested, none proved to be a significant predictor of writing ability; therefore, none was used as a covariate in the analysis.

4.2 Differences between groups results

Independent sample t-tests were performed on the coding results for the handwritten essays taken before the e-mail program became operative (essay 2). These analyses were used to determine whether the e-mail school and the control school significantly differed at the beginning of the project. Although numerous precautions were taken to control for variables in addition to the use of e-mail, differences between the two schools before the e-mail treatment would affect mid- and post-treatment results. Using SPSS, tests were performed on overall scores as well as at the categorical (e.g., language control, organization) and elemental (e.g., capitalization errors, presence of introduction) levels. Because a longer essay cannot necessarily be interpreted as being a better essay, no composite score was calculated for this category, and each of the base measure elements was tested individually. The results of the t-tests on essay 2 variables were used to determine the appropriate statistical test (t-test or ANCOVA) for comparing the schools in essay 3 and in essay 4. If the t-test showed no significant difference for the variable in essay 2, another t-test was used in testing that variable in essay 3 or 4. If the t-test showed a significant difference for the variable in essay 2, an ANCOVA was used in testing that variable in essay 3 or 4, allowing adjustment for pre-treatment differences.

Table 9. Statistical Results for Essays 2 and 3 by School

Category	Element	Essay2		Essay 3	
		B	SC	B	SC
Overall					
Audience awareness				+	
	Greetings			+	
	Correct audience			+	
	Questions			+	
	Requests for approval			+	
	Requests for opinion			+	
	Thanks				+
	Compliments				+
	Personal "you"				
	Requests for action				
	Apologies				
	Inclusive "we"				
	Imperatives				
	Violations				
Argumentation				+	
	Introduction score	+			
	Reasons relevant to audience			+	
	Reasons irrelevant to audience			−	
	Reasons detracting to audience			−	
	Reasons relevant to topic		+		
	Reasons irrelevant to topic				
	Reasons detracting from topic	−			
	Conclusion score				
	Elaboration				
Organization					
	Breaks in logical progression				−
	Presence of introduction				
	Presence of supporting reasons				
	Presence of conclusion				
Language control					
	Capitalization errors				
	Punctuation errors	−			
	Spelling errors	−			
	Incomplete sentences				
	Grammar errors not affecting mng.				
	Grammar errors affecting mng.	−			
Oral/informal features					
	Prosody				−
	Slang/colloquial language				
	Interjections				
	Contractions				
	Abbreviations				
	Arabic numerals				
	Repetition				
	Tag questions				
	Quotes				
Base measures	Words/essay				
	Sentences/essay				
	Words/sentence				
	Grammatical complexity				

Table 9—*Continued*

Category	Element	Essay2		Essay 3	
		B	SC	B	SC
TEA overall		+			
	Obj1 Purpose/aud	+		+	
	Obj2 Organization of ideas				
	Obj3 Language control				
	Obj4 Development of cent idea				

4.2.1 Comparison of e-mail essays at Boyd to handwritten essays at Stewarts Creek

T-tests conducted for essay 2 revealed significant differences between the initial writing abilities of students at Boyd and Stewarts Creek in only eight of the variables examined. Table 9 illustrates the areas of significant difference between Boyd (B) and Stewarts Creek (SC) for the variables examined in essay 2, which was handwritten at each school prior to the e-mail treatment. Significantly more occurrences or better performance with respect to a variable is indicated with a "+", while significantly fewer or less is indicated with a "–". The results of these t-tests were used to determine which statistical test should be used to compare the schools for any given variable in essay 3 (i.e., either a "+" or "–" in one of the essay 2 columns indicates the need for ANCOVA testing).

Based on the pre-treatment analysis, the schools are quite comparable. There were no significant differences between the schools for the overall score based on categories or any of the composite category scores for essay 2. The Boyd students demonstrated significantly better performance for seven elements and the Stewarts Creek students showed better performance for one element. ANCOVAs were necessary for only these eight of the fifty-five elements, while t-tests were used for analysis of all other variables in essay 3.

The t-tests and ANCOVAs performed on essay 3 allowed the researcher to determine if there were significant differences between the control and experimental schools for essay 3. First, the overall score based on categories identified in the research

questions was tested. Tests were then performed on the aggregate scores for each of five categories: audience awareness, argumentation, organization, language control, and oral and informal features. Next, individual scores for each element within each of these categories and the base measures were tested. Finally, the overall score based on the TEA objectives, and scores for each of the individual objectives identified by TEA, were tested.

Of the t-tests and ANCOVAs performed, fifteen demonstrated a significant difference between the two schools for essay 3 (see table 9). In eleven instances, the e-mail group performed significantly better than the control group, while the control group performed better than the experimental group in four areas. The remaining tests showed no significant difference, so that the null hypothesis was retained for these tests. The results, grouped by category, are discussed in the remainder of section 4.2.1.

4.2.1.1 Overall score based on categories

No significant difference existed between the schools for overall scores in essay 3 (see appendix G for a representative example of an essay 3 composition from each school). The results of the t-test for the overall score based on categories indicate no significant difference between the two groups (table 10; essay 3 $p>.05$); therefore, the null hypothesis is retained.

Table 10. T-test for Overall Scores Based on Categories in Essay 3

	Mn2	Mn3	N	Std dev 3
B	56.51	58.26	69	8.03
SC	55.13	56.73	58	7.92
	Essay2	Essay3		
df	125	125		
t Statistic	0.967	1.042		
p (two-tail)	0.336	0.299		

4.2.1.2 Significant differences from tests
of the aggregate category scores

Tests performed on the aggregate scores for each of the categories revealed that the e-mail group demonstrated significantly better performance in the categories of audience awareness and argumentation. The schools demonstrated no significant difference in their performance with respect to organization, language control, or oral and informal features.

Boyd students showed significantly better audience awareness than students at the control school. The significant difference between the groups with respect to audience awareness is shown in table 11 (essay 3 $p<.05$). The mean 3 score of the e-mail group (13.04) was greater than the mean 3 of the control group (8.94), revealing that the e-mail group demonstrated significantly better performance.

Table 11. T-test for Audience Awareness in Essay 3

	Mn2	Mn3	N	Std dev 3
B	5.90	13.04	69	5.48
SC	4.56	8.94	58	4.52
	Essay2	Essay3		
df	125	125		
t Statistic	1.626	4.546		
p (two-tail)	0.106	0.000		

In addition, the e-mail group showed significantly better argumentation (table 12; essay 3 $p<.05$). A comparison of the mean scores shows that Boyd improved their argumentation from essay 2, while Stewarts Creek declined in their demonstrated ability. The means for essay 3 show that students in the e-mail group (12.45) demonstrated better argumentation than those in the control group (10.74).

Table 12. T-test for Argumentation in Essay 3

	Mn2	Mn3	N	Std dev 3
B	10.83	12.45	69	3.65
SC	11.72	10.74	58	4.95
	Essay2	Essay3		
df	125	103		
t Statistic	-1.314	2.176		
p (two-tail)	0.191	0.032		

In order to distinguish which elements within the categories contribute to differences at the categorical level, the remainder of section 4.2.1 includes a more detailed analysis of both categories which revealed significant differences. In addition, the remaining categories are examined for significant differences at the elemental level.

4.2.1.3 Elements of audience awareness

As noted in section 4.2.1.2, a significant difference was found between the e-mail and control schools in their demonstration of audience awareness. The e-mail school showed greater audience awareness in their use of greetings, assumptions of correct audience, questions, requests for approval, and requests for opinion. In contrast, students at the control school appeared to show greater audience awareness in their use of thanks and compliments (see section 4.2.1.10 for probable reasons). More than half of the audience awareness elements tested proved to differ significantly between the groups; each of the significant elements is discussed individually in this section.

The e-mail students were found to use more greetings.[1] A t-test showed a significant difference between the schools for greetings (table 13; essay 3 $p<.05$). The mean 3 for Boyd students (0.52) is larger than the mean 3 for Stewarts Creek (0.13), demonstrating that students at the e-mail school used significantly more greetings.

[1] Although some consider e-mail to be electronic letters and, therefore, would expect to find greetings, empirical evidence shows that electronic messages do not necessarily include a greeting (Herring 1996b; Cho forthcoming).

Table 13. T-test for Greetings in Essay 3

	Mn2	Mn3	N	Std dev 3
B	0.05	0.52	69	0.71
SC	0.07	0.13	58	0.46
	Essay2	Essay3		
df	125	118		
t Statistic	-0.454	3.733		
p (two-tail)	0.651	0.000		

The e-mail compositions also included more assumptions of correct audience. The t-test reveals a significant difference between the groups for this variable (table 14; essay 3 $p<.05$). Because Boyd's mean 3 (4.20) is higher than Stewarts Creek's (3.08), the experimental school is also shown to have used significantly more assumptions of correct audience.

Table 14. T-test for Assumptions of Correct Audience in Essay 3

	Mn2	Mn3	N	Std dev 3
B	3.43	4.20	69	2.61
SC	2.99	3.08	58	2.01
	Essay2	Essay3		
df	125	125		
t Statistic	1.368	2.668		
p (two-tail)	0.174	0.009		

Another variable on which e-mail essays included more instances was questions. A significant difference was revealed between the schools for use of questions (example 24; table 15; essay 3 $p<.05$). Boyd had a higher mean 3 (0.65) than Stewarts Creek (0.10), showing that the e-mail students used significantly more questions.

Example 24
Do you like to visit with your family? I do because you tell some funny stuff and it is better than t.v. [B3ba]

Table 15. T-test for Questions in Essay 3

	Mn2	Mn3	N	Std dev 3
B	0.08	0.65	69	0.88
SC	0.09	0.10	58	0.30
	Essay2	Essay3		
df	125	87		
t Statistic	-0.149	4.820		
p (two-tail)	0.882	0.000		

In addition, Boyd writers more often indicated a desire for the approval of their reader. The t-test revealed a significant difference between the groups with respect to requests for approval (example 25; table 16; essay 3 $p<.05$). A higher mean for the e-mail school (0.43) than for the control school (0.13) demonstrates that the e-mail students made significantly more requests for their reader's approval.

Example 25
I hope that I have convenced you to not watch as much T.V. [B3cw]

Table 16. T-test for Requests for Approval in Essay 3

	Mn2	Mn3	N	Std dev 3
B	0.47	0.43	69	0.60
SC	0.69	0.13	58	0.31
	Essay2	Essay3		
df	125	105		
t Statistic	-0.638	3.634		
p (two-tail)	0.525	0.000		

Compositions written on the computer and sent via e-mail also included more requests for the addressee's opinion. The test for requests for opinion revealed a significant difference between the schools (table 17; essay 3 $p<.05$), and the e-mail school's higher mean 3 (0.21) than the control school's (0.06) shows that Boyd made significantly more requests for opinion.

Table 17. T-test for Requests for Opinion in Essay 3

	Mn2	Mn3	N	Std dev 3
B	0.00	0.21	69	0.06
SC	0.01	0.06	58	0.03
	Essay2	Essay3		
df	57	108		
t Statistic	-1.000	2.276		
p (two-tail)	0.322	0.025		

Greater use of greetings, assumptions of correct audience, questions, requests for approval, and requests for opinion by students at Boyd contributes to the categorical result that the students who used e-mail showed significantly more audience awareness. These results support claims from studies with young students regarding the importance of communicative context and an authentic audience (Cohen and Riel 1989; Hubbard 1985), particularly an audience which will respond (cf., TEA 1997). With respect to studies of CMC, the findings of the present study provide further evidence that computer-mediated discourse is more interpersonally involved than written material (cf., Ko 1996).

In an apparent exception to the previously discussed findings for audience awareness, two elements, thanks and compliments, were used more by the control students. T-test results show a significant difference between the schools in use of thanks (table 18; essay 3 $p<.05$). A higher mean for Stewarts Creek (0.10) than for Boyd (0.00), whose students offered no thanks in either essay 2 or 3, indicates that the control school gave significantly more thanks to their readers.

Table 18. T-test for Thanks in Essay 3

	Mn2	Mn3	N	Std dev 3
B	0.00	0.00	69	0.00
SC	0.01	0.10	58	0.04
	Essay2	Essay3		
df	57	57		
t Statistic	-1.422	-2.528		
p (two-tail)	0.160	0.014		

A t-test for use of compliments in essay 3 also showed a significant difference between the groups. No compliments were used in any compositions from either school in essay 2; therefore, the standard deviation of both groups was 0.00. A t statistic cannot be computed under these conditions; however, a t-test was conducted to compare Boyd and Stewarts Creek students' use of compliments in essay 3. Because the p-value is significant (table 19; essay 3 $p<.05$), a comparison of the essay 3 means reveals that Stewarts Creek students (0.11) gave significantly more compliments to their readers than Boyd students (0.01). The inconsistency of the thanks and compliments findings with previously discussed audience awareness features is surprising; in fact, these findings will be shown to result from factors other than awareness of the target audience (see section 4.2.1.10).

Table 19. T-test for Compliments in Essay 3

	Mn2	Mn3	N	Std dev 3
B	0.00	0.01	69	0.08
SC	0.00	0.11	58	0.25
	Essay2	Essay3		
df	na	66		
t Statistic	na	-2.883		
p (two-tail)	na	0.005		

4.2.1.4 Elements of argumentation

A significant difference between the schools was found in the category or argumentation. Comparison of the e-mail and handwritten compositions in essay 3 showed that, regarding the elements of argumentation, there were three statistically significant differences, for which the null hypothesis was rejected. For all three features—number of reasons which are relevant to the audience, number of reasons which are irrelevant to the audience, and number of reasons which are detracting to the audience—Boyd students showed better performance. Results for each of these elements are discussed in this section.

The e-mail school gave significantly more reasons which were relevant to the audience than the control group did. The t-test for number of reasons relevant to the audience showed a significant difference between the two schools (table 20; essay 3 $p<.05$). Surprisingly, both schools gave fewer reasons relating to the audience in essay 3 than they gave in essay 2; nonetheless, the mean 3 for the e-mail group (2.46) was greater than the mean 3 for the control group (1.90), indicating that Boyd students gave significantly more reasons which were relevant to the target audience.

Table 20. T-test for Number of Reasons Relevant to the Audience in Essay 3

	Mn2	Mn3	N	Std dev 3
B	2.70	2.46	69	1.04
SC	3.05	1.90	58	0.97
	Essay2	Essay3		
df	125	125		
t Statistic	-1.770	3.165		
p (two-tail)	0.079	0.002		

Boyd also performed better with respect to the number of their reasons which were irrelevant to the audience. The statistical tests reveal a significant difference between the groups regarding the number of reasons which were irrelevant to the audience (table 21; essay 3 $p<.05$). It is surprising that both schools used more irrelevant reasons in an essay composed later in the school year. A larger mean 3 for Stewarts Creek (1.00) than Boyd (0.43), in this case, shows that the control students gave more irrelevant reasons; therefore, the e-mail students had better performance for this variable.

Table 21. T-test for Number of Reasons Irrelevant to the Audience in Essay 3

	Mn2	Mn3	N	Std dev 3
B	0.01	0.43	69	0.08
SC	0.03	1.00	58	0.12
	Essay2	Essay3		
df	125	125		
t Statistic	-0.735	-4.153		
p (two-tail)	0.464	0.000		

A third significant difference for argumentation was found in the number of reasons which were detracting to the audience (table 22; essay 3 $p<.05$), again with Boyd's compositions representing better writing. Boyd students decreased their use of detracting reasons by a small margin, and Stewarts Creek increased their use. As in the instance of irrelevant reasons, a higher mean for the control group (0.28) than for the e-mail group (0.06) reveals that students at Stewarts Creek gave more reasons which would have distracted their audience from the point of the argument. Boyd students were shown to have significantly fewer reasons which were detracting to the audience, and therefore better performance.

Table 22. T-test for Number of Reasons Detracting to the Audience in Essay 3

	Mn2	Mn3	N	Std dev 3
B	0.07	0.06	69	0.24
SC	0.02	0.28	58	0.59
	Essay2	Essay3		
df	82	72		
t Statistic	1.090	-2.657		
p (two-tail)	0.279	0.010		

Because all three argumentation elements which are concerned with relevance to the target audience were significant, and especially given that none of the elements related to topic relevance was statistically significant, these results provide strong evidence for the

positive influence of an authentic audience on students who use e-mail. These data support claims that computer-mediated writing leads to the provision of more relevant information in educational settings, at least regarding the target audience (cf., Levin et al. 1987; Bull et al. 1995). Moreover, the findings support the conclusions of Cohen and Riel (1989) that improved writing skill, as demonstrated in compositions to be sent via e-mail to a peer audience, was due to the children's perception of an authentic audience. A sense of the target audience is essential to effective argumentation. It is this sense which most heavily contributed to the significant difference in argumentation between the two schools.

4.2.1.5 Elements of organization

Although no significant difference was found between the schools at the categorical level, an analysis of the individual elements of organization shows that the control group showed better performance in including fewer breaks in logical progression.

A t-test for inclusion of breaks in logical progression reveals a significant difference between the two schools (table 23; essay 3 $p<.05$). Stewarts Creek's mean 3 (0.14) is smaller than Boyd's (0.30), so significantly fewer of the control students included breaks in logical progression in their compositions.

Table 23. T-test for Breaks in Logical Progression in Essay 3

	Mn2	Mn3	N	Std dev 3
B	0.17	0.30	69	0.07
SC	0.12	0.14	58	0.05
	Essay2	Essay3		
df	125	117		
t Statistic	0.786	2.068		
p (two-tail)	0.433	0.041		

Previous research indicates better organization for both word processing samples (Graves and Haller 1994) and compositions written for transmission via e-mail among

students (Cohen and Riel 1989). These claims are not supported in the present study. Probable reasons for these findings are discussed in section 4.2.1.10.

4.2.1.6 Elements of language control

As in the result for the language control category, t-tests reveal no significant differences between the groups for any of the elements in this category: capitalization errors, punctuation errors, spelling errors, incomplete sentences, and grammar errors which either do or do not compromise intelligibility. These results do not support the findings of previous research for children's computer compositions. Both Mehan (1989) and DeGroff (1990), in studies of word processing among young students, found that mechanical accuracy improved in the students' writing. Conversely, neither does the present study coincide with findings that e-mail use results in less control over language mechanics. A higher frequency of reductions and omissions, which were classified as errors in the present study, has been found in both synchronous (Ko 1996; Werry 1996) and asynchronous (Cho forthcoming) computer-mediated discourse among adults. The predictions of Baron (1984) that CMC use would necessarily lead to deterioration of writing conventions are thus not born out by this study. Probable reasons for the relationship of this study to previous findings is discussed in section 4.2.1.10.

4.2.1.7 Elements of oral and informal features

Although the category of oral and informal features did not significantly differ between the schools, one element, "prosody" was used less by Stewarts Creek students. The oral and informal feature of prosody significantly differed between the schools (example 26; table 24; essay 3 $p<.05$). The e-mail group increased their use of prosody from essay 2, while the control group, to a lesser extent, decreased their use. Based on the traditional classroom teacher's perception that compositions should not contain informal features, having fewer oral and informal features is considered better in this study. The

result is that Stewarts Creek students used less prosody, and had better performance, according to their mean 3 (0.12) compared to the mean 3 for Boyd (1.21).

Example 26
This is my last reason. Watch televison that is RIGHT for YOU!!!!!!! [B3sa]

Table 24. T-test for Prosody in Essay 3

	Mn2	Mn3	N	Std dev 3
B	0.24	1.21	69	2.11
SC	0.17	0.12	58	0.41
	Essay2	Essay3		
df	125	74		
t Statistic	0.664	4.199		
p (two-tail)	0.508	0.000		

The features included in the oral and informal category render a less formal, more oral style (cf., Herring 1997; Zyngier and de Moura 1997; Dale and Traun 1998; Cho forthcoming). As such, the results for prosody are not surprising. Previous research indicates that both synchronous (Werry 1996) and asynchronous CMC (Cho forthcoming) contain more prosodic cues than written discourse, similar to the findings for the present study.

4.2.1.8 Elements of base measures

Among the tests for base measures—number of words per essay, number of sentences per essay, number of words per sentence, and grammatical complexity—none was found to differ significantly between the schools. These findings contradict the results of Newman (1986) and Dale and Traun (1998), who found longer texts from students at the elementary and secondary levels, respectively, as a result of e-mail use. Dale and Traun's research included only e-mail texts, but Newman found the increased production in subsequent handwritten material as well. Cho (forthcoming) found longer e-mail texts

compared to typewritten memoranda in an adult, professional context. Rather than supporting claims that CMC will lead to reduced grammatical complexity (Baron 1984), this study instead coincides with Herring's (1997) findings that there was no decrease in grammatical complexity, although the data for this study span a much shorter period of time (3 months as opposed to 11 years). These results are discussed in section 4.2.1.10.

4.2.1.9 TEA objectives

After t-tests and ANCOVAs were run on individual elements in each of the categories, the same statistical tests were conducted for the composite scores based on an overall TEA (1995) score and the individual objectives. Results show that the schools did not significantly differ on the overall TEA score (table 25; effect $p>.05$), or objectives 2, 3, or 4; however, the e-mail group demonstrated a significantly better score on objective 1, responding appropriately to the purpose and audience.

Table 25. ANCOVA for Overall TEA Scores in Essay 3

	Mn2	Mn3	AdMn	N			
B	39.35	43.55	43.18	69			
SC	36.89	43.16	43.60	58			
		SS	df	MS	F	p	B
Cov	S2	660.20	1	660.20	12.06	.001	.325
Effect	Sch	5.35	1	5.35	0.10	.755	
Model		665.55	2	332.78	6.08	.003	
Resid		6785.74	124	54.72			
Total		7451.29	126	59.14			

In contrast to the other TEA findings of no significant difference, Boyd proved to be superior in appropriately addressing the specified purpose and audience. Table 26 shows a significant difference between the schools (effect $p<.05$) for this objective and demonstrates that the e-mail group's performance was better, according to their higher adjusted mean (13.18), than Stewarts Creek (10.39).

Table 26. ANCOVA for Purpose/Audience in Essay 3

	Mn2	Mn3	AdMn	N			
B	11.37	13.38	13.18	69			
SC	9.40	10.16	10.39	58			
		SS	df	MS	F	p	B
Cov	S2	234.50	1	234.50	11.44	.001	.271
Effect	Sch	236.57	1	236.57	11.54	.001	
Model		471.07	2	235.54	11.49	.000	
Resid		2542.37	124	20.50			
Total		3013.44	126	23.92			

The results for objective 1 are not surprising given the findings for the categories of audience awareness and argumentation, from which the components are taken. In addition, the improvement in compositions from Boyd relative to those from Stewarts Creek coincides both with previous research concerning students who improved their skills through use of word processing (Moore 1989) and through use of CMC (Peha 1995), especially in the context of an authentic audience and communicative context.

4.2.1.10 Discussion

The positive effects of e-mail use in the categories of audience awareness and argumentation are not surprising. Several linguistic features are produced in response to an authentic audience, some of which reflect the interaction itself (e.g., questions, requests for opinion), while others show consideration for the audience (e.g., providing reasons relevant rather than detracting to the audience). TEA describes writing as "a process in which one individual attempts to communicate to another, who responds in some way to the message being conveyed" (1997:1). This communication factor gave Boyd students a distinct advantage, because they were told that their keypals would reply, stating whether or not they were convinced by the persuasive composition. When students received those responses, the instructional designer was convinced that, given the same communicative context, the children would write better essays the next time. As evidence of audience awareness, when composing the reply to her keypal's initial message, one girl was

overheard saying, "I hope this is a girl, because he's going to hate what I write." Even the gender neutral name of her keypal did not prevent this student from considering the probable response to her message. The strength of audience awareness shown by Boyd fourth graders indicates that some findings for synchronous CMC are applicable to asynchronous CMC as well. Ko's (1996) generalization that CMC is more interpersonally involved than handwritten communication is supported by the evidence in the present study.

If the increased use of audience awareness elements is to be attributed to e-mail use, why would the control school perform better on 2 elements of audience awareness? The answer to this question lies in the instruction of one particular teacher at Stewarts Creek. During the interview, she stated that she suggests her students close their persuasive essays by thanking the audience for reading the composition and then "sweet-talking" them, such as telling them how smart they are. In essay 3, 71% (n=5) of the students who offered thanks and 91% (n=10) of those who gave compliments were in this teacher's class (example 27). Rather than a genuine indication of audience awareness, greater use of these features was the result of mechanical compliance to instruction and, therefore, does not neutralize the importance of an authentic audience and communicative context.

Example 27
Thank you for reading my paper. You I know are very smart and I hope you will consider my reasoms. Thank you agin have a nice day. [SC3rv]

The findings of no significant differences for control of the mechanics of language and grammatical complexity can be explained by the educational context. Students in this study do not show the improvement found in previous research among students who used word processing (Graves and Haller 1994); however, the students in Graves and Haller's study were given the opportunity to return to their compositions at a later point in order

to make revisions. Boyd students did not have that privilege. In addition, the students had only been using e-mail for one month when essay 3 was collected. The results therefore do not necessarily support claims that CMC use will inevitably lead to the deterioration of mechanical writing conventions (Ferrara et al. 1991; Baron 1984). Even with extended use of e-mail, the educational context would likely prevent deterioration that might otherwise occur. This conclusion is supported by findings of different standards in computer-mediated discourse with a task-focused as opposed to a recreational purpose (cf., Herring and Nix 1997), and findings of students' concern for the appearance of their final product (Bruce et al. 1985; DeGroff 1990).

To some extent, e-mail students seemed uncertain of the standards expected in the new medium. As a result, they transferred some but not all of their educational patterns from the classroom. When one student began to write his essay on the computer, he commented that he knew what to do: state his opinion, give three supporting reasons, and state his opinion again. This is a direct transfer from the classroom pattern for persuasive essays. Not all patterns transferred, however, as evidenced by a lack of prewriting.

The technological context affects (i.e., influences but does not determine) organization, use of oral and informal features, and the amount of text produced. Results in this study do not support findings of improved organization in compositions written for transmission via e-mail to a peer audience (Cohen and Riel 1989). The finding in the present study may be due to the limited use of e-mail by students at Boyd (cf., Graves and Haller 1994). In particular, essay 3 was the first time students had been assigned the task of composing a persuasive essay on the computer. As the students typed their compositions, the researcher observed that none of the students wrote any notes, either by hand or on the computer, to act as a guide for their writing, whereas prewriting in some form is a regular part of handwritten composition in classrooms at both schools. Given this fact, it is not surprising that Boyd students demonstrated more breaks in logical

progression. Prewriting is an important step in the writing process, especially for those acquiring literacy skills (cf., Graves 1983; Calkins 1986; Tompkins 1994).

In addition, the fact that essay 3 was not printed for the Boyd students to examine may have affected their organization. Many computer users prefer to inspect a hard copy of their compositions before revising and editing. The e-mail students did not have the opportunity to see a printed copy of their texts or to return to their essays to make revisions after the allotted time. Both of these factors distinguish the e-mail compositions in this study from those of word processing research, which has shown improvement in organization (cf., Graves and Haller 1994).

On the day the first two groups of e-mail students composed and sent the persuasive essay for essay 3, the instructional designer commented that she did not feel the project had helped their writing skills; however, on the day the students received responses from their Story Elementary keypals telling whether or not they were convinced, she remarked that she believed they would do better if they performed that task again. This was due to the confirmation that an authentic audience would read and respond, and a heightened awareness of the informational requirements of that audience. In other words, through actual audience feedback, the children developed a better understanding of the requirements for convincing their audience, both what information to provide and how that information should be presented. Because the students sent only one persuasive message, however, their progress in this area could not be analyzed.

Use of informality in e-mail compositions is also influenced, but not determined, by the technological context. Because the medium is novel, the students may associate its use with play. In addition, students interact more with their keypals and their classmates in composing the computer-mediated texts, and interactive language tends to be more informal, perhaps following the model of conversation. The medium, however, does not determine use of informality, as evidenced by the variation among students using e-mail,

including the relatively few oral and informal features demonstrated in Boyd essay 3 (see appendix G). Moreover, because researchers have identified e-mail texts as having a more "oral" style than written discourse (Zyngier and de Moura 1997; Cho forthcoming), the e-mail compositions were expected to demonstrate more oral and informal features than the handwritten essays. In fact, only one of the nine oral and informal features coded in this study proved to significantly differ between the e-mail and control schools.

Poor keyboarding skills forced the students to devote a great deal of concentration to getting the words onto the computer screen. This factor affects both their organization, especially their ability to pursue a logical train of thought, and the amount of text they are able to produce in a given period of time. Students at Stewarts Creek were allowed the usual forty-five minutes to handwrite their compositions for essay 3. Due to limited keyboarding skills, students at Boyd type more slowly than they write by hand. In order to compensate for the slow typing, the e-mail students were allowed one hour in the computer lab for essay 3; however, the researcher observed that fifteen minutes were consumed in logging onto the computers. When it is considered that students also had to spend time sending their messages and logging off, the Boyd students actually spent less time composing. It was also observed that many children were reading from the computer screens of students working on either side of them, which took more time away from their own writing. Given these restrictions, it is surprising that the Boyd compositions were not significantly shorter.

4.2.1.11 Conclusions

The results of statistical comparison for essay 3 show that the e-mail texts represent better writing according to classroom standards (i.e., based on the categories of analysis in this study) than handwritten compositions at the control school. Boyd students' essays showed significantly better audience awareness and argumentation. The control

students demonstrated better performance in only one element each of organization and oral and informal features. According to TEA objectives, Boyd students more fully realized the objective of writing for the appropriate purpose and audience. Thus compositions written by the e-mail students proved to be better than those of the control school for essay 3 according to both classroom standards and TEA criteria. These results can be attributed to the influence of an authentic audience and communicative context, the educational context, and the technological context of the composition.

4.2.2 Comparison of handwritten essays from both schools

In order to evaluate whether the effects of e-mail use transfer to off-line writing, t-tests were first conducted on essay 2 for comparison with essay 4.[2] The results of these t-tests were used to determine which statistical test (i.e., t-test or ANCOVA) was used to compare the schools' performance with respect to each variable on essay 4.

These t-tests revealed significant differences between the schools for eight variables. In table 27, the columns for essay 2 indicate whether Boyd (B) or Stewarts Creek (SC) demonstrated significantly better/more performance of that variable "+" or significantly fewer/less "–". A "(+)" indicates a trend toward more use which approaches statistical significance. For all eight variables which differed between the schools, Boyd students showed better performance than those at Stewarts Creek. ANCOVAs were used to analyze essay 4 with respect to these eight variables, and t-tests were used for all other variables in essay 4.

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[2] This second set of t-tests on essay 2 was necessary to maintain the same population sample for all comparisons on essay 4 (see section 3.4.4.2). The results varied slightly from the t-test results on essay 2 for comparison of essays 2 and 3.

Table 27. Statistical Results for Essays 2, 3, and 4 by School

Category	Element	Essay2		Essay 3		Essay 4	
		B	SC	B	SC	B	SC
Overall						+	
Aud. awareness		+		+		+	
	Greetings			+		+	
	Correct audience	+		+		+	
	Questions			+			
	Requests for approval			+		(+)	
	Requests for opinion			+			
	Thanks				+		
	Compliments				+		+
	Personal "you"						+
	Requests for action						
	Apologies						
	Inclusive "we"						
	Imperatives						
	Violations						
Argumentation				+			
	Introduction score						
	Reasons relevant to aud.			+			
	Reasons irrelevant to aud.			−			−
	Reasons detracting to aud.			−			
	Reasons relevant to topic					+	
	Reasons irrelevant to topic						
	Reasons detracting from top.	−					
	Conclusion score						
	Elaboration						
Organization						+	
	Breaks in logical progression				−		
	Presence of introduction						
	Presence of supporting reas.					+	
	Presence of conclusion					+	
Language control		+					
	Capitalization errors						
	Punctuation errors	−					
	Spelling errors	−					
	Incomplete sentences						
	Gram. err. not affecting mng.					−	
	Gram. err. affecting mng.	−					
Oral/informal							
	Prosody				−		
	Slang/colloquial language						−
	Interjections						
	Contractions						
	Abbreviations						
	Arabic numerals						
	Repetition						
	Tag questions						
	Quotes						
Base measures	Words/essay					+	
	Sentences/essay						
	Words/sentence					+	
	Grammatical complexity						

Table 27—*Continued*

Category	Element	Essay2 B	Essay2 SC	Essay 3 B	Essay 3 SC	Essay 4 B	Essay 4 SC
TEA overall						+	
	Obj1 Purpose/aud	+		+		+	
	Obj2 Organization of ideas					+	
	Obj3 Language control						
	Obj4 Development of cent idea					+	

Essay 4 was analyzed to determine if there were significant differences in the handwritten compositions of the students at Boyd, after they had been using e-mail for approximately three months, and those at Stewarts Creek. The primary objective of this analysis was to determine whether the improvements realized from e-mail use, both those evident in essay 3 and others which resulted from continued e-mail correspondence between essays 3 and 4, transferred to subsequent handwritten work.

The t-tests and ANCOVAs allowed the researcher to determine if there were significant differences between the control and experimental schools for essay 4 (see table 27). As in the analysis of essay 3, the combined overall score based on the categories identified in the research questions was tested. Tests were then performed on the aggregate scores for the five categories and individual scores for each element within the categories and the base measures. Tests were also conducted on an overall score based on the objectives identified by TEA (1995) and on the composite scores related to each of the four individual TEA objectives. The results are shown in table 27. Results for essay 3 are repeated for ease of comparison.

Of the t-tests and ANCOVAs performed for essay 4, nineteen demonstrated a significant difference between the two schools. In fifteen of these instances, the e-mail group performed significantly better than the control group. One further test demonstrated a strong trend toward a significant difference between the groups, also with the e-mail group showing better performance. The remaining tests showed no significant difference

between the groups, so that the null hypothesis was retained for these tests. The results of these t-tests and ANCOVAs are discussed in the remainder of this section.

4.2.2.1 Overall score based on categories

The results of the t-test for the overall score based on the categories indicated a significant difference between the two groups (table 28; essay 4 $p<.05$); therefore, the null hypothesis was rejected. The mean 4 score of the e-mail group (64.18) was higher than the mean 4 score of the control group (59.53), revealing that the e-mail group scored significantly higher than the control group and therefore demonstrated better writing (see appendix G for representative essay 4 compositions from each school). This finding supports claims that the use of telecommunications aids in increasing students' overall writing ability (Schrum 1988; Noden 1995).

Table 28. T-test for Overall Scores Based on Categories in Essay 4

	Mn2	Mn4	N	Std dev 4
B	57.05	64.18	63	8.03
SC	55.94	59.53	61	11.73
	Essay2	Essay4		
df	122	106		
t Statistic	0.765	2.567		
p (two-tail)	0.446	0.012		

4.2.2.2 Significant differences from tests of the aggregate category scores

Significant differences were found to exist between the two groups for audience awareness and organization, with the e-mail group performing significantly better in both categories. The remainder of this section includes the data for the separate categories.

With respect to the category of audience awareness, a significant difference between the schools was found (table 29; effect $p<.05$). Students at both schools demonstrated less audience awareness in essay 4 than in essay 2; however, because the

adjusted mean for Boyd (6.35) is higher than the adjusted mean for Stewarts Creek (3.26), the e-mail group showed significantly more audience awareness.

Table 29. ANCOVA for Audience Awareness in Essay 4

	Mn2	Mn4	AdMn	N			
B	6.37	6.18	6.35	63			
SC	4.22	3.44	3.26	61			
		SS	df	MS	F	p	B
Cov	S2	19.02	1	19.02	0.59	.445	-.087
Effect	Sch	280.27	1	280.27	8.66	.004	
Model		299.29	2	149.65	4.63	.012	
Resid		3915.34	121	32.36			
Total		4214.64	123	34.27			

Boyd students also showed better organization in their compositions. The t-test for organization revealed a significant difference between the schools (table 30; essay 4 $p<.05$). The e-mail group had a higher mean 4 (17.86) than the control group (16.31), so the e-mail group used significantly better organization in essay 4.

Table 30. T-test for Organization in Essay 4

	Mn2	Mn4	N	Std dev 4
B	14.29	17.86	63	3.33
SC	14.10	16.31	61	4.99
	Essay2	Essay4		
df	122	104		
t Statistic	0.211	2.023		
p (two-tail)	0.833	0.046		

A more detailed analysis of these categories follows in the remainder of section 4.2.2. This analysis allowed the researcher to distinguish which elements within the categories contributed to the differences at the categorical level. In addition, elements of the other categories and the individual base measures are examined for differences between the schools.

4.2.2.3 Elements of audience awareness

As in essay 3, there was a significant difference between the schools in the category of audience awareness, with Boyd showing better performance. The tests of the audience awareness elements for essay 4 demonstrated significantly better performance by Boyd in greetings and assumptions of correct audience, with a trend toward significance in requests for approval. Stewarts Creek showed more use of compliments and personal "you." Data for each of these elements follow.

Boyd students used more greetings in their essays. The t-test showed a significant difference between the schools with respect to greetings (table 31; essay 4 $p<.05$). A comparison of the means for essay 4 reveals that Boyd had a higher mean (0.69) than Stewarts Creek (0.20); therefore, the e-mail group included significantly more greetings in their compositions.

Table 31. T-test for Greetings in Essay 4

	Mn2	Mn4	N	Std dev 4
B	0.04	0.69	63	0.85
SC	0.07	0.20	61	0.49
	Essay2	Essay4		
df	122	100		
t Statistic	-0.619	3.924		
p (two-tail)	0.537	0.000		

Furthermore, the compositions of the e-mail group included more assumptions of correct audience. Table 32 shows a significant difference between the schools for this variable (effect $p<.05$); moreover, although both schools use this feature less in essay 4 than in essay 2, Boyd had a higher adjusted mean (2.17) than Stewarts Creek (1.22). The result is that the e-mail group, as opposed to the control group, more often used assumptions of correct audience in essay 4.

Table 32. ANCOVA for Assumptions of Correct Audience in Essay 4

	Mn2	Mn4	AdMn	N			
B	3.62	2.14	2.17	63			
SC	2.83	1.25	1.22	61			
		SS	df	MS	F	p	B
Cov	S2	0.14	1	0.14	0.05	.823	-.019
Effect	Sch	26.89	1	26.89	9.37	.003	
Model		27.04	2	13.52	4.71	.011	
Resid		347.31	121	2.87			
Total		374.34	123	3.04			

E-mail students also showed a trend toward including more requests for approval (table 33; essay 4 p=.052). Subsequent examination of the means shows that Boyd's larger mean 4 (0.43) than Stewarts Creek's (0.24) should be interpreted as a greater use of requests for approval, albeit not significantly so.

Table 33. T-test for Requests for Approval in Essay 4

	Mn2	Mn4	N	Std dev 4
B	0.05	0.43	63	0.21
SC	0.07	0.24	61	0.19
	Essay2	Essay4		
df	122	122		
t Statistic	-0.599	1.961		
p (two-tail)	0.550	0.052		

The findings for better audience awareness among the students who used e-mail contradict claims that use of CMC will so detach authors that they will be unable to communicate with those to whom their writings are addressed (Kiesler et al. 1984; Baron 1984). Nonetheless, the results for essay 4 are not as striking as those for essay 3, in which the e-mail students demonstrated significantly greater use of 5 audience awareness elements. This contrast is discussed in section 4.2.2.10.

No compliments were used by either group in essay 2, but the t-test for essay 4 showed a significant difference between the groups with respect to compliments (table 34;

essay 4 p<.05). Since the mean 4 score for the control group (0.05) was higher than that for the e-mail group (0.00), who used no compliments in essay 4, it was shown that the control group scored significantly better than the e-mail group with respect to compliments. The use of compliments at the control school can again be attributed to the instruction of one teacher at Stewarts Creek. 100% (n=6) of the students who used compliments in essay 4 were in her class.

Table 34. T-test for Compliments in Essay 4

	Mn2	Mn4	N	Std dev 4
B	0.00	0.00	63	0.00
SC	0.00	0.05	61	0.17
	Essay2	Essay4		
df	na	60		
t Statistic	na	-2.354		
p (two-tail)	na	0.022		

The schools also significantly differed with respect to the use of personal "you" (table 35; essay 4 p<.05). Since the mean 4 of the control group is higher (1.85 compared to 1.17 for the e-mail group), the control group used more expressions of personal "you" than did the e-mail group. This result is contrary to what would be expected and is discussed in section 4.2.2.10.

Table 35. T-test for Use of Personal "You" in Essay 4

	Mn2	Mn4	N	Std dev 4
B	0.19	1.17	63	1.59
SC	0.23	1.85	61	2.15
	Essay2	Essay4		
df	122	110		
t Statistic	-0.386	-2.006		
p (two-tail)	0.700	0.047		

4.2.2.4 Elements of argumentation

The test scores for the elements of argumentation demonstrate a significant difference between the groups with respect to the number of reasons which are relevant to the topic and the number of reasons which are irrelevant to the audience. The e-mail group performed significantly better on the former and the control group performed significantly better on the latter.

A t-test for the number of reasons which are relevant to the topic showed a significant difference between the schools (table 36; essay 4 $p<.05$). The mean for the e-mail school's essay 4 (2.89) was higher than the mean for the control school's essay 4 (2.33), revealing that Boyd students gave significantly more reasons which related to the topic under consideration.

Table 36. T-test for Number of Reasons Relevant to the Topic in Essay 4

	Mn2	Mn4	N	Std dev 4
B	1.67	2.89	63	1.08
SC	1.93	2.33	61	1.12
	Essay2	Essay4		
df	122	122		
t Statistic	-1.530	2.839		
p (two-tail)	0.129	0.005		

A significant difference also exists between the groups with respect to reasons irrelevant to the audience (table 37; essay 4 $p<.05$). The mean 4 of the e-mail group (0.24) is higher than the mean 4 of the control group (0.07), indicating that the e-mail group used more reasons which were irrelevant to the audience. As a result, the control group performed significantly better than the e-mail group, although both schools used more irrelevant reasons in essay 4 than in essay 2.

Table 37. T-test for Number of Reasons Irrelevant to the Audience in Essay 4

	Mn2	Mn4	N	Std dev 4
B	0.00	0.24	63	0.50
SC	0.03	0.07	61	0.25
	Essay2	Essay4		
df	60	92		
t Statistic	-1.426	2.447		
p (two-tail)	0.159	0.016		

The results for argumentation in essay 4 differ from those for essay 3. Only one of the elements for which the schools significantly differed in essay 3 also significantly differed in essay 4; moreover, one of the elements for which the schools significantly differed in essay 3 reversed the school showing more use in essay 4. Probable reasons for these findings are discussed in section 4.2.2.10.

4.2.2.5 Elements of organization

The t-tests conducted on the elements of organization reveal that the significant difference between the schools at the categorical level is largely due to two elements, both with better performance by the e-mail school. There is a significant difference between the two groups with respect to the presence of three supporting reasons, identified as necessary by most of the teachers (see section 4.4), and the presence of a conclusion.

T-tests showed a significant difference between the schools with respect to including at least three supporting reasons (table 38; essay 4 $p<.05$). Since the mean 4 score for the e-mail group (3.30) is higher than that for the control group (2.90), the e-mail group performed significantly better than the control group for this variable. In fact, Boyd increased in their demonstrated ability to provide supporting reasons, but Stewarts Creek declined.

Table 38. T-test for Presence of Supporting Reasons in Essay 4

	Mn2	Mn4	N	Std dev 4
B	2.84	3.30	63	0.89
SC	3.20	2.90	61	1.22
	Essay2	Essay4		
df	109	122		
t Statistic	-1.708	2.088		
p (two-tail)	0.090	0.039		

Moreover, statistical testing revealed a significant difference between the two groups' essays concerning the presence of a conclusion (table 39; essay 4 $p<.05$). Again, the Boyd students had a higher mean 4 (3.62) than the Stewarts Creek students (3.08), showing that significantly more of the e-mail group included a conclusion in their compositions.

Table 39. T-test for Presence of Conclusion in Essay 4

	Mn2	Mn4	N	Std dev 4
B	2.79	3.62	63	1.18
SC	2.62	3.08	61	1.70
	Essay2	Essay4		
df	122	107		
t Statistic	0.505	2.039		
p (two-tail)	0.615	0.044		

Compared to the results for essay 3, Boyd students demonstrate improved skills relative to their non-e-mail using counterparts in the category of organization. Boyd showed significantly better scores for supporting reasons and for conclusions. In addition, no significant difference exists between the groups with respect to breaks in logical progression, an element for which Stewarts Creek demonstrated better performance in essay 3. These results support claims of improved organization due to e-mail use (e.g., Cohen and Riel 1989).

4.2.2.6 Elements of language control

Within the category of language control, a significant difference was found between the two groups with respect to only one variable, grammar errors which do not compromise intelligibility. Regarding grammar mistakes which do not affect the meaning, Boyd students committed significantly fewer errors. Table 40 reveals a significant difference between Boyd and Stewarts Creek for this variable (essay 4 $p<.05$). A comparison of the means for essays 2 and 4 indicates that Boyd students decreased their number of errors in this element, while Stewarts Creek increased theirs. The e-mail group has a lower mean 4 (1.08) than the control group (1.56), and therefore fewer errors. Consequently, the e-mail group performed significantly better with respect to grammar errors which do not compromise meaning.

Table 40. T-test for Number of Grammatical Errors Not Affecting Meaning in Essay 4

	Mn2	Mn4	N	Std dev 4
B	1.27	1.08	63	1.02
SC	1.52	1.56	61	1.45
	Essay2	Essay4		
df	122	107		
t Statistic	-1.099	-2.130		
p (two-tail)	0.274	0.035		

Better performance on the compositions of the e-mail students in the element of grammar errors which do not compromise meaning, and the lack of significant differences for other variables, do not support predictions that use of CMC would necessarily lead to a decline in mechanical accuracy (Ferrara et al. 1991; Baron 1984). However, because the significant differences are limited to one element of the language control category, neither do the findings support claims of improved language control among students who composed texts on the computer (Mehan 1989; DeGroff 1990). These results are discussed further in section 4.2.2.10.

4.2.2.7 Elements of oral and informal features

Within the category of oral and informal features, a significant difference exists between the groups with respect to one variable, the element of slang and colloquial language (table 41; essay 4 $p<.05$). The mean 4 for the e-mail group (1.39) is higher than the mean 4 for the control group (1.00). Although compared to their performance in essay 2, students at both schools used fewer such expressions in essay 4, the e-mail group used significantly more slang and colloquial language than did the control group. In the context of this study, the result is that the control group demonstrated significantly better performance.

Table 41. T-test for the Use of Slang/Colloquial Language in Essay 4

	Mn2	Mn4	N	Std dev 4
B	1.83	1.39	63	1.03
SC	1.38	1.00	61	1.12
	Essay2	Essay4		
df	122	122		
t Statistic	1.914	1.995		
p (two-tail)	0.058	0.048		

Thus the e-mail group used more of one oral and informal feature relative to Stewarts Creek in essay 4 which did not significantly differ between the schools in essay 3. Conversely, the use of prosody, for which the schools differed in essay 3, did not differ in essay 4. See section 4.2.2.10 for further discussion.

4.2.2.8 Elements of base measures

T-tests for each of the base measures in essay 4 revealed significant differences between the schools in two elements, the number of words per essay and the number of words per sentence. In each case, Boyd students wrote significantly more.

Table 42 shows that the t-test for the number of words per essay significantly differed between the schools (essay 4 $p<.05$). The mean number of words per essay 4 for

the e-mail group (153.8) was higher than the mean for the control group (120.8), indicating that the e-mail group wrote significantly more words than the control group. Boyd students increased the number of words they wrote from essay 2, while Stewarts Creek decreased their number of words.

Table 42. T-test for the Number of Words Per Essay in Essay 4

	Mn2	Mn4	N	Std dev 4
B	116.9	153.8	63	72.36
SC	125.6	120.8	61	61.14
	Essay2	Essay4		
df	122	122		
t Statistic	-0.830	2.739		
p (two-tail)	0.408	0.007		

Furthermore, Boyd students wrote more words per sentence. The test for the number of words per sentence revealed a significant difference between the schools (table 43; essay 4 $p<.05$). Because Boyd had a higher mean for essay 4 (12.56) than Stewarts Creek (11.15), the e-mail school produced significantly more words per sentence in their essay 4 compositions. Boyd and Stewarts Creek both used fewer words per sentence in essay 4 than in essay 2.

Table 43. T-test for the Number of Words Per Sentence in Essay 4

	Mn2	Mn4	N	Std dev 4
B	14.87	12.56	63	4.70
SC	14.66	11.15	61	3.03
	Essay2	Essay4		
df	122	122		
t Statistic	0.262	1.975		
p (two-tail)	0.793	0.050		

By producing more text, the Boyd students' essays corroborate the assertion that e-mail use increases the length of text written (Newman 1986; Dale and Traun 1998).

While Dale and Traun's findings were for actual e-mail messages, Newman discovered longer texts in subsequent handwritten journal entries following e-mail use.

4.2.2.9 TEA objectives

T-tests and ANCOVAs for the composite scores based on TEA (1995) objectives show that the e-mail group performed significantly better overall and on three of the four individual objectives: appropriate response to the designated purpose and audience, organization of ideas, and development of the central idea. The results for each are presented in this section.

The t-test results for the overall score based on TEA criteria are given in table 44. This table shows a significant difference between the groups for the overall score (essay 4 $p<.05$), and a higher mean 4 for the e-mail school (46.30) than for the control school (40.54) demonstrates that students at Boyd showed significantly better performance overall on essay 4.

Table 44. T-test for Overall TEA Objective Performance in Essay 4

	Mn2	Mn4	N	Std dev 4
B	39.76	46.30	63	6.94
SC	37.72	40.54	61	9.35
	Essay2	Essay4		
df	122	122		
t Statistic	1.643	3.906		
p (two-tail)	0.103	0.000		

The e-mail group performed significantly better than the control group on appropriate response to the designated purpose and audience (table 45; essay 4 $p<.05$). Although both schools decreased in their appropriateness from essay 2 to essay 4, the adjusted mean score for Boyd (9.35) was higher than for Stewarts Creek (6.43), showing that the e-mail group performed better.

Table 45. ANCOVA for Purpose/Audience in Essay 4

	Mn2	Mn4	AdMn	N			
B	11.85	9.30	9.35	63			
SC	9.36	6.48	6.43	61			
		SS	df	MS	F	p	B
Cov	S2	2.77	1	2.77	0.11	.744	.029
Effect	Sch	248.36	1	248.36	9.62	.002	
Model		251.13	2	125.57	4.87	.009	
Resid		3122.43	121	25.81			
Total		3373.56	123	27.43			

Concerning objective 1, writing to the appropriate purpose and audience, the e-mail students' performance helped their scores on two features and hurt them on one. Both their assumptions of correct audience and their use of conclusions contributed to higher scores for addressing the purpose and audience designated in the prompt. Although Boyd students included significantly more reasons which were irrelevant to the audience, costing them points on this objective, the combined effect of all the purpose/audience features was strong enough to give them significantly better scores for objective 1.

Organization is also better in Boyd students' essays. The results show a significant difference between the groups concerning the organization of ideas (table 46; essay 4 $p<.05$). Again, the higher mean 4 for the e-mail group (10.35) compared to the control group (9.30) shows Boyd to have better performance. This is due primarily to their greater use of supporting reasons and conclusions. These features, in conjunction with others included in objective 2, resulted in the e-mail group showing a higher level of organization in their compositions for essay 4.

Table 46. T-test for Organization of Ideas in Essay 4

	Mn2	Mn4	N	Std dev 4
B	7.86	10.35	63	2.03
SC	7.95	9.30	61	3.17
	Essay2	Essay4		
df	122	102		
t Statistic	-0.156	2.194		
p (two-tail)	0.876	0.031		

With respect to objective 3, control over the mechanics of English, no significant difference was found between the two schools. Boyd's performance in grammar which does not affect the meaning helped them, but not enough to cause the composite score to differ significantly. Because the computation of a score for this objective is the same as for the category of language control, the results of the t-test again show no significant difference between the schools for language control in essay 4.

Boyd students also demonstrated better development of the central idea, objective 4. Table 47 reveals the significant difference between the schools for this objective (essay 4 $p<.05$), and Boyd's higher mean 4 (9.76) than the mean 4 for Stewarts Creek (7.95) reveals that the e-mail students developed the central idea better in their essays. The strongest contributing feature to this result is the e-mail students' greater use of reasons which are relevant to the topic. This feature combined with the others included in calculating scores for development to show a significant difference, with Boyd's performance superior to that of Stewarts Creek on objective 4.

Table 47. T-test for Development of the Central Idea in Essay 4

	Mn2	Mn4	N	Std dev 4
B	5.52	9.76	63	3.36
SC	5.51	7.95	61	3.45
	Essay2	Essay4		
df	122	122		
t Statistic	0.028	2.961		
p (two-tail)	0.978	0.004		

The results based on TEA criteria show an improvement for Boyd relative to Stewarts Creek. In essay 3, the e-mail school was significantly better than the control school only on the purpose/audience objective. In contrast, essay 4 reveals that the e-mail students demonstrate significantly better performance overall, in writing to the appropriate purpose and audience, in organizing, and in developing the central idea.

4.2.2.10 Discussion

The primary question addressed by the essay 4 analysis was whether or not the effects of e-mail would transfer to subsequent handwritten material. Cohen and Riel (1989) note that the more similar the contexts, the more likely is successful transfer. Boyd students composed essay 3 for a real communicative context, in which they e-mailed their keypals to convince them that families either do or do not watch too much television (appendix C). The target audience was a friend. Although the keypals may not have considered themselves friends, they were at least acquainted by the time the essay was written, and the keypal was a peer of those the writers would consider friends; thus, the target audience matched the recipient of the text. In contrast, essay 4 required decontextualized classroom writing. This composition was to convince their parents to allow them to go either hiking or bicycling with a friend (appendix C). The target audience was the parent, but the recipient of the text was the teacher. Because students knew their parents would not see the essay, except possibly as a graded paper, the sense of audience would have been far less than in essay 3.

Although audience awareness continues to be stronger among the e-mail students than the control group, compared to the results for essay 3, fewer of the audience awareness features in essay 4 show significant differences, and Boyd students gave more reasons which were irrelevant to the audience. These findings highlight the importance of the authentic audience provided by e-mail communication. Eaton writes that "nowhere is

audience more important than in persuasive writing" (1989-90:unit 5, page 1). He adds that audience perception is least effective when it is imagined rather than real. Because the parental audience was necessarily imagined in essay 4, it is not surprising that demonstrated audience awareness among e-mail students was not as strong in essay 4 as in essay 3. This further confirms Cohen and Riel's (1989) emphasis on the communicative context. The lack of an authentic audience in essay 4 results in a decrease in the number of individual audience awareness features for which there is a significant difference between the schools, and affects the argumentative features which are directly related to the audience. The reasons for greater use of personal "you" by the control group are uncertain, and further research would be required to identify these reasons.

On a positive note, the previous experience via e-mail with an authentic audience influenced the experimental group's ability to provide more information which is relevant to the topic and to demonstrate better organization, especially regarding their ability to provide adequate structure and support for their arguments. Based on the findings of previous research, better organization is to be expected following e-mail use. The effects of e-mail use between the time of the two essays, in addition to other writing they did, had an impact on the students' demonstrated abilities.

As in essay 3, the educational context affects language control and grammatical complexity. Boyd students showed better performance for only one element of language control, so that strong claims cannot be made for either a beneficial or a detrimental effect. It should be noted that the deterioration projected by some researchers (Baron 1984; Ferrara et al. 1991) had not begun at the end of three months' time using e-mail. Further, if it is true that the use of e-mail leads students to focus more on content (cf., Mehan 1989), the findings show that, at least with limited e-mail use, the altered focus does not necessarily harm their mechanics in the process.

The results for the oral and informal features and amount of text produced are impacted by the technological context. The greater use of slang or colloquial language by the e-mail group in essay 4 indicates the influence of informality associated with e-mail (Zyngier and de Moura 1997; Dale and Traun 1998). As noted in section 4.2.1.10, this result may be due to the novel and interactive atmosphere of computer-mediated compositions. In essay 4, like essay 3, only one of the nine oral and informal elements proved to be significant, demonstrating again that use of technology does not determine language choices.

Base measures are also affected by the use of e-mail. While there were no significant differences in essay 3, two months later, Boyd students wrote significantly more words per essay and words per sentence. Several factors are likely to contribute to these effects, including additional e-mail use in the meantime, lack of hindrance from keyboarding, and fewer distractions in a traditional educational environment. The results add further evidence to the claims of increased text length in previous research (Newman 1986).

4.2.2.11 Conclusion

T-test and ANCOVA statistical tests comparing handwritten essays from both schools show that the students who used e-mail produced better compositions than the control group. Significant differences were found overall and in audience awareness and organization, with Boyd showing better performance for all three.

Concerning TEA objectives for fourth grade writing, Boyd students proved to be better in meeting the objectives of writing for a specific purpose and audience, organizing ideas, and developing the central idea of the essay. In the overall assessment according to TEA standards, the e-mail group demonstrated significantly better writing than their non-e-mail using counterparts. The e-mail school therefore was shown to demonstrate better

writing skill according to both classroom and TEA standards. These results show that e-mail use has a positive impact on the writing skills of fourth grade students.

The improvements shown in this study cannot be attributed solely to e-mail use. The credit must be shared with the effects of instruction, maturation, and more opportunities to write; however, it should be noted that given the experimental condition, with accompanying controls, the writing of the e-mail students was more representative of "good writing" than that of students at the control school.

4.3 Student survey results

Student participants at both schools were asked to complete a survey designed by the researcher (appendices D and E). In addition to the information used to determine student comparability, questions concerned writing and computer habits outside of school.

Children's attitudes toward writing can have an enormous impact on their writing performance. Students at both Boyd and Stewarts Creek seem to have generally positive attitudes toward this essential component of literacy. More than 70% of participants at each school reported that they like writing, and almost 80% at each school believe they are good writers. The majority of at-home writing for students at both schools is in the form of notes and letters, followed by journal or diary writing, stories, and other types of writing (e.g., poems).

Many teachers dislike the use of writing prompts to initiate composition of an essay. They maintain that responses to prompts too often are a better indication of the student's knowledge of the topic than of their writing abilities. Whether it is the teachers' attitudes toward prompts or the students' own perspectives, only 33% of the Boyd students and 21% of the Stewarts Creek students reported that they prefer writing with a prompt to writing without one.

Computer ownership, frequency of use at home and school, and access to e-mail at home were highly similar between students in the experimental and control groups. Further, responses to other questions concerning computers revealed similarities between the schools. For students at both schools, computer use at home consisted primarily of playing games, while Internet use was the second most frequent use.

Students were also questioned regarding e-mail use and attitudes. Few students at either school reported using e-mail before age eight. Students who had at least some experience with e-mail were asked if they thought using e-mail had helped them become a better writer. 44% of Boyd students responded positively, but only 25% of Stewarts Creek e-mail users did. This discrepancy between the otherwise similar students may be a reflection of the project. Students at the control school, who probably use e-mail for friendly messages, would be unlikely to perceive this task as improving their writing abilities. Boyd students, who used e-mail in an educational setting and received feedback on their writing via e-mail, would be more likely to perceive that the keypal exchanges improved their writing skills.

Students who responded that e-mail had helped their writing were asked an open-ended question concerning how it had helped. The responses were then grouped according to the essence of their content, with some children reporting improvement in more than one area (see table 48). The five most frequent answers at Boyd were in the realms of writing content (example 28), audience presence (example 29), writing practice, mechanical skills, and keyboarding skills. Only five children at Stewarts Creek chose to answer this question. Of those who did, the perceived benefit was in the areas of content, practice (example 30), and mechanical skills.

Example 28
It helped me describe and persuade stuff better. [BSjj]

Example 29
It gives me an idea of what other people think of my writing. [BSst]

Example 30
becaus any time you write you get better at whritting [SCSbb]

Table 48. Children's Perceptions of How E-mail Helped Their Writing

	Boyd	Stewarts Creek	Total
Writing content	10	2	12
Audience presence	8		8
Writing practice	7	2	9
Mechanical skills	5	1	6
Keyboarding skills	4		4
Total respondents	31	5	36

Students who had used e-mail were also asked what they like about e-mail. Their responses are summarized in table 49. Fourth graders at both schools overwhelmingly name "talking to someone" as their favorite characteristic of e-mail (of whom many especially enjoyed that their conversational partner was geographically distant; example 31). Other students report that they like reading messages from their keypal (example 32) and the fun of using e-mail. A few Boyd students most enjoy getting to use the computer, while those at Stewarts Creek, whose e-mail use is outside the classroom context, like talking to their parents and the speed of communication (example 33). Four students reported liking nothing about e-mail and two liked everything.

Example 31
get to talk to other people in a different school [BSre]
amazing how you can contact someone miles away [BSjv]

Example 32
reading letters [BScs]
get it back with answer [BSvt]

Example 33
e-mail mom out of town [SCSjl]
send dad letters faster [SCSac]

Table 49. E-mail Characteristics Which Students Like by School

	Boyd	Stewarts Creek	Total
Talking to someone	40	26	66
(Geographical distance)	(17)	(10)	(27)
(Making new friends)	(2)		(2)
(Communicating with parents)		(6)	(6)
Reading messages from others	13	7	20
Fun	9	7	16
Using computer	4		4
Speed of communication		4	4
Everything	2		2
Nothing	3	1	4
Total respondents	71	43	114

The final question regarding e-mail asked what the students disliked about using e-mail (see table 50). Students in both groups dislike problems with the e-mail system (example 34), not getting a response, and keyboarding. Most students who responded to the question report disliking nothing. The consistency of answers to open-ended questions for dislikes highlights commonly perceived drawbacks of using e-mail. The difference in context of use influences students' dislikes. Some Boyd students, who composed their messages in an educational context, dislike having to write "too much." Those at Stewarts Creek, composing outside the class, and therefore apart from a teacher checking for "school appropriate content," are concerned with privacy (example 35).

Example 34
sometimes it doesn't work [BSad]
at the beginning didn't work great [BSas]

Example 35
if put wrong address, someone else reads your letter [SCSap]
parents might read e-mail [SCSpb]

Table 50. E-mail Characteristics Which Students Dislike by School

	Boyd	Stewarts Creek	Total
Problems with e-mail system	16	10	26
"Too much" writing	8		8
Not getting a response	4	4	8
Keyboarding	4	2	6
Chance of others reading mail		3	3
Nothing	17	13	30
Total respondents	69	38	107

It is somewhat surprising that so many Boyd students disliked nothing about e-mail after all the problems they experienced with the system (see section 3.3.3). The instructional designer commented that the children quickly adapted to changes. Students were well aware of the new procedures and problems, but the obstacles did not seem to deter them. In the early stages of the project, one boy, about to send his message, was seen with his fingers crossed repeating, "Please go. Please go." These observations coincide with Belyaeva and Knox's (1988) conclusion that motivation remains high even in difficult tasks.

4.4 Teacher interview results

Because teachers influence their students, teachers of the fourth grade classes who participated in the study were interviewed individually to determine certain demographic information and their views on writing, computer use, and the combination thereof (appendix F). Some of their responses were used in the statistical tests discussed in sections 4.1 and 4.2. Other findings are discussed in the remainder of this section.

Teachers gave a variety of responses to questions concerning writing philosophy and instruction; however, there was a great deal of overlap in their answers for the most important concepts in teaching writing and what most influences a student's writing ability. Teachers at both schools mentioned that children need to be well read, have good communication and organizational skills, have background information on the given

writing topic, and spend more time writing. In an effort to accomplish the latter, all teachers reported that their students write in all subject areas, commonly known as writing across the curriculum. The methods of writing instruction are generally consistent between the schools, with partner and group writing being the most common. Teachers also use modeling, self-evaluation, individual conferences, and patterns or worksheets.

The teacher interviews also included questions regarding their personal and professional use of computers. The number of years the teachers had used computers was inversely proportional to the number of years they had taught. Teachers at Boyd, of whom one retired at the end of the 1997-98 school year, had taught an average of 26.25 years (sd=3.86), while those at Stewarts Creek had taught an average of 2.63 years (sd=1.80); however, fourth grade teachers at Boyd reported using a computer an average of 7.50 years (sd=4.87), and those at Stewarts Creek had been using one an average of 12.25 years (sd=5.11). These results are shown in figure 12. Since the number of years teaching is related to the teachers' ages, this supports the notion of generational differences in computer use (Negroponte 1995; Kraut et al. 1996).

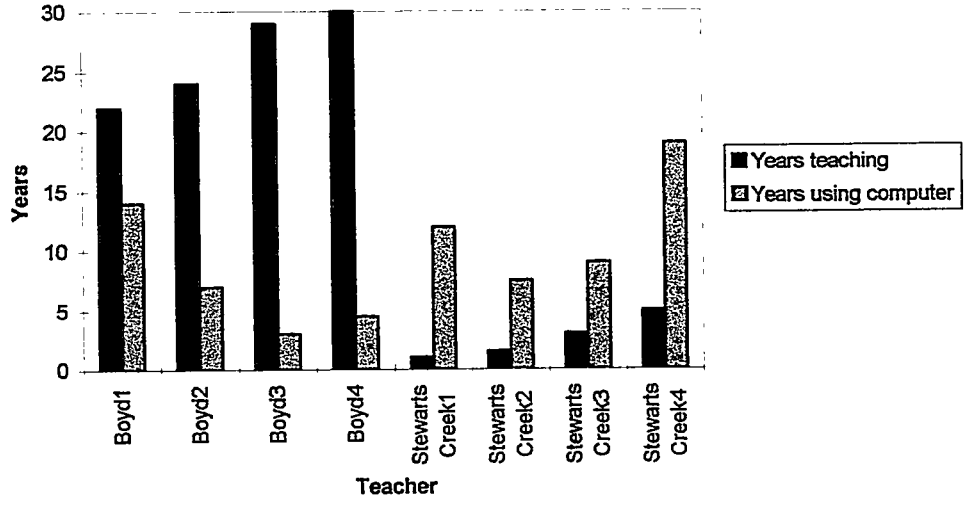

Figure 12. Years Teaching and Using Computer by Teacher.

Could it be that the fact that Boyd fourth graders were taught by more experienced teachers was what determined their greater improvement, rather than their participation in the e-mail exchange program? While teachers at Boyd had far more experience in their profession, the results do not necessarily translate to better writing on the part of their students. The 1997-98 school year was the first year of teaching for only one instructor at Stewarts Creek.[3] All other teachers at both schools had participated in instruction for the previous two school years, in which Stewarts Creek students had demonstrated better performance than Boyd students on the TAAS writing exam (see table 2). Moreover, essay 2 was collected in January and should have revealed the effects of superior instruction; however, the results showed Boyd to have significantly better performance in only eight of the fifty-five variables examined (see table 27). Of these eight, Boyd maintained significantly better performance, as demonstrated by essay 4, for only three variables. Thus most of the improvements were in areas other than those for which Boyd started with better scores. These facts do not support superior instruction at Boyd as the cause for significant differences found in the study.

All eight teachers reported having a home computer, but the frequency of use is affected by the number of years she has been using a computer. Only one Boyd teacher uses her home computer a few times a week (Boyd1 in figure 12) and the other three hardly ever use theirs. At Stewarts Creek, teacher 4 uses her home computer every day, teachers 1 and 3 use theirs a few times a week, and teacher 2 hardly ever uses hers. All teachers use computers every day at school, but some of the Boyd teachers indicated that it was more by requirement than by choice.

Concerning the use of computers in the curriculum, teachers at Boyd reported technology being more integrated into their curriculum than those at Stewarts Creek.

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[3] This was not the teacher who differed from the others by suggesting her students use thanks and compliments in concluding their persuasive essays.

Teachers at Boyd had access to far more training in using computers than those at Stewarts Creek. Most at Stewarts Creek relied on what they had learned in college, while those at Boyd were provided so many opportunities that three said they did not have time to take advantage of much of the training offered. When asked what could be done to make the integration of technology more effective, three teachers at Stewarts Creek requested more access to computers. Only one teacher at Boyd mentioned this aspect. Teachers at each school said they needed more time to, as one teacher put it, "play and plan." They are aware that there are numerous uses for the computer in their teaching activities, but do not always have the experience to know how to perform the tasks and then implement them in their instruction of students.

Many of these answers reflect the approaches of the respective districts to technology. Allen ISD, of which Boyd is a part, has been intentional in acquiring technology and implementing it in the curriculum at all grade levels. The instructional designer at Boyd observed that conferences on this topic are not as helpful as she would like, because Allen is one of the few districts on the "cutting edge," whereas most conferences are targeted to the status quo. The superintendent of Allen ISD was named Superintendent of the Year for Texas in 1997, largely due to the district's progressive approach to technology. For whatever reasons, administrators in the Lewisville ISD, of which Stewarts Creek is a part, have not followed this strategy.

Fourth grade teachers were also asked about using computers in teaching writing. Three teachers at each school said they believed computers could help in teaching writing. They voiced such reasons as improved student performance in both content and mechanics when using word processing, and increased motivation when using e-mail. The instructional designer observed that the first time Boyd students sent messages to their Story keypals, they were so excited it was difficult to calm them down. One teacher at each school responded that she did not know if computers could help in teaching writing.

One of these two said that she did not know in what way, but surely computers could help somehow. The other teacher emphasized the continued need for the teacher, seeming to echo teachers' fears of role change noted by Graves and Haller (1994) and Levin and Thurston (1996). She labeled the project for the present study a "disaster" in her interview. Although this teacher was the most extreme in her negative perceptions, the children's tolerance for technical failures did not prove to be replicated in their teachers (cf., section 4.3 for the children's perspective).

All eight teachers stated that writing on a computer is different from writing by hand. Of the eight, four thought that writing on computer is better and four thought writing by hand is better. The primary reason given for either evaluation concerned keyboarding skills. Those who thought computers are a better medium said that typing is not as laborious as paper and pencil writing. On the other hand, those who perceived handwriting to be better for composition emphasized the children's need to concentrate on typing to the extent that they lose the flow of their writing. One of the teachers who favored paper and pencil writing said, "I even still handwrite things before I'll type them up." One teacher at Boyd noted ease of change as a benefit for computers and claimed that students pay more attention to spelling but less to punctuation. At Stewarts Creek, one of the teachers noted that students write more on the computer and are more daring with word choice.

In general, responses in the teacher interviews support e-mail use. Teachers' goals for their students to be well read, communicate well, and spend more time writing could all be facilitated through an e-mail exchange program. Generational differences in computer use are evident among the teachers, but even those who seldom use computers themselves generally recognize their value in teaching. Training for the teachers at Boyd and the implementation of computers in the curriculum have shown them more of the potential computers have in an educational setting. For them, the technology is available,

and further implementation is a matter of having time to "play and plan." Most of the teachers interviewed believe that computers can help in teaching writing, with a primary concern being keyboarding skills. These attitudes are generally conducive to promoting an e-mail exchange program.

4.5 Observations of e-mail

Even among teachers who disagree with TAAS methods of writing evaluation, most would agree that an essay which fulfills these objectives (writing for the appropriate purpose and audience, organizing ideas, exhibiting control over the mechanics of English, and developing the central idea) represents good writing. Observations of the entire set of e-mail messages exchanged during the time of the study provide additional insight into the children's attention to aspects of these objectives. The e-mail messages discussed in this section are taken from introductory statements by students at both schools, a round robin story to which each individual of the pair of keypals contributed, Story students' responses to the persuasive composition they received via e-mail, Boyd students' replies to those responses, and descriptions of a picture to be reconstructed. Excerpts are classified according to the objective to which they contribute.

4.5.1 Purpose and audience

Students begin demonstrating audience awareness as early as their introductory messages. In response to a message from her Story keypal, one girl mentions both his name and some of his hobbies (example 36).

Example 36
Hi! my name is [R]. My hobies are baseball and football... [S2-12r]

Hi, [R] I see you are a boy . My name is [C] I am a girl . I like football , and soccer , I am not a baseball fan... [B2-13cm]

Other students include information from the introductory messages in their round robin stories. Some children use a common interest to begin the narrative (example 37), while others include their keypal's name. The author of example 38 weaves both partners' names and hobbies into the story.

Example 37
HI my name is [A]. I like beanie baby's.Do you have eney beanie babys.I just got 3 new beanie baby's.BY. [S2-13a]

Hi I im [M] I do like beanie babys. I don't have a lot I have Stripes, Lio, and Bones do you. ...Talk to ya later Bye.
One day I was walking down the street and [B2-13me]

I saw a Beanie Baby walking towards me. I said hi and i said can i keep you it was a igey the igona. Then i ternd around and I was being invated by beanie babies [S2-23a]

Example 38
Hi my name is [N]. What is your name. What is your hobby? Mine is gymnastics... [S2-09n]

Hi my name is [KF],
and my hobbys are roller hocky and football.
now I'm going to start a story and you will finish it here it goes.
One sunny warm day two friends were walking down the street and thire names were [K] and [N].Well [K] started geting board so she asked if [n] wanted to play a game of rollerhocky and he said yes.So they playd and played and [K] won.And [N] challened [K] to to judge to see who was the best at gymnastics. [B2-13kf]

Although some Story students' responses to Boyd's persuasive compositions were too general to be helpful to the original author, others provided constructive feedback in their evaluation. A number of responses indicated that the messages were appropriate to the target purpose and audience and achieved the goal of persuasion. Example 39 includes options listed by the original author in the reader's new plan of action, and example 40 refers to a specific reason which seems to have been pivotal in convincing the reader. Both examples affirm the original authors' audience awareness.

Example 39
I was convensed not to watch so much T.V. ,and instead of watching T.V. I think I'll go outside , play with my friends ,or help my parents. [S4-15n]

Example 40
You convinced me because people do imitate T.V. That can cause violence at shcool and at home. [S4-15c]

One Story student responded with only a general evaluation of the original persuasive text. Because he did not include the reasons for remaining unconvinced despite "a really good" argument, the Boyd student further questioned him. Example 41 demonstrates the importance of audience feedback in children's writing.

Example 41
That was really good, but I wasn't really convinced. [S4-15k]

Why weren't you convinced??? [B4-24mg]

These examples show audience awareness in action. Without an authentic audience, these texts would have been much less interactive. These observations provide evidence that an e-mail exchange program is effective in providing the genuine communicative context advocated for process writing (cf., Graves 1983 and Cohen and Riel 1989).

4.5.2 Organization of ideas

One Story student complimented the original author on the organization of her persuasive composition (example 42). He also commented on the Boyd student's use of the word "else" four times in the essay, three times within four lines. This example shows that fourth grade students are able to evaluate the organizational structure of a text. Many teachers use partners or groups within the class to evaluate others' compositions. An e-mail exchange program provides for the same feedback, with the additional benefit of increased motivation (see section 4.3 for students' appreciation of interaction with others

via e-mail). Students who cannot see organizational problems in their own compositions can be made aware of the problems through feedback from others.

Example 42
You have a good story structer,but I think you used too many else word. [S4-20]

4.5.3 Language control

A number of students edit the work of their keypal with respect to control of the mechanics of English. Examples of revisions include correcting spelling and punctuation (example 43) and deleting and replacing the end of a sentence that does not make sense (i.e., a break in logical progression; example 44). Such factors could influence both language control and organization.

Example 43
...There was one beaney baby in it . It was Princess the purple bear. I was so happy. Then I hered this girl looking for somthing. I asked her what she was looking for. She said "Princess." I said "oh". The girl said" have you seen her." [S2-26c]

...There was one **Beanie** baby in it . It was Princess the purple bear. I was so happy Then I **heard** this girl looking for somthing. I asked her what she was looking for. She said "Princess." I said "oh". The girl said" have you seen her?"Then I said yes, I have I saw princess the Beanie Baby i'ts in this bag I found it over there.I'm so glad I found the owner. [B2-27ed]

Example 44
...So I ran to where the DRAGON lived and he gave me some food. But I didn't know that he was trying to stuff me. And the next night he tried to eat me! So I ran away and started crying. A strange little guy and instead he turned into the dragon! [B2-27jg]

...So I ran to where the DRAGON lived and he gave me some food. But I didn't know that he was trying to stuff me. And the next night he tried to eat me! So I ran away and started crying. A strange little guy told me I would be safe in his car. I know that I shouldn't go with people I don't know,but it was better than letting the dragon [S3-04a]

Some students show a use and recognition of metalanguage. In example 45, the Boyd student closes his message with a statement that is not a part of the narrative. The Story student deletes the metalanguage before continuing the story.

Example 45
...I heard the kid come through the kitchen and when I turned around the kid on the skateboard was a few feet from me. I closed my eyes and I felt all tickly. I opened my eyes and I wasn't at home. I was floating. Finish the story. [B2-27sa]

...I heard the kid come through the kitchen and when I turned around the kid on the skateboard was a few feet from me. I closed my eyes and I felt all tickly. I opened my eyes and I wasn't at home. I was floating. The kid was not next to me , he was above me. I started to scream as loud as I could... [S3-161r]

These examples show students working with features of language control. The students recognize at least some mistakes in the writing of others and make appropriate corrections. A greater awareness of errors in the writing of others than in one's own writing is common among those developing literacy skills. An e-mail exchange program assists in improving language control by providing authentic data for students to correct, and is more representative of a genuine task than "find the five errors in this paragraph" drills.

4.5.4 Development of the central idea

Some children at Story show high level evaluation of the compositions they have read. In response to the persuasive messages, some noted a need for more elaboration (example 46) and others a need for more reasons, perhaps especially those relevant to the audience (example 47). Boyd students demonstrate a willingness to accept the constructive criticism (examples 48-49).

Example 46
I was almost cinvined. You need to put more elaboration. [S4-15a]

Example 47
I read your persuasive paragraph. I am convinced withed your reasons to watch to TV. I agree with your two reasons to watch TV. Allthough, you could try to give your reader, which is me, a couple of more reasons why it is good to watch TV. [S4-15k]

Example 48
I think you did ok. Youu could still add a few things. [S4-20e]

Thank you for reading.I would have added more but we didn't have enuf time to finish.THank you for telling me.Now I can do better if I ever do this again. [B4-24ki]

Example 49
Next time I willadd more detail [B4-24ct]

The extent of elaboration may be influenced by the task. The final phase of the e-mail project consisted of students at Story drawing a creature using the Paint accessory on their computers and sending a written description via e-mail to Boyd, where students would reconstruct the picture. Students were then to exchange pictures by attaching them to an e-mail message to determine how well the pictures matched. Boyd students exhibited great frustration in trying to recreate the pictures due to incomplete and inconsistent descriptions. One student showed the researcher the incomplete description and asked, "How am I supposed to finish it?" Another bewildered student pointed out, "First, it says he has red eyes. Then it says he has black eyes." The instructional designer's evaluation of the confusion was that it would result in better descriptions from Boyd students if they were asked to describe a picture they had drawn. It is conceivable that elaboration would improve through such exercises or more extensive e-mail use, as indicated by the findings of Graves and Haller (1994) after students used word processing for one year.

Input concerning development of the central idea shows that students are able to identify what is lacking in the text of a peer. Rather than reacting negatively to criticism of their essays, the Boyd students accept the suggestions and state that they will incorporate them in future writings. In fact, results for essay 4 (see section 4.2.2.4) show significantly better performance by Boyd students, relative to the control group, in the number of reasons relevant to the topic. The e-mail exchange thus provided an effective avenue for audience input regarding adequacy of the author's development of the central idea.

At times, the children demonstrate an awareness of the medium itself. Some of these comments are due to the numerous problems they encountered in the early stages of the e-mail exchange. In example 50, the author expresses his realization that the message may not get to the keypal. After a week with no response, one girl sent a message repeating much of the material she had included before. This action was probably due to her assumption that the previous message had not reached the intended recipient.

Example 50
...I hope you get my message. [S2-12k]

In other instances, students adapt familiar phrases to the new context (examples 51-52):

Example 51
...Hear you next time. [instead of "See you next time."] [B3-31ki]

Example 52
...please type back. [instead of "Please write back."] [B3-30ar]

In each case, rather than allowing the medium to dictate their meaning and form of expression, as suggested by strong forms of technological determinism, the students adapt their messages to communicate ideas in a manner which reflects the new medium.

4.5.5 Summary

The observations made from the e-mail messages show that the fourth grade students are often adept in evaluating the writing of their peers. The children demonstrate abilities in making both changes and constructive suggestions for change with respect to all four TEA objectives. Specifically relating to the questions of this study, these effects apply to the categories of audience awareness, organization, language control, and argumentation; moreover, according to the replies of the Boyd students, these suggestions

would influence their subsequent writing of the same genre. The impact of the e-mail exchange program as a whole is summarized in chapter 5.

CHAPTER 5

CONCLUSIONS

5.0 Introduction

This study has investigated the impact of e-mail use on fourth graders' persuasive writing skills. This chapter provides a summary of the study and conclusions, especially as they relate to specific areas of impact on children's writing, as identified in the original research questions in section 1.2. Implications of the study for linguists, CMC researchers, and educators are also considered. The chapter closes with suggestions for further research.

5.1 Summary and conclusions

In this study, three types of data—handwritten compositions, e-mail messages, and surveys/interviews—were analyzed according to language-focused guidelines. The researcher compared two sets of persuasive compositions, and found results which are consistent with demographic, psychological, and behavioral tendencies discovered in the survey and interview analysis.

5.1.1 Comparisons between e-mail and handwritten compositions

According to the analysis of e-mail and handwritten compositions, e-mail composition has a positive impact on two of the research questions: audience awareness and argumentation. The influence of an authentic audience and the educational and technological contexts of composition are primarily credited for the effects shown in Boyd students' writing.

Interacting with other students via e-mail improves the quality of writing. A heightened sense of audience produces the most pronounced impact on the e-mail texts, and affects elements in both the audience awareness and argumentation categories. The awareness of an authentic audience gives rise to the use of certain linguistic features, some of which demonstrate interaction itself (e.g., questions, requests for approval) and others of which show consideration for the audience (e.g., providing reasons which are relevant rather than detracting to the audience). Proponents of process writing emphasize the need for writers to interact with others concerning their writing. With respect to handwritten material, this is generally accomplished through conferences with the teacher and/or peers (cf., Calkins 1986). In e-mail, the interaction occurs via CMC. It is interesting to note that even the relatively limited interaction students had via e-mail in the present study yielded statistically significant results.

The educational context influenced the findings through the purpose for communicating and expected standards. Herring and Nix (1997) found differences in the language used for task-focused and socially motivated Internet Relay Chat. In the present study, the children were more task-focused, due to the institutional setting and the nature of the prompt as an assignment. In addition, the standards in an educational context differ from those expected in recreational correspondence. The e-mail texts in this study should exhibit better language control and more grammatical complexity than e-mail messages composed "just for fun." The fourth grade participants were accustomed to expected standards of classroom-composed essays, but seemed uncertain how to transfer this knowledge to the new medium. During the time students were composing the e-mail essays, some were observed asking, "Is this enough?," a question for which they would presumably know the answer in paper and pencil writing. Moreover, they chose to transfer some of their composition practices from the handwritten context, but not others. One student stated that he knew what to do, and recited the pattern he had been taught in class.

This student directly transferred the pattern from the traditional classroom context; however, other practices did not transfer. For example, students did not do any prewriting prior to writing the e-mail texts. Even in a non-computerized setting, most students fail to realize the value of creating an outline before they begin writing. They tend to view prewriting as extra work; thus it is not surprising that the e-mail students in this study chose, consciously or not, to forego this practice in the new context.

The e-mail students' use of technology also affected the results. Because Boyd Elementary encountered numerous problems with the e-mail system through the initial stages of the project, the students at the experimental school used e-mail for only a limited time. In interpreting the results of the current study, it is difficult to say whether e-mail use has no effect on language control skills or whether the limited use did not allow students sufficient opportunity to improve as they might have if they had used e-mail more extensively. The e-mail context influenced some variables by requiring that students keyboard their essays. Students demonstrated great difficulty in typing, and their teachers verified that this was common. As a result, students had to concentrate on finding the letters on the keyboard, distracting them from their content. Poor keyboarding skills also decreased the amount of text they were able to produce in a set period of time.

5.1.2 Comparisons between handwritten compositions

The researcher found significant differences between the two schools' handwritten texts at the end of the e-mail exchange project. These findings reveal that using e-mail positively affects four of the eight research questions. Students who had used e-mail improved overall, were more aware of their audience, were more organized, and produced lengthier texts. Given the limited exposure of the experimental school to e-mail, these results are remarkably strong. The effects of e-mail use, especially those from interacting

with an authentic audience and using technology in an educational context, appear to transfer to subsequent handwritten essays.

As noted in section 5.1.1, students who wrote to an authentic audience composed better persuasive essays. By interacting with their keypals prior to essay 4, Boyd students learned to support their arguments by providing more reasons, especially those which are relevant to the topic, and providing a conclusion; however, they had to imagine their audience for prompt 4. In this essay, the e-mail group used fewer audience awareness features and more reasons which did not relate to their audience. The study thus reveals that an authentic audience and communicative context heavily influence students' writing.

Essay 4 was handwritten in a traditional classroom setting. As discussed in section 4.2.2, the researcher sought to determine how e-mail use affects subsequent paper and pencil writing. The e-mail group produced longer texts than the control group in essay 4, in part because students were not distracted by the work of other students or the need to keyboard. The results also show that e-mail users perform similarly to non-e-mail users in controlling the mechanics of language and grammatical complexity; therefore, three months of e-mail use was not detrimental in either of these areas.

Based on previous research, one might hypothesize that students who use e-mail will be more informal in subsequent handwritten texts and will write longer texts. In this study, students who became accustomed to using oral and informal features in their messages between essays 3 and 4 may have transferred their use to handwritten compositions. The remedy to the greater use of slang or colloquial language, to the extent that this is considered to be a problem, could involve teachers instructing students in appropriate registers of use in classroom discourse. With respect to text length, the e-mail group produced longer texts than the control group in essay 4. While longer compositions do not necessarily represent better writing, teachers generally prefer more rather than less text.

Since the researcher built controls for other variables into the experiment, these improvements are largely attributed to e-mail use. While credit for improvement should be shared with instruction, maturation, and other opportunities to write during the time of the study, the results for the e-mail and control schools strongly differed following the e-mail treatment, and favored the experimental school.

5.1.3 Survey/interview evaluation

The researcher evaluated responses to student surveys and teacher interviews to determine what effect attitudes and practice concerning writing, computers, and e-mail had on the research questions. Most students like writing and think they are good writers. These attitudes tend to improve overall writing skill both within and outside the context of an e-mail program. Almost half of respondents from Boyd reported that e-mail had helped their writing, while only a quarter of the home e-mail users at Stewarts Creek thought their writing had improved due to using e-mail. The perceived improvement was reportedly the result of better organization and expansion of text, writing practice, an authentic audience, better writing mechanics, and/or keyboarding skills. Of these, all except the keyboarding skills were evaluated in this study, and all except writing mechanics, for which there was no significant difference between schools, showed improvement for Boyd, according to essay 4. By far the majority of the participants in the e-mail exchange described the experience as either "fun" or "okay." In fact, children from both schools report liking interaction with others via e-mail (both writing and reading messages), getting to use the computer, and the speed of transmission. These factors motivate students to improve their writing ability.

Interviews revealed that teachers tend to emphasize the importance of communication skills, reading experience, organization, and background information concerning a writing topic. These factors positively influence audience awareness,

organization, and argumentation. As for methods of instruction, teachers at both schools have their students write in groups or with partners, model writing for their students, and teach the students certain forms. The group and partner writing have been found to be especially effective in improving language control and organization. Boyd teachers have been using computers fewer years and use them less frequently outside of school, but the training they have received, and the effects of computer use they have observed among their students, have given them generally positive attitudes toward using computers in an educational setting. Most teachers at both schools believe that computers can help in teaching writing. A key factor in how they think writing on computers differs from writing by hand involves keyboarding skills, which likely affect organization and the amount of text produced in the current study.

5.1.4 E-mail message evaluation

The researcher also examined e-mail messages sent and received, other than the compositions already discussed, during the e-mail exchange between Boyd and Story Elementary. These messages also shed light on the research questions. Students promoted audience awareness through using such elements as their keypal's name or hobbies. Keypals, through their comments, rewarded adequate argumentation and organization in the persuasive compositions. They also gave constructive criticism to Boyd students whose presentations were inadequate. These responses led to better writing overall and in the areas of organization and audience awareness. Some children edited the work of their keypal (e.g., spelling, logical progression) when they sent their addition to a narrative. Edited messages promoted better control of the mechanics of language and organization.

5.2 Implications

5.2.1 Implications for linguists

Because little research examines children's computer-mediated communication, the present study constitutes research in a relatively new field. This study demonstrates the usefulness of linguistic research on CMC use in an educational context. By using a linguistic approach, the researcher can discover patterns of language use which would not otherwise be apparent (e.g., through breaking down broader categories into detailed, language-focused elements). Neither discourse analysis nor the study of educational classroom discourse is a new field, but the two have seldom been combined in CMC research efforts. By bringing the methods of discourse analysis to bear on educational classroom discourse, the present study revealed new and interesting results concerning linguistic differences in the way students at the two schools write.

These findings raise further questions for sociolinguists, discourse analysts, and language acquisition researchers. What specifically about the e-mail project led to the observed results? Was it the context of the writing, the interaction with other children either inside the classroom or with whom they exchanged messages, or some other factor? Further sociolinguistic and discourse research in this area will lead to a better understanding of interaction and its effect on language use in computer-mediated contexts. Another question concerns whether or not CMC features are age-sensitive. In the context of language acquisition, additional data would provide information concerning how children communicate and the role of developmental issues at the intersection of literacy acquisition and classroom discourse.

As educational institutions, particularly at the elementary level, acquire and implement computer technology in general, and CMC in particular, they constitute a source of language data largely untapped outside the discipline of education. As more schools incorporate word processing into their curricula and go on-line, these activities

will constitute a vast source of pretranscribed data much like the Internet data discussed by Herring (1996a). For those discourse analysts who are willing to make the effort to gain permission for access, these data could be used to address questions in the areas of literacy acquisition and the nature of classroom discourse.

5.2.2 Implications for CMC researchers

The results of the present study indicate that educational context is important in CMC use. While the students demonstrate some informality, overall they show few of the adaptations observed among adults. Rather than being an age-related phenomenon, the primary difference appears to be in task-focused versus recreational CMC. With respect to the research questions, CMC in an educational setting would be expected to demonstrate greater grammatical complexity, control of the mechanics of language, organization, and overall writing ability (according to traditional standards) than CMC for social purposes only. In contrast, recreational CMC would be expected to include more oral and informal features. The presence of the teacher as an authority figure, even in the role of mentor, could also lead students to different language choices than they might make in a social setting. The effects of these different contexts are evident as Boyd students reported that they improved in their writing skill as a result of e-mail use, while those at Stewarts Creek did not.

The findings of this study contradict strong claims of technological determinism, in that the educational context has a stronger influence than the synchronicity of CMC exchange. Students maintain relatively high topic coherence, both within and between the e-mail messages, making the data similar to the pedagogical chat studied by Herring and Nix (1997). These results stem from the messages being composed in an educational setting, in response to a particular assignment, and in the presence of a teacher. The writing context led students to be somewhat more formal (e.g., concerned with adherence

to the topic) than they might have been in communicating for social purposes only, while still interacting with their addressees as characteristic of CMC. Enhanced interpersonal involvement is evident in the audience awareness features and responses of the keypals (cf., Ko 1996). These findings support the perspective that "any message constructed in the mind of a social being implies choice..." (Zyngier and de Moura 1997:130). It is not the machine itself, but what people do with the machine that makes the difference (Mehan 1989).

In comparison to previous CMC research, the students' e-mail compositions show similarities in some but not all areas. When students omit linguistic material which is generally required in written discourse, they seem to do so from a genuine lack of knowledge rather than economy of keystrokes, thus differing from the findings of Cho (forthcoming). In addition, e-mail students do not write shorter sentences or abbreviate or omit more words as found by Cho. E-mail and paper and pencil compositions did not significantly differ in grammatical complexity (cf., Herring 1997). Contrary to Zyngier and de Moura (1997), children were no less explicit in CMC than in handwritten essays. It is conceivable that more of the effects found in previous research would appear in the students' messages with increased use of e-mail; however, given the strength of the educational setting, it is unlikely that writing would worsen either in content or mechanics over a longer period of use when it did not do so after three months (cf., Cohen and Riel 1989 and Meagher and Castaños 1996 concerning improved performance in these areas).

The preceding point brings up a more general observation, which is that students do not follow the patterns of deterioration predicted by some researchers. The fourth graders did not tend toward homogeneity in their writing, as predicted by Baron (1984), nor did they reduce and omit language as predicted by Ferrara et al. (1991). On the contrary, the findings of this study coincide with previous studies of children who

improved their demonstrated writing skill by using e-mail (Moore 1989; Cohen and Riel 1989).

Attempts to compare the discourse of fourth graders to that of adults lead to complications. Children are developing in their literacy skills as well as adapting to a new medium. Graves (1994) provides a rough outline of development in writing as children progress from first through twelfth grades. Students begin with "invented" spelling, which corresponds to their understanding of sounds and symbols. As they progress, they gain a stronger sense of what a sentence is but will encounter difficulty with this concept as their texts become more complex. Children at a second level include more detail in their compositions and fewer invented spellings. At the third level, students demonstrate an ability to relate the various components of a text to one another. They are aware of their audience and show an ability to include elements which others will find interesting. Students then progress to a more focused pursuit of the subject, although some elements are still out of place. Finally, they reach a point of extracting essential meaning from a larger context and including reflections on life in their writings. Graves emphasizes the influence of maturity and instruction on development. According to his research, a child from age ten through seventeen, depending on their level of development, may demonstrate either or both of the final two levels.

The TEA expects the writing of fourth grade students, nine to ten years of age, to demonstrate development at least into the third stage, showing audience awareness. Undoubtedly, the student participants in this study represent a variety of developmental levels in their writing. Writing samples from the general population of adults would also represent various stages; however, the context in which many studies are conducted (e.g., university settings, professional work environments) would include more adults whose writing exemplifies higher levels of development. As such, in comparisons between adults' and children's written discourse, the children might be expected to produce less complex

texts, more errors in language control, and more extraneous information. Developmental issues, as opposed to a lack of concern with accuracy, could conceivably lead to many of the children's mistakes. Despite the difficulties inherent in comparing children's and adults' texts, such studies give CMC researchers and linguists insight into how children respond to the new medium and whether their approaches match or differ from those of their adult counterparts (cf., Nix forthcoming).

5.2.3 Implications for educators

The findings of the current study have implications for educational research findings, administrators, schools, teachers, students, and writing. Computer access and use varies in the present study both between schools and within schools. Some teachers are using technology to promote higher order thinking skills (cf., DeGroff 1990; Jacobson 1994), while others continue to rely on drill and practice. Computer use by the students which is led by the teachers (i.e., not led by the lab instructor) confirms the notion that training is an important determining factor in whether and how teachers use computer technology in their instruction (Moore 1991; LeBlanc 1994; Levin and Thurston 1996).

If claims that computer use makes little difference in student abilities are meant to apply to all aspects of computer use, the findings of this study contradict this claim as regards e-mail use. Students demonstrate the ease of editing by altering their own work, as observed by the researcher, and the work of others (cf., Mehan 1989). Teachers concur with the motivation and development of research skills afforded by computer-mediated communication, but have yet to discover or implement other tasks of potential benefit (cf., Schrum 1988).

Skeptics contend that e-mail is unnecessary, because authentic audiences can be invoked by other means (i.e., the technology has no beneficial effect in and of itself). Contrary to this assertion, certain collaborative projects require the participation of those

outside the local community (cf., Levin et al. 1989 for a project designed to calculate the circumference of the earth which required input from sources worldwide). Teachers would likely never initiate such projects without the timeliness of responses and the ease of contacting others who might be interested in the project facilitated by CMC. In addition, anecdotal evidence suggests that experts are more likely to respond to e-mail correspondence due to the ease of replying (cf., Negroponte 1995).

The effect of an authentic audience (DeGroff 1990; TEA 1997) was especially evident in comparisons of the e-mail and handwritten composition; however, the e-mail compositions do not support findings of better language control, organization, and development as reported by Cohen and Riel (1989) in compositions written to be sent via electronic mail to peers in other countries. Although students did not write more in the e-mail composition itself, as expected from the results of Dale and Traun (1998), they did write more in subsequent handwritten material (cf., Newman 1986 for lengthier texts in other writing after CMC use). Children also seemed eager to read their e-mail messages and write more frequently to their keypals, thus confirming that CMC provides increased motivation (Bowen 1994). Even in the midst of numerous system failures, the students eagerly persisted in their attempts to e-mail (cf., Belyaeva and Knox 1988). The children also showed a strong desire to interact with classmates during the reading and writing stages of e-mail communication, and often consulted their peers rather than the teacher (cf., Peha 1995). Teachers at Stewarts Creek, where access is lacking, appear more ready to implement technology in their curriculum than those at Boyd. This hesitation on the part of Boyd teachers may reflect their familiarity with a teaching style they have developed over many years (cf., Graves and Haller 1994; Levin and Thurston 1996), their lack of time to develop computer-based lessons, and their negative experience with the e-mail system for the first several months of the study.

For school administrators to implement computer-mediated communication in the schools, they will initially need to make large outlays of funds. Hardware, software, personnel, and training require an investment of resources. While limited budgets often force the most economical route in equipping a school with CMC capability, administrators will want to be certain that their acquisitions allow computer-mediated communication with those outside the school and simultaneous performance by all students of the tasks for which the equipment is purchased. For those school districts unable to afford such expenditures, research could be done into the availability of grants or cooperative efforts with local businesses and corporations. Another option now being pursued in some schools is the purchase of laptop computers which are leased to students.

One of the most effective steps in implementing computer technology in schools is the hiring of a full-time computer coordinator (Becker 1993). The computer coordinator is responsible for learning how to perform certain technological tasks and then training the teachers. S/he also devises plans for computer projects which are included in the curriculum. The instructional designer at Boyd functioned in this role in addition to other duties. For example, she implemented a plan in which all grade levels (kindergarten through sixth) were responsible for assigned aspects of designing a web page. As computer coordinator, she learned how to use new equipment or software and taught groups of teachers as necessary and individual teachers who had earned additional computer training based on a reward system. She sometimes assisted in the computer lab and was "on call" when teachers needed assistance in their rooms.

Schools could provide more training for teachers both in how to use the technology and how to implement it in their teaching. Training classes, such as during in-service, could be taught with teachers using the actual equipment students will use. Through coordinated efforts they could even carry out a joint project with other teachers, thus enabling them to see some of the benefits of the medium. Building a vision for the

potential of CMC is one of the major obstacles with the few teachers who remain reluctant to alter longstanding curricula. This can be accomplished to some extent through awareness of the literature, including the results of the present study, which has found increased writing skill due to e-mail use, but is most effective when the teachers have hands-on experience (cf., Moore 1991). Schools might also provide more computer time for their students and communicate the educational value to those who would question extensive use of e-mail in schools (cf., Daisley 1994).

Teachers whose schools do not have a computer coordinator would need to learn to use computer-mediated communication and design ways it could be used to expand their students' knowledge and skills. This investment of time and energy may only be possible if teachers are given release time from current obligations. CMC promotes many of the factors that teachers report are important in teaching writing (e.g., communication skills, spending more time writing). Joint projects are also conducive to partner or group work. Generational differences in computer use indicate that training in computer operation is especially important for those who have been teaching longer; however, training in implementing computers and CMC into the curriculum is important for all teachers. In addition, teachers' attitudes toward CMC will be conveyed to their students. As they involve themselves in students' e-mail use, they will see benefits in addition to increased motivation and perhaps be willing to try more enterprising projects. Projects could also match students in other than a one-to-one relationship. While there are advantages to one-on-one matching (e.g., building a friendship), finding classes or schools which are equal in number of students is difficult, and regular interaction is interrupted if one student is absent or transfers to another school. It is also important for instructors to enforce keyboarding skills. Both schools in the present study report that students are trained in this area, but seldom practice correct use unless encouraged to do so. Because

keyboarding skills make such a difference in the mechanical act of computer writing, the earlier students learn these, the better.

The implications for students include improvement in their writing and interaction skills. When compared to their non-e-mail using counterparts, fourth graders who used e-mail showed an improvement in writing overall and writing to the appropriate purpose and audience, organization of ideas, and development of the central idea. Students are also likely to demonstrate increased motivation to both read and write in the context of computer-mediated interaction. This interaction may be extended from peers within the same city to peers around the world via the Internet (cf., Hubbard 1985). Last but not least, in the process of improving their writing and interaction, children gain skills in CMC, which is becoming an increasing part of everyday work and life for adults.

Implications for writing include the significant improvement demonstrated in compositions overall and in the areas of audience awareness, organization, and amount of text produced. Based on TEA criteria, the writing samples of students who used e-mail improved overall and in three of the four objectives. These benefits have strong implications for those who are concerned with TAAS writing scores. Moreover, the presently demonstrated gains would be expected to improve if children were able to return to their work for revisions, incorporating the audience feedback they receive, as they participate in the writing process. The results of this study thus confirm claims that an authentic audience and communicative context are important in producing good writing. For teachers whose students do not have access to e-mail, the task of finding authentic communicative contexts is often more expensive (e.g., postage costs) and more time-consuming.

5.3 Further research

Some lessons were learned in the process of conducting this study which are mentioned here in an effort to minimize their repetition in further research. With respect to data collection, it would be beneficial to acquire the participation of an experimental school with a functioning e-mail system. While this factor was beyond the control of the researcher, and largely beyond the control of the school, the study would have benefited from a school where the system had been thoroughly tested or in use by students in higher grade levels for some time. It would also have been helpful to have a school for the e-mail exchange which had equal access to a computer lab, and therefore could have spent equal time on the e-mail project.

Better communication between the participating teachers and the researcher would have enhanced the project. This measure would help prevent large time spans between when the prompts are given at the two schools. Because teachers viewed the project as "extra," they did not have students who missed one of the compositions make up the assignment. Had they done so, the researcher would have been able to include more students in the sample and would have had more data for analysis.

Teachers at the e-mail school should also be more involved in the e-mail exchange project. The instructional designer at Boyd coordinated the project and had the training and experience to lead the children in using e-mail effectively; however, she commented at the end of the school year that the project would likely have been more effective if the teachers had remained in the computer lab as students worked on their messages. This observation coincides with Bruce et al. (1985), who wrote that students and teachers must participate if CMC is to be successful in education. Further, if the schools involved in the study had maintained the same teachers for the previous few years and the year of the data collection, comparisons of standardized test scores could have been better controlled.

Further research might include studies designed to explain the results of the present study for which the researcher found no plausible explanation. These include the greater use of personal "you," an audience awareness feature, in the handwritten texts of the control group compared to those of the e-mail group, and the decline in performance by students at one or both schools in areas for which they would be expected to increase throughout the school year.

This study has investigated how including e-mail in elementary school curricula affects children's writing; however, the results are based on limited use of e-mail over a short period of time. A study in which the children use e-mail more extensively would provide a clearer understanding of its effects. These effects should be evident both in the computer-mediated messages themselves and in subsequent handwritten work. Two separate studies might be done, one focusing on the effects of high frequency e-mail use for a short period of time, and the other focusing on the effects of moderate frequency use over an extended period. Such a research design would examine whether the intensity or the consistency of e-mail interaction is more important in producing the desired results.

Another study might be conducted to determine what effect the distance of the audience has on writing skill. It has been suggested that students adapt their writing, providing more detail for those who are unfamiliar with their topic of discussion or elements contained therein (Cohen and Riel 1989). Research involving students who communicate with audiences of varying geographical or social distances (e.g., different ages), or of varying backgrounds (e.g., different genders) may demonstrate how writing to different target audiences affects children's writing.

Other variables which could be the focus of further study are the prompt itself and the means of composition (i.e., keyboarded as opposed to handwritten). A more extensive study which uses multiple prompts in each condition would help isolate the impact of the prompt itself on the demonstrated writing ability. A study involving participants who have

keyboarding skills which approximate their speed of handwriting would provide more control for this factor.

Still further research might compare the effect of different CMC activities on writing. In the current study, students who used e-mail only for recreation did not perceive the benefit to their writing that those who used it in an educational setting did. A study could be designed to compare the writings of students who use e-mail for only one of the different purposes of writing, or for joint problem solving, to ascertain the potentially different effects on students' writing abilities. Because persuasive writing is asserted to be the most difficult, improvement in other text types would be expected as well. These studies could be expanded to evaluate the impact of different forms of CMC (e.g., IRC, web page design) on writing skill.

In particular, a study of Internet Relay Chat use in an educational setting would provide information concerning its impact on subsequent handwritten texts. Due to the temporal time constraints, the chat text itself would be expected to exhibit more mechanical errors, less grammatical complexity, shorter texts, and more informality, particularly those features associated with abbreviation. Audience awareness should be strong as a result of the real-time interaction. Organization has been shown to exist in teacher guided chat, similar to that in teacher guided discussions in a face-to-face setting. It would be interesting to note the organization of chat in an educational setting which is assigned to accomplish a task but is not teacher guided. Further study could identify what influence these chat effects have on handwritten texts.

APPENDIX A

BOYD LETTER AND CONSENT FORM

Alton Boyd Elementary School

ALLEN
INDEPENDENT
SCHOOL DISTRICT

August 12, 1997

Dear Parents and Guardians:

Your child's class has the opportunity to participate in a yearlong e-mail project that will be a learning experience for the teachers and students at Boyd. Boyd will be part of a research effort which has more effective use of telecommunications in an educational setting as its goal. As an active participant in this study, Boyd will contribute to furthering knowledge in this area. The proposed e-mail exchange program will be an extension of what teachers at Boyd are already doing.

Carole Nix, a doctoral student at UT at Arlington, is preparing a study for her dissertation that will study the impact of e-mail use on fourth graders' writing skills. Students will be assigned a "keypal" in another fourth grade class within AISD and will use a group e-mail address to communicate. The messages that the students generate will be directly related to the writing objectives that are taught in fourth grade. Each e-mail message will have a purpose intended to strengthen your child's writing skills. The incorporation of an e-mail exchange program will broaden the skills and experiences of the student. The students will be identified in the message only by their first names and will otherwise remain anonymous to the researcher. Their messages will be carbon-copied to Carole for use in her study. She will be looking for things like writing purpose, fluency, elaboration, and sense of audience.

Please read and sign the attached consent form and return it to your child's teacher. We look forward to taking part in a study that will help to determine the best way to use current technology in the classroom.

Sincerely,

Joyce Bowman

Susan Lerew

Joyce Bowman, Principal
Susan Lerew, Instructional Designer

Boyd Elementary School • 800 S. Jupiter Rd. • Allen, Texas 75002 • (214) 727-0560 • Fax (214) 727-0566

Consent Form

I understand that for the study I will participate in this school year (1997-98), the researcher, Mrs. Carole Nix, will receive copies of all the e-mail messages I send and some handwritten work I will do for class. This written work will be analyzed by Mrs. Nix. At any time during the year, my parents or I may ask questions about the study or end my participation. Mrs. Nix will give me a full explanation of the study at the end of the school year.

The major benefits I will receive from participation in this study are training and practice in using e-mail on computers and the knowledge that I helped contribute to research in how to use e-mail effectively in elementary schools.

I understand that participation in the study is not a requirement of the class, and it will have no effect on normal classroom policies and procedures. Since the study will not change the regular assignments of the class, it will not interfere with my schoolwork. Neither will my participation in the study result in any extra responsibilities or time commitments for me or my parents.

I understand that records of my participation in this study will be held strictly confidential. Neither my name nor any other personal information will be used in reporting the results.

This research is supervised by Carole Nix, Ph.D. student, in cooperation with Susan Lerew, Instructional Designer, Boyd Elementary. Mrs. Nix may be reached at:

Address:	Linguistics Department University of Texas at Arlington P.O. Box 19559 Arlington, TX 76019	Boyd Elementary 800 S. Jupiter Rd. Allen, TX 75002
Phone:	817-272-3133 (metro)	972-727-0560
E-mail:	nix@uta.edu	

I understand the above explanation and agree to participate in this study.

Signature (student) Date

Signature (parent or guardian) Date

APPENDIX B

STEWARTS CREEK CONSENT FORM

Consent Form

I understand that for the study I will participate in this school year (1997-98), the researcher, Mrs. Carole Nix, will receive copies of some handwritten work I will do for class. This written work will be analyzed by Mrs. Nix. At any time during the year, my parents or I may ask questions about the study or end my participation. Mrs. Nix will give me a full explanation of the study at the end of the school year.

The major benefit I will receive from participation in this study is the knowledge that I helped contribute to research in how to use technology to teach writing in elementary schools.

I understand that participation in the study is not a requirement of the class, and it will have no effect on normal classroom policies and procedures. Since the study will not change the regular assignments of the class, it will not interfere with my schoolwork. Neither will my participation in the study result in any extra responsibilities or time commitments for me or my parents.

I understand that records of my participation in this study will be held strictly confidential. Neither my name nor any other personal information will be used in reporting the results.

This research is supervised by Carole Nix, Ph.D. student, in cooperation with Jennifer Jones, Stewarts Creek Elementary. Mrs. Nix may be reached at:

Address:	Linguistics Department University of Texas at Arlington P.O. Box 19559 Arlington, TX 76019	Stewarts Creek Elementary c/o Jennifer Jones 4431 Augusta The Colony, TX 75056
Phone:	817-272-3133 (metro)	972-625-9065
E-mail:	nix@uta.edu	

I understand the above explanation and agree to participate in this study.

Signature (student) Date

Signature (parent or guardian) Date

APPENDIX C

PROMPTS USED FOR ESSAYS

Prompt 1

"Your friends want to go in this old house and look around, but you do not want to go. Write a composition convincing your friends you are right. Make sure you list and explain your reasons" (Mammen 1996:57).

Prompt 2

"Some students like to do their homework as soon as they get home from school, but others like to wait until later in the evening. Which do you think is better? Write a composition for your teacher and explain which way you think is better. Make sure you list and explain your reasons" (Mammen 1996:58).

Prompt 3

"Some people believe families watch too much television. Others think television is good for families. Which do you believe? Write a composition to convince your friends you are right. Make sure you list and explain your reasons" (Mammen 1996:61).

Prompt 4

"You may go bicycling with one friend or hiking with another. Which one would you choose to do? Make the choice and list reasons to convince your parents to give you permission to go. Explain your reasons fully" (Mammen 1996:60).

APPENDIX D

BOYD STUDENT SURVEY

Computer login: bd_____ _____
number color

1. What kinds of writing do you do at home besides homework?
   ____ notes and letters
   ____ stories
   ____ journal or diary
   ____ other _____
   How often do you write at home?
   ____ never
   ____ hardly at all
   ____ a few times a week
   ____ every day
2. Do you like writing? ____Yes ____No
3. Are you a good writer? ____Yes ____No
4. Do you like writing better with a prompt or without one? ____With ____Without
5. Do you have a computer at home? ____Yes ____No
   If yes, how often do you use it?
   ____ never
   ____ hardly at all
   ____ a few times a week
   ____ every day
   What do you do?
   ____ schoolwork
   ____ games
   ____ e-mail
   ____ chat
   ____ World Wide Web/Internet
6. Do you have e-mail at home? ____Yes ____No
   If yes, how often do you use it?
   ____ never
   ____ hardly at all
   ____ a few times a week
   ____ every day
   How old were you when you first used e-mail? ____ years old
7. How often do you use a computer at school?
   ____ never
   ____ hardly at all
   ____ a few times a week
   ____ every day

What do you do?
____ schoolwork
____ games
____ e-mail
____ chat
____ World Wide Web/Internet

8. How often did you use the Community Lab Program this year?
____ a few times
____ once a month
____ every week

9. How would you describe sending and receiving e-mail from your keypal at Story Elementary?
____ boring
____ okay
____ fun
____ other _____

10. Which of the following was written for a real person to read:
____ your paper about whether you could go hiking or bicycling
____ your e-mail about whether families watch too much television
____ both of the above
____ neither of the above

11. Has using e-mail helped you become a better writer? ____Yes ____No
If yes, how?

12. What do you like about using e-mail?

13. What do you dislike about using e-mail?

14. Are you a ____girl or ____boy?

15. What grade do you think you will get in English? ____A ____B ____C ____D ____F

16. What is the first language you learned to speak?
____English
____Spanish
____Other _____

APPENDIX E

STEWARTS CREEK STUDENT SURVEY

1. What kinds of writing do you do at home besides homework?
   ____ notes and letters
   ____ stories
   ____ journal or diary
   ____ other _____
   How often do you write at home?
   ____ never
   ____ hardly at all
   ____ a few times a week
   ____ every day
2. Do you like writing? ____Yes ____No
3. Are you a good writer? ____Yes ____No
4. Do you like writing better with a prompt or without one? ____With ____Without
5. Do you have a computer at home? ____Yes ____No
   If yes, how often do you use it?
   ____ never
   ____ hardly at all
   ____ a few times a week
   ____ every day
   What do you do?
   ____ schoolwork
   ____ games
   ____ e-mail
   ____ chat
   ____ World Wide Web/Internet
6. Do you have e-mail at home? ____Yes ____No
   If yes, how often do you use it?
   ____ never
   ____ hardly at all
   ____ a few times a week
   ____ every day
   How old were you when you first used e-mail? ____ years old
7. How often do you use a computer at school?
   ____ never
   ____ hardly at all
   ____ a few times a week
   ____ every day

What do you do?
____ schoolwork
____ games
____ e-mail
____ chat
____ World Wide Web/Internet

8. Which of the following was written for a real person to read:
____ your paper about whether you could go hiking or bicycling
____ your e-mail about whether families watch too much television
____ both of the above
____ neither of the above
9. If you use e-mail, has it helped you become a better writer? ____Yes ____No
If yes, how?

10. If you use e-mail, what do you like about it?

11. If you use e-mail, what do you dislike about it?

12. Are you a ____girl or ____boy?
13. What grade do you think you will get in English? ____A ____B ____C ____D ____F
14. What is the first language you learned to speak?
____English
____Spanish
____Other _____

APPENDIX F

TEACHER INTERVIEW QUESTIONS

Interview for Teachers

1. What do you think are the most important concepts in teaching writing? (philosophy of teaching writing)
2. What 2 or 3 things most influence a student's writing ability?
3. Is writing taught just in language arts, or is it taught explicitly in other areas (like social studies), too?
4. How much time do your students spend per day/week in writing? Does that include only the time the children are writing, or does that include time for instruction/modeling?
5. What percentage of time would you say you spend on each of the different modes of writing? (narrative, descriptive, persuasive, process)
6. What methods of instruction do you use in teaching writing? (worksheets, conferences, peer editing, partner writing)
7. How would you describe a good paper written for a prompt? Do you give your students specific instructions to help them meet that goal?
8. What specific instructions do you give your students for writing persuasive essays? (prompts, worksheets, peer editing, partner writing) Is this different from what you use for other modes?
9. Would you say technology is integrated into the curriculum you use? In what ways? What could be done to make it more effective?
10. How do you use the computer in your classroom? (reward, modeling, demonstrations)
11. How much time do your students spend using the computer at school (lab time/outside lab)? What do they do? (schoolwork, games, e-mail, chat, WWW/Internet)
12. How do you teach kids to use computers? What do they learn (keyboarding, MS office, etc.)?
13. What training has the school given you in teaching computers?
14. Are the children given training in keyboarding?
15. Do you think computers can help in teaching writing?
16. Is writing on computers different from writing by hand? Do skills transfer?
17. Are you optimistic about the use of computers in teaching writing?
18. How long have you been teaching? 4th grade?
19. How long have you been using a computer?
20. Do you have a computer at home? How often do you use it? (never, hardly at all, a few times a week, every day) What do you do? (schoolwork, games, e-mail, chat, WWW/Internet) Has it affected your writing?
21. How often do you use a computer at school? (never, hardly at all, a few times a week, every day) What do you do? (schoolwork, games, e-mail, chat, WWW/Internet)

APPENDIX G

EXAMPLE ESSAYS

Essay 3, Boyd

Hi! my name is [B]. Do you think it is good to watch T.V.?
I don't because you don't really do any thing. I also think it is not good because it teaches you bad things. I also think it is bad because you learn some stuff your not suppost to learn. I also think it is bad bad because you look at bad influences. I also think it is bad because you don't need to be watching bad things like that. Thats's like Dawson's Creek it showes bad thing's like Dirty Danceing what it showes. Do you think it it good or bad to watch it? I think that it is bad to watch stuff that is not for kid's. I hate to watch t.v when my family is at home because you should be able to visit with your family. Do you like to visit with your family? I do because you tell some funny stuff and it is better than t.v. Do you think that?
Sincerly,
[B] [B3ba3-31]

Essay 3, Stewarts Creek

J .14

May, 6, 98

I think it is ok to wach tv. for a little bit but not too much. If you wach too much t.v. People eat alot while there wwaching it. Alot of times when yowr too much tv you Gan wait. When you are wach ing too much t.v. you forget alot. When you waching alot of t.v. your eyes and head hert. Somtimes when you wach too much tv you can get Scared or stuff like that.

Essay 4, Boyd

May 11, 1996

S A. Prompt #3

Dear Mom, and Dad,

I was asked to go on a biking trip with J., and I was asked to go on a hiking trip with A. I would rather go on the biking trip with J. I like biking because it is fun, and it gives me good exercise. I know that hiking gives me good exercise, but it tires me out more than any thing. I know that you want me to be hiking but, I'll wear a helmet, knee pads, elbow pads, and water on the bottom of the bike in case I get thirsty. I'll be safer than safe, really. No need to fret. Besides, J.'s parents are bringing a first aid kit. Mom, on the way to where we're going, you don't have to make me a thing. J.'s mom, C.,

is baking us brownies, and cookies. She is also bringing Sunny Delight. Gee, I really love that drink! Now, if I go, of course, We will be going to Arizona, June 16, at 7:00 in the morning. Or, if were busy, they can schedule a different time. I'll even call her after I convince you to let me go. So, can I go?

Love,

A

Essay 4, Stewarts Creek

J R

My friend wants me to go ride my bike with him, but my other friend wants me to go hiking with him. I want to go biking with my friend. This is why.

The first reson is it is fun to ride bikes. It feels good letting the wind hit you. It is fun to go fast. It is fun to go down big hill.

The next reason is you get good exercise. you not being lazy all the time.

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BIOGRAPHICAL STATEMENT

Carole G. Nix holds a B.S. in Education from Baylor University, an M.Div.B.L. from Southwestern Baptist Theological Seminary, and a Ph.D. in Linguistics from The University of Texas at Arlington. She focused her latter studies in the areas of sociolinguistics, literacy acquisition, and teaching English to speakers of other languages. In addition to her native language of English, she has conversational abilities in Cantonese and a reading knowledge of Greek, Hebrew, and French.

Dr. Nix has taught English for speakers of other languages both formally at The University of Texas at Arlington and informally for two years in the Philippine Refugee Processing Center, Morong, Philippines. In addition, she has taught mathematics courses at the high school level.

Her research interests include children's computer-mediated discourse and computer-mediated distance education. She has presented papers at local, national, and international conferences, and has published "Talking to strangers: Children's conversational openers on the Internet," forthcoming in Computer-Mediated Conversation, edited by Susan C. Herring.