The Explained Effects of Computer Mediated Conferencing

on Student Learning Outcomes and Engagement

by

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(ABSTRACT)

There has been an increasing growth in the use of technology resources in traditional classroom styled higher education courses. This growth has received with both optimism and criticism. One of the issues critics have posed is that the use of technology resources does little, if anything, to improve student learning. As a result, this research examined if the use of technology contributes to student learning outcomes and student engagement activities, above and beyond student demographic variables. Specifically, this study investigated if the use of computer mediated conferencing (CMC) tools (i.e., email and electronic discussion boards) and computer aided instructional (CAI) resources (i.e., use of the computer and the Internet) contribute to student learning.

Included in the sample were 2000 college students, which were randomly drawn from the 2003 College Student Experience Questionnaire database. The survey included 53 Likert scale items with reliability ranges from .78 to .88 on each of the composite scales. For the data analysis, eight multiple regressions were conducted on student learning outcomes and student learning engagement. Student learning outcomes included four composite scales, measuring students' personal and social development, general education gains, intellectual development, science and technology gains, and vocational preparation. The student engagement scale was comprised of three composite scales, which included faculty interactions, social, political and scientific discussions, and diversity and social interactions.

The findings revealed that the use of technology resources does contribute to student learning, above and beyond student's background variables. The model inclusive of technology variables explained 4% to 7% of the gains in student learning, while student background variables contributed .03% to 2% of the gains. The findings suggest incorporating the use of technology can aid students in the learning process, though the effect size was fairly modest in most cases. The use of computer mediated conferencing and computer assisted learning tools should be used in combination with traditional classroom instructions to have the best effects.

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For those traveling down a similar path*, "the difference between a successful person and others is not a lack of strength, not a lack of knowledge, but rather a lack of will."*

Vince Lombardi

Table of Contents

Chapter I 1

Introduction 1

Theoretical Framework 5

Research Questions 8

Significance of the Study 9

Definition of Terms 11

Limitations 12

Delimitation 13

Organization of the Study 14

Chapter II 15

Literature Review 15

Emergence of Technology in Education 15

Learning Outcomes in Computer Mediated Learning Environments 25

Faculty and Student Interactions 25

Collaborative Learning 29

Learning Outcomes 30

Knowledge Discovery through Computer and Internet Use 34

Computer Supported Learning Resources 35

Demographic Variables 39

Gender 39

Race 40

Class Standing / Academic Classification 41

Summary of Research Designs 42
Summary 43
Chapter III 47
Methodology 47
Instrumentation and Sampling 47
Scale Development 51
Validity 51
Reliability 52
Measures 52
Dependent Variables 52
Independent Variables 59
Sets of Correlations 61
Independent Variables 65
Data Analyses 67
Summary 69
Chapter IV 71
Findings 71
Regression Models for Student Learning Outcomes 72
Summary of Effects on Student Learning Outcomes 76
Regression Models for Engagement Outcomes 77
Summary of Effects on Student Engagement 81
Summary 82
Chapter V 84

Discussion and Implications 84
Overview of the Study 84
Technology and Its Influence on Learning Outcomes 86
Collaborative Learning Tools 86
Computer Assisted Instruction 89
Demographical Influences on Student Learning 91
Race 91
Gender 93
Senior Students 94
Implications of the Study 96
Implications for Future Practice 97
Implications for Instructional Design 98
Implications for CMC Delivery 99
Implications for Infrastructural Design 99
Implications for Future Research 100
Conclusion 102
References 104
Appendix A 120
Appendix B 121
Appendix C 122

Tables

Table 1. Constructivism Assumptions in a Computer Mediated Environment 22

Table 2. A Summary of Variables with Works Cited.. 45

Table 3. Characteristics of CSEQ 2003 Sample 50

Table 4. Items and descriptive statistics for learning outcomes 54

Table 5. Items and Descriptive Statistics for Student Engagement....................... 57

Table 6. Items and Descriptive Statistics for Independent Variables 60

Table 7. Correlations among Dependent Variables.. 62

Table 8. Correlations among Independent Variables 64

Table 9. Correlations among Independent and Dependent Variables 66

Table 10. Research Variables and Analysis 70

Table 11. Regression Model for Technology and Student Learning Outcomes .. 73

Table 12. Regression for Technology and Student Engagement 80

Chapter I

Introduction

The use and integration of information technology in the classroom remains an important factor at many higher education institutions. Today, more traditional types of classrooms utilize some form of technology as part of instruction. This may be in the form of placing the course content on a web page, communicating with an instructor or other students via email or relay chat, or using the web to find information that will aid the learning process. Some faculty members use newsgroups or discussion boards to facilitate interactivity among students in the class.

Since 1996, assisting faculty members to integrate technology into instruction remains as the single most important information technology issue for most college campuses (Green, 2001). This is not likely to change immediately as a third of college officials' list instructional technology integration as a key issue for their institutions in the coming years, compared to 29.6 percent in 1997. The demand for increasing use of technology in academia is further accentuated as many college officials' identify course management systems (CMS) as "very important" at their institutions.

The use of web based technologies has caught on in the higher education arena because it is seen as an enhanced learning tool. Web based technology such as hypermedia allows more flexibility than traditional media corresponding to different learner preferences. In addition to self-directed learning, knowledge can be acquired in more-depth; it is also possible to obtain information quickly, and in a well directed manner. Another advantage of web based technologies is that they have the capacity to facilitate communication and collaboration between and among students and teachers with out having face to face contact.

The advances in technology have changed the way students and faculty members can interact. Much of this growth has occurred because of the development of electronic communication and the Internet. Today, more faculty members at colleges and universities are using web based technology as a resource to communicate and to supplement their course instruction. In the year 2000, 60% of all college courses utilized electronic mail, compared to 20.1% in 1995 (Green, 2000). A similar increase occurred with faculty use of the web. In 2000, 43% of college instructors used web resources as a component of their syllabus, compared to just 11% in 1995. These types of courses are referred to as web enhanced because they incorporate both traditional and electronic elements of learning.

Computer mediated conferencing tools allow students to interact through multiple modes of communication, both asynchronously (i.e., interchange between the learner and other learners where there is a difference in response time) and synchronously (i.e., communication that take place in real-time). Some tools that allow students to collaborate in asynchronous mode include e-mail, threaded discussions, and calendars. Examples of synchronous modes include chat rooms, whiteboards, and two-way videoconferencing. Because of these technologies, students can interact with peers and instructors without the geographical and time limitations in a face-to-face format.

As a result of computer mediated conferencing tools, more instructors are using advanced authoring tools, such as web based courseware. Web-based courseware systems manage the content and communication delivery systems of online courses. This authoring tool allows the instructor to manage the administrative features such as setup and maintenance, enrollment and registration, access control, and the use of tracking functions. Instruction features include control over the look and feel of the course, such as synchronous and asynchronous communication, assessment tools and course management functions. Students have access to communication, authoring, and self-assessment functions. In 2001, approximately one-fifth (20.6 percent) of all college courses used course management tools, a 14.7 percent increase from previous year (Green, 2001).

Though there has been tremendous growth in the use of web based technologies to manage and teach traditional courses, it makes little difference if such mediums do not increase learning performance. As a result, there has been an increase in the research examining the impact that technology has on student performance. The growth of this movement began in the 1980s when theoretical foundations of educational technology research were not analyzed closely using theoretical principles (Clark, 1983). Most of the research was composed of formative evaluations of computer-based applications and products. Next, there was a surge of experimental and quasi-experimental studies comparing technology-based to non-technology-based methods to determine which method produced better results (Lenehan, Dunn, & Ingham, 1994; Tuovinen, 2000).

After such studies were conducted, some researchers began to explore trends in the findings using technology tools (Fletcher, 1990; Hays, Jacobs, Prince, & Salas, 1992; Roblyer, Castine, & King, 1988). Many of the findings showed no significant difference between learners using technology based methods and traditional methods. This was due in part to the past methods used, which had uncontrolled effects. For example, some studies were compared similar methods that often had different treatments. As a result, some researchers implied that any effects attributed to technology were caused by the methodological informalities such as lack of linkage to theoretical foundations, poor treatment implementation, measurement flaws, inconsequential learning outcomes for research participants, inadequate sample sizes, and inaccurate statistical analyses (Clark, 1983; Kozma, 1994).

Clark (1983), one of the acclaimed critics of media comparison studies, was quick to point out that the use of such technologies are “mere vehicles that deliver instruction but do not influence student achievement” (p. 445). In addition, Clark argued that the critical factor in determining student achievement is the instructional method and not the media such as the computer or instructor. As a result of such cynicism, others have refuted Clark’s claim in defense of the effectiveness of learning technologies (Ehrmann, 1995; Kozma, 1994), arguing that the point of this type of research should not be to make the computer instruction identical to teacher instruction, but rather to determine whether computer based delivery systems have inherent benefits over teacher-based delivery systems. Kozma states that technology should be viewed as a media that assists with instruction, rather than to take the place of traditional teaching methods.

As a result of many past flawed studies, Ehrmann (1995) calls for a new research agenda that takes into account Clark's and Kozma's theoretical viewpoint stating that both the design and delivery methods should be taken into account. The use of technology should not be viewed to take the place of another continuum, but to enhance instruction, and as a result, more accurate reflections of learning will be occur. Ehrmann uses the metaphor of an orchestra using an amplifier to increase the sound quality. An amplifier extends the sound of the band producing stronger electronic signals to cover a wider range of area. When elements of a component are analyzed, more accurate assessments are produced to measure the true impact. This is the direction this study will follow (i.e., measuring technological elements that impact learning); not to analyze if technology produces greater learning outcomes, but to determine whether the use of technology assist students to become better learners.

Theoretical Framework

Since the late 1970s, one of the most renowned theories that set the premise for learning in educational research is constructivism (Applefield, Huber, & Moallem, 2000; Ewing, Dowling, & Coutts, 1999; Stage, Muller, & Kinzie, 1998; Vygotsky, 1978). This theory is based on the concept that learning is constructed by the learner actively seeking out meaning to match his or her needs. A constructivist view of learning rests on the assumption that knowledge is constructed by learners as they attempt to make sense of their environments.

The notion that learners must interpret and transform complex information if they are to understand it is the essence of constructivism. The metaphor of carpentry or architecture can be used to portray constructivists emphasis on a dynamic process of developing understanding through building, shaping, and configuring meaning (Vygotsky, 1978). Learning is the result of ongoing modifications of the learner's mental frameworks as they attempt to make meaning out of their experiences.

The emphasis in constructivism is different from the more traditional classroom "lecture" model, in which teachers directly convey knowledge to students. It is based on the fundamental assumption that people create knowledge from the interaction between their beliefs or existing knowledge and the new situations or ideas they encounter. Therefore, constructivists recognize the need to foster interaction between students and instructors. In the constructive classroom, active student participation, peer interaction, critical thinking, and reflection, as well as considering multiple perspectives by means of a collaborative process is integral. According to the constructivist model, learning is a communal activity, or sharing of culture (i.e., collaboration among learners provides them with an opportunity to share their understanding with others and provides an exposure to multiple perspectives of other students, which results in better understanding of the material). In constructivism, providing a communal environment is an important part of learning.

The uses of web based technologies are seen as tools that assist learners to discover knowledge and to allow for collaboration, key principles of constructivism. Web based technologies support constructive environments by providing access to information to acquire a better understanding of concepts and ideas. The Internet allows learners to actively discover rich resources to solve problems or construct knowledge. Thus, the web becomes a common tool for learner-centered or constructivist learning. Similarly, computer mediated conferencing tools allow for collaboration which provides a path for learners to communicate in nontraditional manners to share and explore knowledge from one another. This can be done using synchronous and asynchronous communications where participants share information in the pursuit of a meaning then reflect on the knowledge that they have constructed and the processes that they used (Jonassen, 1999).

Purpose of the Study

Many of the studies measuring the impact of technology on learning have been flawed because of methodological and theoretical errors (Clark, 1983). Such studies have attempted to measure technology in place of traditional teaching methods by comparing the two, rather than differentiating how types of technology can be used as tools to support instruction. Some attempts have begun to examine the impact of information technology in relation to specific cognitive areas, such as examining environmental factors associated with the development of life-long learning competencies (Hayek & Kuh, 1999), teachers' effective educational practices (Carini & Kuh, 2003), and student typologies based upon engagement (Kuh, Hu, & Vesper, 2000). However, much of the research emphasis has been limited by the sample population, a convenient sample made up of one or two classes, or through the eyes of online learners, not fully capturing the views of learners using technology in a traditional lecture type of class (Jarveka, Bonk, & Lehtinen, 1999).

With the increased use of information technology in conventional classrooms, there is a need to know if the use of technology resources and communication tools supports engaging learning activities. Because of the overlap of using information technology in traditional style courses, it is important that educators know if this new teaching and learning paradigm supports fundamental educational principals. Without such knowledge, there is little guidance on how to best utilize technology and its' resources to support learning. Therefore, the purpose of this study is twofold; first, to examine if students' who frequently use technology communication tools such as email; threaded discussions achieve greater learning outcomes. Second, this study will examine if frequent users of computer and web based technology participate in more engaging educational practices than infrequent users. Specifically, this study will attempt to examine:

Research Questions

1) Do the frequency of online interaction and frequency and duration of technology use for academic work explain a significant amount of variance in student learning outcomes for undergraduate students?

2) Do the frequency of online interaction and frequency and duration of technology use for academic work explain a significant amount of variance in student engagement for undergraduate students?

Significance of the Study

It is important that technology resources are identified to assist students in their learning process. The findings from this study can help instructors determine which types of technology, if any at all, can assist with improving learner performance. Examining the relative effectiveness of how computer mediated conferencing (CMC) tools and computer assisted instruction (CAI) usage will enable instructors to more appropriately select learning technology resources that will have greater effects. In addition, instructors will be able to look at this study and develop a general understanding of the types of students most likely to benefit from various types of CMC and CAI usage.

Distance education consultants or instructors will be able to use the findings of this study to better design training materials and/or workshops for their staff. By identifying the best use of CMC or CAI resources, trainers will be able to advise instructors on how to best incorporate the use of these tools as a part of their instruction. In addition, trainers will be able to better identify the best types of resources that will compliment a course's instructional strategy, in turn, improving the instruction of a course.

Assumptions

This study is based on two assumptions. First, that the more frequently learners use computer mediated conferencing tools for collaborative interaction, the more likely that greater learning outcomes will be achieved, above and beyond demographic factors. Second, the more frequently learners use CAI for class assignments, the more likely they will participate in engaging learning activities, above and beyond demographic factors. Based on these central ideas, the following hypotheses will guide this analysis:

1. Frequency of interaction via email with instructor makes a significant contribution to the prediction of student outcomes.

2. Frequency of online collaboration makes a significant contribution to the prediction of student outcomes.

3. Frequency of computer use makes a significant contribution to the prediction of student outcomes.

4. Frequency of use of the Internet for course related information makes a significant contribution to the prediction of student outcomes.

5. Frequency of interaction with instructor makes a significant contribution to the prediction of student engagement.

6. Frequency of online collaboration makes a significant contribution to the prediction of student engagement.

7. Frequency of computer use makes a significant contribution to the prediction of student engagement.

8. Frequency of use of the Internet for course related information makes a significant contribution to the prediction of student engagement.

Definition of Terms

Collaborative Learning: an approach to learning that stresses, in general, the importance of such factors as teamwork, interdependence, and interaction among students.

Computer-assisted Instruction (CAI): an interactive instructional technique in which a computer is used to present instructional material, monitor learning, and select additional instructional material in accordance with individual learner needs. CAI may also encompass *Computer Supported Learning Resources (CSLR)* which is the use of a computer to provide access to information to be used by a learner in the learning process.

Computer-mediated Communication (CMC): communication across distances by the use of a computer, phone line, modem, and in some instances, computer networks. CMC can be broadly defined as human communication via computer. It involves interaction between humans using computers to connect to each other and generally refers to any communication pattern mediated through the computer. Communication takes place through a computer between human beings, instead of to an already determined computer system. CMC may incorporate audio and visual input into text (Nuernberger, 1998).

Email: electronic mail that enables learners to send messages over the Internet or an intranet.

Instructional Technology: the systemic and systematic application of strategies and techniques derived from behavioral, cognitive, and constructivist theories to the solution of instructional problems.

Student Learning Outcomes: the knowledge, skills, and abilities that a student has attained at the end (or as a result) of his or her engagement in a particular set of higher education experiences (Kuh, 2001,).

Student Learning Engagement: the extent to which students engage in good educational practices, such as time on task, active/collaborative learning, and quality interaction with faculty (Kuh, 2001, 2003).

Web Site: A set of interconnected web pages, usually including one or more pages located on the web, generally located on the same server, maintained as a collection of information by an organization.

Web-enhanced: courses that provide web-based information or testing as a supplement to learning activities in the classroom. Students attend their traditional classrooms and log on to the Internet outside of regular class times. Also described as "hybrid" classes (Zirkle, 2003), the web-enhanced approach combines online and face-to-face activities in varying degrees, dependent on teacher preference and expertise.

Limitations

A major concern with the use of surveys is the reliability of self reported data because several of the outcomes of interest cannot be empirically measured (Chun, 2002). The challenge of self-reported data is determining the accuracy of it. Another challenge is the unwillingness of respondents to supply data listed on the survey. However, some researchers found that self-reports are correlated with high quantifiable measures of student progress (Anaya, 1999; Astin, 1993). Though there is no way to assure that respondent responses are reliable, there are some steps that can be taken to reduce the chances of inaccurate data given. Specifically, Kuh (2001a) suggests making the sure the five following conditions are met: (a) the respondents are familiar with the information requested; (b) the questions are phrased clearly and unambiguously; (c) the questions refer to recent activities; (d) the respondents think the questions merit a serious and thoughtful response; and (e) answering the questions does not threaten, embarrass, or violate the privacy of the respondents or encourage the respondent to respond in socially desirable ways. This study worked within the scope of these conditions to insure the self reported data is reliable.

Delimitation

This study will use secondary data from the College Student Experiences Questionnaire Research Program. The advantage of using secondary data is that it allows the research to utilize an existing database and that the sample sizes are usually large; therefore, making the data collection process more cost and time efficient (Gall, Borg, & Gall, 1996). Though this method has many advantages, there are also some disadvantages that need to be considered such as the data variables and sample population are limited to the exploration of the initial researcher (Babbie, 1995). Despite the disadvantages, secondary analysis was selected as the method of choice because the data captured in College Student Experiences Questionnaire coincided with the research questions to be explored.

Organization of the Study

This study consists of five chapters. Chapter One provides an introduction to constructivism and the use of technology to improve learning within this frame work. This chapter also outlines the research questions, key assumptions to guide the study, the significance of the study, and the study's limitations. Chapter Two is a review of related literature that provides a more in-depth examination of the theoretical model used and past research that has been done in this area. Chapter Three describes the sample, design, methodology, and statistical procedures of the study. Chapter Four presents findings of the research. Lastly, chapter five presents a discussion of the results related to previous research, the research questions, and implications for further research and practice.

Chapter II
Literature Review

This chapter includes a synthesis of the literature as it was used to help guide and develop this study. Key components of this chapter include an exploration of the growth and use of technology in education, the use of computer mediated conferencing tools and computer assisted instruction as it works within the confines of constructivism, and previous research conducted in this area as it relates to learning outcomes, including demographical variables.

Emergence of Technology in Education

With the emergence of new technology, many traditional college courses have employed modern techniques to assist with student learning. College courses can now be delivered using multiple types of technologies: one-way or two-way video and audio transmission, or through the Internet using asynchronous or synchronous modes of instruction. One of the first types of classes to be taught using a new media mode can be traced to the 1880s when instruction was delivered to students via correspondence through the mail (Lundin, 1996). This mode of delivery can be traced to the 1800s, which spawned the first generation of distance education (Padolina, 1997).

The advances in technology during the 1960s and 1970s led the second generation of technology media, which involved the use of open broadcast technology (Morabito, 1997). This allowed one-way, primarily audio and videotapes and two-way communication through the use of satellite systems to be broadcast to students. This system differs from other forms of correspondence in that the instructor and students enrolled are able to see one another via satellite (Ritchie & Newby, 1989). Television monitors are placed in the common area where the students are and where the instructor is teaching and is done with the use of a video camera and an audio hook-up. Students are given at least one microphone at the place where they are located so they can ask the instructor questions at any time during the lecture.

An example of the use of broadcast technology can be found at the University of Laval in Quebec, which teaches several courses by utilizing cable television and videotapes (Boulet, Boudreault, & Guerette, 1998). Students enrolled with Laval turn their cable-connected televisions to specific stations at particular times to view their instructors teaching. Each lesson can be recorded to enable the viewer to access the lesson when it is most convenient. In addition, each class is videotaped by the participating instructors and can be checked out at the university library at any time. According to Boulet et al. (1998) this type of learning has worked well for the students of the University of Laval.

Multi-media components are also used, which enhances the delivery broadcast technology. At Appalachian State University, in Boone, NC and East Tennessee State University in Johnson City, TN, more than one hundred students enrolled in a computer information systems courses are taught using multi-media presentations (Perry & Perry, 1998). As part of the course, instructors taught classes using computers, video scan boxes, televisions, and radio frequencies.

The third generation of technology emerged in the 1980s with the development of the computer and Internet (Morabito, 1997). The Internet allows asynchronous (educational events that take place independent in time) and synchronous (educational events that take place in real-time) communication to take place between the students and facilitators. Offering classes through the Internet is probably the fastest growing technology employed in the delivery of distance education classes. In 1998, fifty-eight percent of institutions offered some form of asynchronous Internet instruction (National Center for Education Statistics, 1998).

Because of the accessibility of the Internet, many of the delivery options are available including text, audio, and video. Many of these media types are used today. For example, asynchronous interaction can occur through the use of email, listserv, and threaded discussions (Hsiu-Mei, 2002). Because of modern technology, both audio and video can be accessed through the Internet. Real-time audio gives a person the ability to carry on a conversation over the Internet. Videoconferencing allows video images to be displayed similar to television whether both audio and videoconferencing can be done asynchronously or synchronously. With the advances of the Internet, delivery options may include first, second, and third generation types of technology, allowing text, audio, and video to be displayed over one media. The Internet, with its increasing capacity for multimedia has provided educators with exciting opportunities to enhance teaching and learning (Zhao, 1998).

Constructivism and Computer Mediated Learning Environments

The constructivism approach to learning is consonant with the accepted student centered teaching approach (Stage et al., 1998). This view takes the focus from the instructor teaching style and directs it toward the way students learn. As a result, many educational reforms have occurred in student learning. In student centered classrooms, instructors' roles are characterized as facilitators in that they assist students' investigations to stimulate reflection (Applefield et al., 2000). Similar to student-centered teaching, a constructivist approach places more emphasis on constructing learner-generated solutions through problem solving rather than memorizing procedures and using them to derive the correct answers (Hsiu-Mei, 2002).

The focus of constructivism is that students engage in active learning, making their own meaning from the information given. There are four guiding assumptions which constructivism is based: (a) knowledge is constructed by learners who are involved in active learning; (b) knowledge is symbolically constructed by learners who are making their own representations of action; (c) knowledge is socially constructed by learners who guide their meaning making to others; and (d) knowledge is theoretically constructed by learners who try to explain things they do not completely understand. Through the use of constructivism, students become better learners because they are active participants in the learning process rather than being mere spectators.

With the recent growth and use of various technologies, such as the Internet and computer mediated conferencing tools, students are able to discover and to interact with an almost unlimited amount of information and resources. Web based publishing provides a knowledge construction environment incorporating information search engines for better understanding of information and video for visualizing the range of ideas that students generate. They engage in a web-based activity such as searching the Internet, gathering information, organizing their thoughts, or communicating with peers via email thus adding to their cognitive infrastructure (Kyung-Sun, 2001).

Others concur that effective learning can occur using CMC and web based technology (Cradler, McNabb, Freeman, & Burchett, 2002; Rourke & Lysynchuk, 2000; Uribe, Klein, & Sullivan, 2003). In the technological environment, students are able to construct meaning through interacting in a hypertext environment by self directed inquiry, guided activity, and discovery. Users are able to discover principles and knowledge for themselves. It is the learner who determines which link or step to take next instead of being lead by an instructor. This is possible because of the connective and communicative nature of the web. The web is also seen as an innovation tool that encourages students to think beyond their normal range (Warschauer, 1997). This infrastructure provides a platform that gives the students more control and ownership of their final creation (Hsiu-Mei, 2002). Technology tools such as the web allow learners to continue seeking new information in the exploration and discovery process. As a result, students are more willing to learn and are more likely to modify their class projects (Zhao, 1998).

From the modern constructivist perspective, learning environments that are technology-based allow learners to engage in meaningful interactions (Oliver, 2000). Emphasis is on learners who interpret and construct meaning based on their own experiences and interactions. Educators adopting a constructivist approach are now challenged to change their instructional design strategies to actively engage learners in meaningful projects and activities that promote exploration, experimentation, construction, collaboration and reflection of what these learners are studying (Swigger et al., 1999). The application of constructivism in a computer mediated learning environment is shown in Table 1.

The concept of constructivism emphasizes the need for students to be active learners, playing a major role in mediating and controlling their learning (Jonassen, 1999). More emphasis is placed on student-centered learning rather than other traditional teaching methods, where ownership in the learning experience takes precedence. According to Greening (1998), “where ownership occurs, active learning and regard for students’ prior constructions follow quite naturally” (p. 25). The Internet and computer mediated learning applications allow learners to store and retrieve information with few boundaries. Because of the growing use of cognitive technology tools in education, students are being placed at the center of educational practice as apposed to conventional instruction and curriculum (Yakimovicz & Murphy, 1995). This trend is likely to continue as researchers find learner centered practices combined with technological applications continue to produce positive outcomes (Lane & Aleksic, 2002; Stage et al., 1998).

It is obvious that the use of technology alone does not help students to learn. Therefore, it is important for instructors to design strategies that guide learners in the discovery process. From a constructivist view, this can be done by placing learning theory in the forefront of educational practices. Unfortunately, some of computer mediated learning applications are driven by the designers view of how technology should work, instead of theory driving the use of them (Lawless & Brown, 1999). Technology-based learning can be effective, but educational theory must be evident in the design stages.

Table 1.

Constructivism Assumptions in a Computer Mediated Environment

Constructivism Assumptions	Application in Computer Mediated Environment
Knowledge is constructed by learners who are involved in active learning	Searching, retrieving, storing, and organizing information from the Internet
Knowledge is symbolically constructed by learners who are making their own representations of action	Identifying web sites/pages containing or pointing to information of interest
Knowledge is socially constructed by learners who guide their meaning making to others	Utilizing computer mediated conferencing tools such as email, relay or video conferencing to communicate with other students
Knowledge is theoretically constructed by learners who try to explain things they don't completely understand	Comparing and contrasting information and resources found on the Internet

Another design factor that needs to be considered when applying technology from a constructivist perspective is that real-world problems must be a part of the instruction. Learners must be presented with interesting, relevant, and meaningful problems to solve before technology applications be considered (Applefield et al., 2000). This should be done by partially constructing the learning activity without overly defining it, to allow students to seek out a solution to the problem. Using this scenario, learners are able to use their logic and understanding of issues that is relevant for them to solve.

A second design factor is that the task must be presented in a meaningful way. Presenting the task or activity to the student in a meaningful context is an important design consideration. The initial presentation of the problem must be appealing, interesting, and engaging for the learner to "buy into" the problem (Ewing et al., 1999). When presenting complex problems, several tools may be necessary to aid the learner in seeing the problem in a different light. This allows the learner to recognize the complex relationships that exist with a problem. Interactive multimedia, simulations, demonstrations, and hypermedia programs can be used to assist and help the learner better understand the problem in its complexity.

A third design factor is to make sure the learner is an active participant with in the context of the learning environment. Productive learning environments require manipulation of space that allow learners to conduct research, experimentation, and pose hypotheses (Jonassen, 1999). Active engagement gives ownership of the problem to the learner. More complex problem solving techniques may require the learner to have access to resources so that he or she can make an informed decision. The Internet, for example, provides quick immediate access to a multitude of resources. This permits the learner to be acquainted with multiple perspectives in the problem solving process, particularly if the learner has inadequate prior knowledge.

Providing adequate resources is fourth design factor that needs to be considered when incorporating technology from a constructivist view. When designing learning environments, educators must have an understanding for the resources and information learners need. Such knowledge will aid and direct learners to the appropriate resources to become sufficient problem solvers. Technological resources like text documents, computers, World Wide Web access, hypermedia applications, animation, and sound devices, provides the learners with an ample amount of resources to sustain their inquiry for knowledge. The layout of these resources must be organized in a meaningful way to support the end users. A simple layout in the navigation is critical in assisting learners' network through a complex environment. Both the Internet and computer-mediated communications are powerful tools that allow information to be stored and retrieved quickly and easily. Learning from a constructivist view allows the learner to manipulate information into a meaning way in which they are able to comprehend (Jonassen, 1999).

The last design consideration is that there needs to be collaborative framework so students can learn through sharing and exchanging their thoughts and ideas. Learners share information to collaboratively construct socially shared knowledge (Greening, 1998). Applications such as computer conferencing, chat lines, newsgroups, and bulletin boards promote conversation and collaboration. The use of these tools helps facilitate discussion and sharing of ideas among learners as they attempt to achieve a common goal. Successful student-to-student communication in the constructivist sense results in peers being identified as resources for one another rather than competitors (Ewing et al., 1999).

Learning Outcomes in Computer Mediated Learning Environments

Ultimately, the amount of learning is determined by measuring if the desired outcomes were achieved. Much of the research in this area has demonstrated that positive outcomes can occur if instructional methods are used effectively. For the purpose of this study, the next body of research will focus on faculty and student interactions in an online collaborative learning environment, and the use of the computer and Internet as a knowledge discovery tool, which are key principles of constructivism.

Faculty and Student Interactions

The impact of interactions between students and faculty members on student outcomes has received increasing attention by researchers. Faculty members serve in key positions to help students learn. Their role may encompass teaching, facilitating, and providing resources to assist students engage in various learning activities. This engaging interaction has proven to be significant in the production of learning outcomes. Work done by Bradley, Kish, Krudwig, Williams, Wooden (2002), Walker (2001), and Pascarella (1986) are just a few studies that have found that relationships between students and faculty members are important predictors of academic achievement.

The weight of data suggests that when pre-college characteristics, academic aptitude, secondary school achievement, and personality traits are controlled, the frequency and quality of student interactions with faculty members tend to be significantly and positively associated with student learning (Pascarella, 1985). Faculty interactions have also been seen positively correlated with self-reported intellectual and personal growth (Astin, 1993). When there is increased contact between faculty members and their students, there are likely to be developmental gains on the students' behalf.

Other research distinguishes between the type of interactions that occur between faculty members and students. Endo and Harpel (1982) findings suggest that informal interactions between faculty members and students have greater impacts on student performance then formal interactions. The frequency in which informal interactions take place is also reported to affect students' personal and social outcomes, intellectual outcomes, and student satisfaction. A later qualitative study by Kuh 1995, noted that out-of-class student experiences also impact students' self-concept and academic skills, which further supports the importance of faculty-to-student interaction.

In 1980, Pascarella and Terenzini examined faculty members and students interactions from a different path by distinguishing between the quantity and quality of contacts in their longitudinal panel study. Findings from this study concluded that the quality of contact between faculty members and students has a greater influence than the frequency with which interactions occur. The findings from Volkwein, King, and Terenzini (1986) reported similar results to Pascarella and Terenzini findings in that the frequency of contact is not as important as the quality of the contact. The three researchers recognized that the interaction between faculty members and transfer students was not significantly related to students' intellectual development. Though intellectual growth improved among the participants, the researchers contributed this growth to student perceptions of quality interaction rather than specific content discussed between faculty members and students.

Most of the research conducted on faculty and student interactions has been examined from the traditional face-to-face perspective. When mode, such as email, has been investigated, there are fewer studies presented. However, the literature has been expanding taking into account mode of communication. The outcomes of these studies appear to be mixed when measuring student performance. For example, positive gains were noted when teachers maintained daily contact with their students by email (Hu & Kuh, 2001; Yu & Yu, 2002). The results provided evidence that email can aid in the cognitive growth of learners knowledge and skill acquisition. Comparable results were also illustrated in Flower's and Zhang's (2003) study of 45,000 undergraduate students located in United States. The results showed significant gains in students' science and technology knowledge, vocational skills, personal and social development, and in students' writing and thinking skills when they interacted with their instructors via email.

One researcher found less favorable results regardless of the amount of personalized electronic messages posted by the instructor (Woods, 2002). Though outcomes were not specific variables measured such as knowledge gains, Wood's study explored how students engaged in academic related activities to produce educational outcomes. Specifically, he examined the extent in which personalized electronic messaging contributed to students' perceived sense of community, their satisfaction with their overall learning experience, and their establishment of a personal relationship with their instructor. It was recognized that regardless of the number of personal electronic messages sent to students throughout the semester, there was no statistically significant difference between groups that received personalized emails than those who did not.. These finding are in contrast to studies conducted by Hu and Ku, Yu and Yu, and Flowers and Zhang.

Haworth (1999) took a similar approach as Woods (2002) for his investigation on the effectiveness of sending frequent personalized electronic messages to students. He found that these messages contributed little to the amount of student participation in class discussions. The increasing use of personalized messages was seen as complementary communication to students who tended to send only one or two messages during the semester. It appeared that the use of electronic messages did not significantly increase student-to-faculty interaction but redistributed the contact to an alternative form. Similar to Woods (2002) and Haworth (1999), Gatz and Hirt (2000) reported that their sample of traditional-age, residential, first-year students (n=23) used email quite extensively, but only a limited amount of their correspondence enhanced students' ability to academically or socially integrate into their environment. The findings appear to be mixed on the effectiveness of learning through the use of email, though there is a slight favor showing the use of email can improve learning, however, further exploration is warranted.

Collaborative Learning

The method of collaborative learning has been recognized by many cognitive constructivist theorist as a effective technique to improve learning for students (Gagné, 1985; Vygotsky, 1978). Collaborative learning is an instructional method in which students (i.e., two or more) at various performance levels work together toward a common goal. In this process, students share responsibility for each other's learning (Vygotsky). Thus, the success of one student is based on the assistance he or she receives from their peers.

Collaborative learning is a well documented approach to assist students with learning within a group setting of two or more individuals. The success of collaborative learning is highly dependent on the quality of interaction. Therefore, it is important that paired students' are active participants in the learning process. An enriched learning experience occurs when students share and discuss their ideas amongst one another. In group situations, there is likely to be a variety of opinions and perspectives from the participants. The learners' ability to explain their rationale helps them to comprehend educational materials from their own experiences. This permits group participants to share and develop a deeper understanding, therefore enhancing cognitive skills.

The effectiveness of collaborative learning is thoroughly documented in the literature as a successful instructional technique. Studies have shown that collaborative environments can be an effective learning method (Dee & Henkin, 1999; Derlin & McShannon, 2000; Gagné, 1985; Hill, 1982). Students who participate in collaborative learning environments tend to show higher levels of achievement than do their peers in more traditional classroom settings. For instance, when comparing achievement scores of collaborative learning participants and non participants, students in the collaborative groups excelled on content performance tests (Lane & Aleksic, 2002). Other researchers, such as Goldman (1965) revealed that when higher ability college students were paired with lower ability students, neither group's performance decreased. Though Goldman's research did not examine the duration of working with lower achievement students which could effect higher achieving performance over time (Hill, 1982), it does show when working collaboration with other students' in short durations that performance benefits is likely to occur regardless of aptitude.

Learning Outcomes

The majority of the research on collaborative learning appears to be in agreement that when students are paired with others in a structured format that student performances are likely to increase, including with low achievers (Dee & Henkin, 1999; Doran & Klein, 1996; Lane & Aleksic, 2002). When taking into account the pairing of students according to academic ability, the results appear to be mixed. For example, in a comparison study of group performance, undergraduate students were paired homogenously and heterogeneously according to academic ability (Goldman, 1965). Student performances improved for all levels (i.e., high, medium, and low) for homogenous groups and heterogeneous groups. The highest gains occurred for low performers when paired with high academic performers. In a similar study, high achievers academic performance decreased when paired with low achievers. Hill (1982) found when fewer than two high ability students are placed among lower ability students, the high ability student performance decreased. There was less of an affect on high ability student performances when three or more students were placed in a group with lower ability students. Chan (1997) reported that students in English as a Second Language classes were able to profit using collaborative electronic chat sessions. Gains were reported in students' sentence construction, vocabulary building, reading comprehension, and thinking skills as a result because the process encouraged of writing, thinking, and expressing ideas more clearly in electronic written format.

The frequency in which students interact collaboratively with other students, both inside and outside of required class formats, is critical to student learning. Some argue that without communication or interactivity the learning experience is greatly diminished (McCormack & Jones, 1998). The use of CMC supports this effort because it has the capability of allowing students to share ideas and information between other students (Campbell, 2000). Furthermore, value is achieved through electronic interaction because it can lead to collaborative and interdependent learning environments among learners in organizations or communities. That is, the more effort (i.e., time devoted to discussions) and frequency of student interaction, the greater sense of co-presence, or social presence, which in turn translates into greater feeling of intimacy and hence connectedness (Warschauer, 1997). Liaw and Huang (2000) provide additional evidence of why it is important to encourage interactivity. Their findings revealed that when online students demonstrated an increase in social interactivity and content interactivity that their achievement ratings also improved in those courses.

Recently, there have been several studies focusing on the equilibrium of collaborative online interaction (Dee & Henkin, 1999; Gilbert & Moore, 1998; Hsiu-Mei, 2002). In general, these studies investigating collaboration using CMC tools show that higher degrees of participation with equal opportunities provide supportive interacting environments. Student participation, specifically among otherwise passive and reticent students, is likely to be greater using CMC than oral discussions. Findings show that more openness occurs in electronic discussions compared to face-to-face interaction because electronic discussions allow democratic participation, equalizing the communication process. This may be due to CMC being perceived as less threatening than face-to-face interaction, thus encouraging risk-taking and a more adventurous spirit in language use (Hollenbeck, 1998).

It is important to have equitable and regular participation as a part of CMC discussions. The more information shared among student group participants better prepares learners to make informed decisions from the interaction that takes place. Improving students frequency of interaction increases the likelihood that all group members will be involved in the learning process and decreases the chances that only a selected few will benefit from the discussions (Cradler et al., 2002). Grudin (1994) recommends controlling the frequency in which students interact with the CMC system and with group mates. His reasoning is that some students may dominate the discussion boards discouraging participation by more passive students. Therefore, it helps if the instructor intervenes, serving in the capacity of a facilitator. In this role, the instructor views the frequency of interaction among classmates, posing questions or requesting for more student shared participation, creating a more equilibrium discussion.

Another area of studies has focused on different types of software to support collaborative learning such as Group Support System (GSS) and NetPeas. Both software tools allow students to conduct collaborative assessment. Studies involving the use of these different types of software revealed that more effective learning is able to occur. Students were encouraged to formulate evaluation criteria to perform a peer assessment. In addition to collaborative assessment, students assessed themselves. Findings from the GSS study illustrated that students took a deeper approach to learning, in turn leading to better project performance and better grades than those in face-to-face collaborative assessment. NetPeas, on the other hand, increased student editing skills by allowing peer projects to be reviewed and critiqued using multiple types of media (Kwok & Ma, 1999).

Despite these apparent advantages, some aspects of electronic discussion could possibly mitigate against collaboration. At times it is more difficult to achieve consensus in online discussion than in face-to-face interaction (Weisband, 1992). In face-to-face discussions, the second speaker tends to agree with the first speaker, and the third even more so. By the time the third person speaks, the group is often close to achieving a consensus. In contrast, using an electronic discussion forum, the third member's position is just as far from the final decision as was the first member's. These results suggest that electronic discussion reduces conformity and convergence.

Not all researchers report greater outcomes either as a result of using collaborative CMC tools. For example, Wells (2000) reported that little influence was found on overall student performance, indicating CMC delivery of instruction does accommodate a variety of learning styles without negative consequences for learning. Though findings such as these appear to be out weighed by more positive outcomes, such results illustrate that not all students are likely to be successful using CMC tools in a collaborative learning environment.

Knowledge Discovery through Computer and Internet Use

From a constructivist perspective, learning occurs best when it is in a meaningful context to the learner, bridging the gap between academics and real-life. Both the Internet and computer based applications allow learning to take place in an exploratory form. In contrast to traditional instructional modes, online learning environments allow users to have greater control of the learning process (Laurillard, 1998).

The World Wide Web (web) provides hypertext linked and a multimedia environment which facilitates investigative learning. When hypermedia is integrated with the Internet, it allows individuals to browse, search, and transfer files and information from thousands of sources. Learners are then able to actively absorb external inputs and construct meaningful knowledge from their prior individual experience. Thus, the web becomes a common tool for learner-centered or constructivist learning (Hsiu-Mei, 2002). The format in which it is displayed is another benefit allowing visual and audio transmission.

Similar to web based instruction, computer applications allow self paced exploratory learning to occur within the limits of the application. Computer-assisted instruction (CAI) can refer to virtually any kind of computer use in an educational settings, including drill and practice, tutorials, simulations, instructional management, supplementary exercises, programming, database development, writing using word processors, and other applications (Cotton, 2001). These may include either stand-alone computer learning activities or computer activities which reinforce material introduced and taught by teachers.

Computer Supported Learning Resources

In general, the literature reveals that the use of CAI as a supplement to traditional teacher-directed instruction produces achievement effects superior to those obtained with traditional instruction alone (Dalton & Hannafin, 1988; Fletcher, 1990; Schacter & Fagnano, 1999). These findings are relevant to students of different ages and abilities and learning in different curricular areas.

Other researchers have compared the effects produced by all forms of computer based instruction (sometimes alone and sometimes as a supplement to traditional instruction) as compared with the effects of traditional instruction alone

(Kini, 1994; Schacter & Fagnano, 1999; Wells, 2000). Yaccub (1998) summarized from his meta-analysis that on the average, higher gains are produced when using CAI rather than just traditional teaching methods. His findings revealed that the effect size is likely to double from .35 to .64 when CAI is utilized. However, some findings have shown no significant difference between traditional teaching methods and CAI (Frick et al., 1999; Hays et al., 1992; Koner, Lamsal, & Banerjee, 2001). Though previous findings on the use of CAI do not indicate superiority over traditional teaching methods, the evidence, nevertheless, indicates that CAI approaches produce higher achievement than traditional instruction by itself.

It is important to note that it is not best to compare two different modes of delivery. When this is done, it is likely to reveal no significant difference between the two (Astleitner, 2002; Clarke, 1993; Sperling, Seyedmonir, & Aleksic, 2003). The delivery mode should be viewed as method to enrich the learning experience. This was best summarized by Dalton and Hannafin (1988) who wrote, "while both traditional and computer-based delivery systems have valuable roles in supporting instruction, they are of greatest value when complementing one another" (p. 32). Therefore, instead of comparing media types, it is best to study how a particular instructional strategy adds value to the instructional method being employed. The use of CAI should be examined from the view point of enhancing the learning environment and not as a replacement solution.

When taking into account cognitive growth, some studies have showed an increase in this learning when CAI was infused with the instructional delivery. One particular study analyzed the incorporation of interactive media to aid students' in a science course. At the end of the six week unit, there was an overall improvement of 24% in the number of correct responses, mainly higher level, thinking skills between the pre and posttests. The findings revealed observable growth in both students' social and thinking skills. By providing media enriched examples of plant and animal fossils, students were able to better identify and classify them (Henderson, Eshet, & Klemes, 2000).

Through the use of CAI software, increases in cognitive domain of higher-order thinking skills have also been reported. Thornburg and Pea (1991) examined the effect of using two software programs--IDEA (Interactive Decision Envisioning Aid) and Notecards--in training high school students' cognitive strategy and metacognitive strategy. The results showed that after the training in learning strategies from the software program, the subjects' argumentation improved in terms of breadth and depth compared to the sentences written by them before the instruction. Moreover, after two months, subjects were able to retain these cognitive strategies. Though the small sample (n=10) size decreases the impact of this study, it does provide insight on design strategies that have the potential to improve student cognitive performance.

Different types of software can promote different types of interactions and learning outcomes among students (Tuovinen, 2000). Some researchers suggest that verbal interactions between students when using simulation software facilitate higher-order thinking as students readily interact with their peers to solve problems (Cradler et al., 2002). Flower's and Zhang's (2003) findings showed that using a computer for word processing, searching for information on the Internet, and using a computer to analyze quantitative information resulted in significant gains in writing and thinking skills. In the context of word-processing, it has been reported that collaborative writing environments encourage students to find solutions to a range of writing problems, largely through extensive discussion (Chan, 1997).

Others have reported that students are able to work longer and develop a better understanding of the writing process when working cooperatively on a writing task (Hsiu-Mei, 2002). The word-processing environment is ideal to motivate students to discuss, reflect upon and edit their work within cooperative groups. In addition, there is increased participation and collaboration among students when grouped to use computers to write (Warschauer, 1997). Word-processing applications also allows more affluent collaborative learning environments to occur which are likely to produce a better quality interaction (Chan, 1997). Applications such as these provide users with the capability to add, delete, and rearrange text, allowing more congruency in the writing process than pencil-and-paper approaches. In turn, the use of word processors leads to better writing outcomes than the use of paper-and-pencil or conventional typewriters. Such outcomes include longer written samples, greater variety of word usage, more variety of sentence structure, more accurate mechanics and spelling, more substantial revision, greater responsiveness to teacher and peer feedback, better understanding of the writing process, better attitudes toward writing, and freedom from the problem of illegible handwriting (Cotton, 2001; Henke, 1997; Yaakub, 1998).

Demographic Variables

Demographic variables are commonly viewed in educational research to form a hypothesis or to conduct analysis. Social scientists are more interested in groups than in individuals; therefore, examining group characteristics provides a better understanding of trends and tendencies among groups (Gall et al., 1996). Research demonstrates that some learner background characteristics are important in that they stand for the input state of nearly every aspect of learning development and have consistent effect on cognitive growth. Therefore, the next section of this review literature will be dedicated to examining background characteristics, including gender, race, socio-economic status, and class standing, and to analyze if these input variables influence frequency of technology use and/or impact learning performance.

Gender

Some research shows there is a slight inclination that men are more frequent users of technology and are more likely to benefit compared to women (Hayek & Kuh, 1999; Hu & Kuh, 2000). However, the majority of findings examining the effects of gender show no differences regardless of use of technology, presentation mode, email use, and learning outcomes (Everett, 1999; Flowers, 2000; Henke, 1997). This was reaffirmed by Roblyer, Castine, and King (1988) in their meta-analysis of 82 studies on the effects of CAI and gender. Their findings revealed that effect differences slightly favored boys over girls, though falling short of statistical significance.

Race

Regardless of ethnicity, some contend that the amount of effort in the use of educational technologies will out weigh any cultural background variables (Kuh & Shouping, 2001). There is a strong inclination that this is true. The majority of studies have shown found no relationships between race and computer use (Flowers & Zhang, 2003; Hayek & Kuh, 1999), including the frequency of interactivity of using email (Flowers, Pascarella, & Pierson, 2000) unless English is the user's second language (Hinkle, 2002). The use of technology appears to blind all cultural barrier lines and encourages all students to become active learners. For example, when African-Americans students were placed in a cyber environment communicating via email, they were more open to participate in open dialogue with their peers and instructors in class related discussions (Ervin & Gilmore). Similar results were noted in a qualitative design, where seventy eight percent of the college students (n=65) found the web forum easier to use when discussing sensitive issues (Soest, Canon, & Grant).

Though no relationships appear by race and learning, some ethnic groups favor computer mediated communication more than others. Flowers and Zhang (2003) reported in their study (n=45,000) that Asian students (71.2%) were more likely to use email to communicate with students or faculty members about course-related matters than other ethnic groups (African American, American Indian/Alaska Native, Caucasian, Native Hawaiian/Pacific Islander). Where as

American Indian/Alaska Native were more likely to use the Internet to search for course related information, use word processing software, and participate in relay chat more than the other groups. It is important to note that in spite of the group disparities that all groups showed significant gains in science and technology knowledge, gains in vocational preparation, gains in personal and social development, and gains in writing and thinking skill. These findings confirmed with Kuh's and Shouping's results that race is not a significant contributor to learning performance when CAI is involved.

Class Standing / Academic Classification

Few studies appear to look at the influence CAI has on learning according to academic classification (i.e., freshmen to seniors). The studies that have examined academic classifications have been mostly comprised of descriptive statistics rather than an empirical analysis (Cotton, 2001; Warschauer, 1997). Findings from these descriptive reports show little variation between academic groups when looking at patterns of technology use for class related activities. For example, Jones (2002) reported only a 4% difference between all undergraduates using email to clarify assignments with their instructors, with sophomores participating the most frequently at 81%. In studies examining the amount of engagement in traditional setting, seniors typically demonstrate more effort toward their academics than other groups, though there is not a larger disparity after students surpass their sophomore year.

Summary of Research Designs

As illustrated throughout the literature, several types of studies have been conducted on independent variable (i.e., frequency of technology use) and dependent variable (i.e., learning outcomes and student engagement). Previous research designs on these variables range from descriptive to quasi-experimental designs, though the majority of the studies have encompasses survey research techniques (Everett, 1999; Flowers & Zhang, 2003; Terenzini, Cabrera, Colbreck, Bjorklund, & Parente, 2001; Yu & Yu, 2002). Studies conducted on student engagement incorporate the most diverse range of study methodologies, including post factor, experimental, and descriptive designs.

The sample populations in previous studies have varied by type of design. Studies that most closely resemble the independent and dependent variables used in this study listed samples of 18,344 (Kuh & Shouping, 2001) and 45,000 (Flowers & Zhang, 2003). However, none of these studies specifically examined how the use of technology impacts learning; instead they provide either a descriptive or empirical analysis of the type of students and colleges participating in engaging learning activities.

As shown in the summary, many of the studies only capture portions of the variables being analyzed. Therefore, this study adds to the literature were gaps exist on how the use of technology contributes to college student learning gains.

Summary

A key position of constructivist is that knowledge is constructed from the view of the learner and is an active process. When this occurs, learners are more likely to be beneficiaries of knowledge acquisition. When taking into account how technology influences the construction of knowledge in relation to learning gains, the literature has been mixed, though a slight edge has favored CMC tools when placed in the context of active learning. This includes multiple types of learning interactions, such as faculty and student interactions, collaborative learning, and learning interaction through the use of computer applications and the Internet. The literature surrounding faculty interactions has shown positive results when faculty members frequently interact with their students and vice versa (Teague, Talbot, & Ward, 2000; Woods, 2002; Yu & Yu, 2002). However, it is important to note that the frequency is not the only determinant because the quality of this discourse could just as likely influence learning gains. For the purpose of this study, the frequency of interaction will be viewed because of the lack of consistency in previous findings and the rare use of large sample sizes which reduces the likelihood of any effects.

Collaborative learning is a key component of constructivist learning. The literature reveals that when students share and interface with other students, greater benefits are likely to occur (Lane & Aleksic, 2002; Trentin, 2000). When media modes such synchronous and asynchronous tools are involved, similar benefits are likely to be found (Teague et al., 2000; Uribe et al., 2003; Williams &

Pury, 2002; Woods, 2002; Yu & Yu, 2002). However, due to the lack of previous research on the frequency of collaboration additional research is worthy.

The use of computer technology and the Internet applications were other variables discovered to impact learning. Applications that provide interaction using visual, audio, touching elements provides for an engaging learning environment (Hubschman, 1996; Kuh & Shouping, 2001). These interactive simulations are known to affect critical thinking, grammar, and problem solving for example (Chan, 1997; Cotton, 2001; Warschauer, 1997). However, the frequency and use of CMC tools appear to be an area not fully explored when measuring specific type of outcomes likely to occur.

Previous results show that demographic variables have limited affects on learning when CAI tools are used. Though there appears to a slight preference that males and Asian students are more frequent users of these types of technologies (Flowers & Zhang, 2003; Hayek & Kuh, 1999), there is little evidence to support that demographic variables are more significant than the type and use of CAI resources.

As a result of this review of literature, this study will explore how types of interactions and uses of technology affect student learning and outcomes. Summarized in Table 2 are a list of independent and dependent variables, including works cited as discussed in this review. In the next chapter, the methodology to explore the reviewed list of variables will be discussed.

Table 2.

A Summary of Variables with Works Cited

Dependent Variables	Types of Outcomes	Research Sources	Sample	Research Design
Learning Outcomes	Gains in personal and social development	(Flowers & Zhang, 2003) (Gatz & Hirt, 2000) (Kuh & Shouping, 2001)	n=45,000 undergraduates n=23 undergraduates n=18,344 undergraduates	Descriptive Study Qualitative Survey Research
	Gains in general education	(Flowers & Zhang, 2003) (Kuh & Vesper, 2001) (Kuh & Shouping, 2001) (Davidson-Shivers, Nowlin, & Lanouette, 2002)	n=45,000 undergraduates n=125,000 undergraduates n=18,344 undergraduates n=42 undergraduates	Descriptive Study Survey Research Survey Research Quasi-experimental
	Gains in practical competence	(Flowers & Zhang, 2003) (Kuh & Vesper, 2001) (Kuh & Shouping, 2001)	n=45,000 undergraduates n=125,000 undergraduates n=18,344 undergraduates	Descriptive Study Survey Research Survey Research
Engagement in Learning Activities	Academic effort	(Kuh & Shouping, 2001) (Hu & Kuh, 2000)	n=18,344 undergraduates n=44,328 undergraduates	Survey Research Survey Research
	Academic integration	(Miller & Pope, 2003) (Gatz & Hirt, 2000) (Shin & Kim, 1999)	n= SAO? n=23 undergraduates n=1,994 undergraduates	Survey Research Qualitative (email Survey Research
	Active and collaborative learning	(Northrup, 2002; Uribe et al., 2003) (Doran & Klein, 1996; Kwok & Ma, 1999) (Teague et al., 2000)	n=52 graduates n=59 undergraduates n=105 undergraduates n=83 undergraduates n=123 graduates	Survey Research Posttest factorial design Posttest factorial design Experimental Design Survey and email content analysis
	Interaction with faculty mem	(Yu & Yu, 2002) (Hu & Kuh, 2001) (Haworth, 1999) (Woods, 2002) (Teague et al., 2000)	n=59 undergraduates n=18,844 undergraduates n=577 undergraduates n= 40 graduates n=123 graduates	Survey and Post-test Survey Research Survey Research Experimental Design Descriptive Research
	Diversity –related experience	(Terenzini et al., 2001)	n=1,194	Survey Research

Table 2 Continued

A Summary of Dependent, Independent, and Demographic Variables with Works Cited

Independent Variables	Types of Outcomes	Research Sources	Sample	Research Design
Faculty and Student Interaction using CMC	Interaction with instructor	(Hinkle, 2002; Yu & Yu, 2002) (Hu & Kuh, 2000)	n=59 undergraduates n=44,328 undergraduates	Survey and Post-test Survey Research
	Working collaboratively online	(Williams & Pury, 2002) (Uribe et al., 2003)	n=98 undergraduates n=59 undergraduates	Survey Research Posttest factorial design
Knowledge Discovery using CAI / Computer Support Learning Resources	Use of technology	(Kuh & Shouping, 2001) (Hewitson, 2002) (Hubschman, 1996)	n=18,344 undergraduates n=101 staff n=83 graduates	Survey Research Survey Research Qualitative Content Analysis
	Time online completing academic assignments	*(Bialo and Sivin 1990)* (Teague et al., 2000)	n=219 studies n=123 graduates	Meta analysis Descriptive Research
Demographic Input Variables	Gender	(Kuh & Shouping, 2001) (Hayek & Kuh, 1999) (Everett, 1999) (Flowers et al., 2000) (Hu & Kuh, 2001)	n=18,344 undergraduates n= 17,541undergraduates n=242 undergraduates n=3,840 undergraduates n=18,844 undergraduates	Survey Research Survey Research Survey Research Survey Research Survey Research
	Race	(Flowers & Zhang, 2003) (Kuh & Shouping, 2001) (Ervin & Gilmore, 1999; Griffin & Anderton-Lewis, 1998) (Flowers et al., 2000)	n=45,000 undergraduates n=18,344 undergraduates n=247 undergraduates n=138 undergraduates n=3,840 undergraduates	Survey Research (descriptive) Survey Research Focus Groups and Survey Descriptive Research Survey Research Regression
	Class Standings	(Hayek & Kuh, 1999) (Pike, 1999) (Alston & McCowan, 1998)	n= 17,541undergraduates n=799 undergraduates n=212 undergraduates	Survey Research Survey Research Survey Research

Chapter III
Methodology

The purpose of this study was to examine how frequency of online interaction and frequency and duration of technology use for academic work affect student learning and other educational outcomes for undergraduate students. Specifically, this study addressed the following research questions:

> 1) Do the frequency of online interaction and frequency and duration of technology use for academic work explain a significant amount of variance in student learning outcomes for undergraduate students?
>
> 2) Do the frequency of online interaction and frequency and duration of technology use for academic work explain a significant amount of variance in student engagement for undergraduate students?

Frequency of online interaction for this study includes two types of interaction: student-to-instructor and student(s)-to-student(s). This chapter presents a schematic of the methodology outlining the instrumentation and sampling process, the instrument scales, and measures used to collect the data.

Instrumentation and Sampling

This study utilized data from the 2003 administration of the *College Student Experiences Questionnaire* (CSEQ). The CSEQ is a national survey of randomly selected undergraduate students from participating colleges and universities in the United States. Institutions can elect to participate in a paper-based version or a web-based version. This study uses the results from the web-based version of the 2003 CSEQ.

Invitations to participate in the survey were sent electronically. Student e-mail addresses were based on fall 2002 enrollment data provided by the institutions. A user code provided by the survey administration agency differentiated students who responded from the various institutions. The procedures for the data collection began in May 2002 – September 2002; institutions registered with CSEQ submitted their application to participate. The respective institutions supplied the email addresses of student participants from their colleges and universities. A general announcement was sent (see Appendix A), inviting students to participate in the survey begin in February 2003. The survey was open for a period of three months. A hyperlink was embedded in the text of the email invitation which directed participants to the instrument. To prevent multiple responses from the participants, students were required to submit contact information (e.g., name, social security number, and phone number), and if duplicates and non registered names were found, they were automatically removed. A follow up email announcement was sent to non respondents in April as a reminder (see Appendix B). The web based survey was closed and removed from the server in early May of 2003.

The *CSEQ* was used for the data collection and focuses on students' engagement in educational practices that lead to positive learning outcomes. The CSEQ instrument is based on extensive research, guided by Chickering and Gamson's (1987) "Seven Principles for Good Practice in Undergraduate Education." The instrument used in this study includes 190 Likert-type items on student academic experiences. However, for the purpose of this study only 53 items were selected from the following scales: Estimate of Educational Gains (general education, personal development, science and technology, intellectual skills, practical and vocational competence) and engagement (student acquaintances). Additional demographic information were collected in the later part of the instrument, including age, martial status, gender, race, living situation, educational status, parent's education level, and major field of study. For the purpose of this study, only gender, race, and educational level were used as part of the analyses.

The sampling frame for this study included students from various colleges and universities across the United States. The standard sample size was based on the number of undergraduate students currently enrolled at these institutions and included freshman, sophomores, juniors, and seniors. The sample used was comprised of a random selection of 2,000 participants from the national sample (n=87,855) who completed the CSEQ survey in 2003**.** The random sample was composed of participants who were enrolled in some form of online instruction. The national sample included both online and students enrolled in traditional courses.

A comparison of the random sample and national sample illustrates that the demographics for both of groups are similar. In summarization of the participants, most of them were female (63%), slightly higher than the national sample (61%) of women enrolled in four year institutions. Caucasian/White students (78%) made up the majority of the sample, which is somewhat higher than the national sample (76%). The largest percentage difference between both groups was the enrollment status with a 19% difference between the random and national sample of freshman and sophomores sampled. Table 3 provides a demographic comparison between the random and national sample of the CSEQ participants.

Table 3

Characteristics of CSEQ 2003 Sample

Characteristic	Online Sample n %	Online Sample n (n=2000)	National Sample n%	National Sample n (n=87,855)
Gender				
Male	35%	704	39%	33,560
Female	64%	1,272	61%	53,485
Race				
African American	4.6%	92	5%	4,356
American Indian/Alaska Native	.7%	13	1%	844
Asian/ Pacific Islander	4.8%	96	9%	7,529
Caucasian/White	78%	1,568	76%	67,277
Hispanic	3%	59	2%	1,630
Other	2.9%	57	3%	2,597
Multiple	3.7%	73	3%	3,090
Enrollment Status				
Freshman	20%	399	42%	36,733
Sophomore	41%	823	20%	17,506
Junior	11%	222	17%	15,096
Senior	25.7%	513	21%	18,520

Scale Development

Though there are challenges with using self reported data, such as the accuracy with which respondents report information, the validity and reliability of the CSEQ have been established through extensive field tests. Psychometric analyses on all survey items and scales were conducted using five survey administrations between June 1999 and August 2002. Sample sizes ranged from 3,226 students (12 institutions) in spring 1999, to 118,355 students (366 institutions) in spring 2002.

Validity

The validity of an instrument refers to the extent to which it provides data that relate to commonly accepted meanings of a particular concept (Babbie, 1995). Many of the items on the CSEQ survey have been used adopted from other highly regarded and longitudinal college research based projects, such as UCLA's Cooperative Institutional Research Program (Astin, 1993; Sax, Astin, Korn, & Mahoney, 1997) and Indiana University's College Student Experiences Questionnaire Research Program (Kozma & Russell, 1997; Kuh, Hu, & Vesper, 2000; Pace, 1990). To insure the instrument's validity, the design researchers checked to see if the items on the instrument were clearly worded, well-defined, and had high face and content validity. Second, each of the summated scales were tested for internal consistency using principal components analysis, to determine that the items within each scale were indeed measuring one construct (Baker & Siryk, 1989).

The items were found to be normally distributed by scale (e.g., general education gains, intellectual skills, educational and personal), by student demographic type (age, race, gender), and within and across major fields of study and institutions. Extensive research by CSEQ concludes students' self-reports of their activities and self estimates of gains from *The College Student Experience Questionnaire is* broadly credible, valid, and consistent with external evidence collected over several years (Kuh, 2001b).

Reliability

Reliability is the consistency of measurement, or the degree to which an instrument measures the same way each time it is used under the same condition with the same subjects. Another characteristic of a reliable instrument is stability, the degree to which the students respond in similar ways at two different points in time. For this purpose, Cronbach's Alpha was used. It ranges from 0 to 1.0. Scores that are at the higher end of the range (e.g., above .70) suggest that the items in a scale are related.

The Alpha coefficients for the learning outcomes and the engagement scales range from .78 to .88, suggesting high reliability. Tables 4 and 5 outline the items and internal consistency estimates associated with the student learning outcome and student engagement scales, respectively.

Measures

The measures used in this study will be outlined in two sections: dependent variables and independent variables.

Dependent Variables

Student learning outcomes. Five student learning outcomes attributed to the college experience were assessed: personal and social development, general education, intellectual development, science and technology, and vocational preparation. An analysis from the Buros Mental Measurement records Yearbooks show that the items on the CSEQ scales are clear, well defined and have face validity, showing that logical relationships exist among same scales items (Gonyea, Kish, Kuh, Muthiah, & Thomas, 2003).

Items on the questionnaire were measured on a four point Likert scale from 4 = Very Often, 3 = Often, 2 = Occasionally, 1 = Never. Cronbach's alpha estimates for the five scales were respective. General Education was measured by six items (α = .79); seven items measured gains in intellectual skills (α=.80); five items measured personal and social development (α = .82); four items measured gains in science and technology (α = .89); and three items measured gains in vocational preparation. (α = .78) Details on item wording, mean, standard deviations and descriptive statistics estimates of the measures are shown in Table 4.

Table 4.

Items and descriptive statistics for learning outcomes

Variable	Scale Statistics	Items (with Codes)	Item-Level Statistics Mean	Standard Deviation	Valid N
General Education at=.79 as=.79	GNVOC	Acquiring knowledge and skills applicable to a specific job or type of work (vocational preparation)	2.81	.893	1824
	GNSPEC	Acquiring background and specialization for further education in a professional, scientific, or scholarly field	3.01	.807	1824
	GNGENLED	Gaining a broad general education about different fields of knowledge	3.06	.758	1824
	GNARTS	Developing an understanding and enjoyment of art, music, and drama	2.51	.946	1824
	GNLIT	Broadening your acquaintance with and enjoyment of literature	2.46	.974	1824
	GNHIST	Seeing the importance of history for understanding the present as well as the past	2.69	.932	1824
	GNWORLD	Gaining knowledge about other parts of the world and other people (Asia, Africa, South America, etc.)	2.65	.955	1824
	GNPHILS	Becoming aware of different philosophies, cultures, and ways of life	2.94	.831	1824
Intellectual Skills at=.81 as=.80	GNWRITE	Writing clearly and effectively	2.98	.834	1826
	GNSPEAK	Presenting ideas and information effectively when speaking to others	2.95	.833	1826
	GNCMPTS	Using computers and other information technologies	3.05	.864	1826
	GNHEALTH	Developing good health habits and physical fitness	2.64	1.006	1826
	GNANALY	Thinking analytically and logically	3.05	.825	1826
	GNSYNTH	Putting ideas together, seeing relationships, similarities, and differences between ideas	3.14	.765	1826
	GNINQ	Learning on your own, pursuing ideas, and finding information you need	3.28	.755	1826

Table 4 (Continued)

Variable	Scale Statistics	Items (with Codes)	Item-Level Statistics		
			Mean	Standard Deviation	Valid N
Personal and Social Development at=.83 as=.82	GNVALUES	Developing your own values and ethical standards	3.18	.828	1834
	GNSELF	Understanding yourself, your abilities, interests, and personality	3.31	.717	1834
	GNOTHERS	Developing the ability to get along with different kinds of people	3.21	.778	1834
	GNTEAM	Developing the ability to function as a member of a team	3.03	.862	1834
	GNADAPT	Learning to adapt to change	3.18	.787	1834
Science and Technology at=.87 as=.89	GNSCI	Understanding the nature of science and experimentation	2.36	.983	1849
	GNTECH	Understanding new developments in science and technology	2.40	.962	1849
	GNCONSQ	Becoming aware of the consequences (benefits, hazards, dangers) of new applications of science and technology	2.44	.943	1849
	GNQUANT	Analyzing quantitative problems (understanding probabilities, proportions)	2.58	.973	1849
Vocational Preparation at=.78 as=.78	GNCAREER	Gaining a range of information that may be relevant to a career	3.06	.782	1848
	GNVOC	Acquiring knowledge and skills applicable to a specific job or type of work (vocational preparation)	2.81	.983	1848
	GNSPEC	Acquiring background and specialization for further education in a professional, scientific, or scholarly field	3.01	.809	1848

Note at is the alpha for the national sample and as *is* the alpha for the sub-sample.

The other dependent variable scale measured engagement in learning activities. Included in this scale were measurements of faculty interactions, diversity and social interactions, and social, political, and scientific interactions. There were ten items that measured student interactions with faculty members (e.g., discussed ideas from your reading or classes with faculty members outside of class) with an (α = .90), ten items measured diversity related experiences (e.g., became acquainted with students whose interests were different from yours) with an (α = .91), and ten items measured student interactions related to social, political, and scientific matters with an (α = .87). Each of the items were measured on a four point Likert scale from 4= Very Often, 3= Often, 2= Occasionally, 1= Never.

Table 5.

Items and descriptive statistics for student engagement

Variable	Scale Statistics	Items	Item-Level Statistics		
			Mean	Standard Deviation	Valid N
Interactions with Faculty at=.88 as=.90	FAC1	Talked with an instructor about information related to a course you were taking. .	2.82	.811	1860
	FAC2	Discussed your academic program or course selection with a faculty member.	2.55	.847	1860
	FAC3	Discussed ideas for a term paper or other class project with a faculty member.	2.41	.901	1860
	FAC4	Discussed your career plans and ambitions with a faculty member.	2.24	.901	1860
	FAC5	Worked harder as a result of feedback from an instructor.	2.63	.894	1860
	FAC6	Socialized with a faculty member outside of class.	1.67	.842	1860
	FAC7	Participated with other students in a discussion with one or more faculty members outside of class.	1.83	.898	1860
	FAC8	Asked your instructor for comments and criticisms about your academic performance.	2.06	.922	1860
	FAC9	Worked harder than you thought you could to meet an instructor's expectations and standards.	2.38	.943	1860
	FAC 10	Worked with a faculty member on a research project	1.48	.845	1860
Social, pol. and sci. discussions at=.87 as=.87	CONTPS1	Current news or events	3.29	.754	1838
	CONTPS2	Social issues such as peace, justice, human rights, equality, race relations	3.06	.850	1838
	CONTPS3	Different lifestyles, customs, and religions	2.99	.850	1838
	CONTPS4	The ideas and views of other people such as writers, philosophers, and historians	2.48	.934	1838
	CONTPS5	The arts (paintings, poetry, dance, theatrical, productions, symphony, movies.	2.56	.939	1838

Table 5 (Continued)

Items and descriptive statistics for student engagement

Variable		Items	Item-Level Statistics		
			Mean	Standard Deviation	Valid N
Social, political, and scientific discussions	CONTPS6	Science (theories, experiments, methods, etc.)	2.09	.920	1838
	CONTPS7	Computers and other technologies	2.37	.906	1838
	CONTPS8	Social and ethical issues related to science and technology such as energy, pollution, chemicals, genetics, military use.	2.53	.915	1838
	CONTPS9	The economy (employment, wealth, poverty, debt, trade, etc)	2.77	.867	1838
	CONTPS10	International relations (human rights, free trade, military activities, political differences, etc.)	2.93	.913	1838
Diversity and Social Interactions at=.91 as=.91	STACQ1	Became acquainted with students whose interests were different from yours	2.98	.775	1838
	STACQ2	Became acquainted with students whose family background(economic, social)was different from yours	3.12	.748	1838
	STACQ3	Became acquainted with students whose age was different from yours	3.02	.812	1838
	STACQ4	Became acquainted with students whose race or ethnic back ground was different from yours	2.98	.825	1838
	STACQ5	Became acquainted with students from another country	2.59	.928	1838
	STACQ6	Had serious discussions with students whose philosophy of life or personal values were very different from you	2.70	.921	1838
	STACQ7	Had serious discussions with students whose political opinions were very different from yours	2.64	.972	1838
	STACQ8	Had serious discussions with students whose religious beliefs were very different from yours	2.67	.952	1838
	STACQ9	Had serious discussions with students whose race or ethnic back ground was different from yours	2.61	.976	1838
	STACQ10	Had serious discussions with students from a country different from yours	2.31	1.022	1838

Note at is the alpha for the national sample and *as* is the alpha for the sub-sample.

Independent Variables

The independent variables or predictors for this study included frequency of interaction via email, frequency of collaborative work online, frequency of computer use to prepare papers or reports, frequency of use of the Internet for course related information. Participants responded to a 4 point scale that ranged from 4= Very Often, 3= Often, 2= Occasionally, 1= Never. All independent variables were measured as single items. Details on item wording, descriptive statistics, and mean, and standard deviation estimates of the measures are shown in Table 6.

Table 6.

Items and descriptive statistics for independent variables

Independent Variables	Items	Mean	Standard Deviation	Valid N
Frequency of Interaction via email	Used email to communicate with an instructor or other students	3.74	.567	1903
Frequency of Collaborative Online Work	Participated in class discussions using an electronic media (email, list serve, chat group, etc.)	2.05	1.045	1903
Frequency of computer use to prepare papers or reports	Used a computer or word processor to prepare reports or papers	3.83	.471	1903
Frequency of Internet use for course related information	Searched the World Wide web or Internet for information related to a course	3.51	.723	1903

Sets of Correlations

Inter-scale correlations were conducted on the independent and dependent variables to gain a better understanding of the strength of the scales. The results showed that there were significant correlations among the scales ($p<.05$). Correlations for the dependent variables were conducted first which measured learning outcomes. The r - values ranged from 20% - 75%, with the majority of the correlations falling within the 27% - 55% range, indicating a moderately strong relationship as shown in Table 7. The scale relating to student's personal and social development and student's intellectual skills showed the strongest relationship (r. =75). The scale with the lowest correlation was the diversity and social interactions scale and vocational preparation (r= .201).

Table 7.

Correlations among Dependent Variables (N = 1921)

Dependent Variables	Contps Scale	Staq Scale	Faculty Scale	General Education Scale	Voc Scale	Sci. Tech Scale	Per. Soc. Scale	Intellectual Skills Scale
Contpts Scale	1							
Staq Scale	.520**	1						
Faculty Scale	.392**	.408**	1					
General Education Scale	.426**	.362**	.405**	1				
Voc. Scale	.202**	.201**	.314**	.607**	1			
Sci. Tech Scale	.274**	.241**	.294**	.368**	.438**	1		
Per. Soc. Scale	.273**	.321**	.338**	.541**	.489**	.410**	1	
Intellectual Skills Scale	.314**	.319**	.400**	.595**	.526**	.534**	.749**	1

** Correlation is significant at the 0.01 level (2-tailed).

The second set of correlations was conducted on the independent variables. The results showed moderate to low correlations when using email to communicate or using a computer/ word processor for papers displaying the highest correlation at $r =.480$. Using email to communicate with classmates and joining in electronic discussions reported the lowest correlation at $r = .134$. All of the items showed a positive relationship and were statistically significant ($p<.01$) as shown in Table 8.

Table 8. Correlations among Independent Variables

Correlations among Independent Variables (N = 1921)

Independent Variables	Used computer/word processor for paper	Used email to communicate with class	Joined in electronic class discussions	Searched Internet for course material
Used computer/word processor for paper	1.00			
Used email to communicate with class	.480**	1.00		
Joined in electronic class discussions	.134**	.192**	1.00	
Searched Internet for course material	.346**	.412**	.279**	1.00

** p< .01

The third set of correlations was conducted between the dependent and independent variables. The results revealed moderate to low correlations between the variables, with the majority of the correlations falling between the 10% to 30% range. This suggests that the dependent and independent variables do not have a strong relationship; therefore, measuring separate constructs. All of the items showed a positive relationship and were statistically significant ($p<.01$) as shown in Table 9. Inter-item correlations were also conducted and can be previewed in appendix C.

Independent Variables

In addition, there were three student input variables which included gender, ethnicity, and class standing. The gender selection included the options of 1 = male and 2 = female. The next input variable included race/ethnicity with the options of 1 = American Indian or other Native American, 2 = Asian American or Pacific Islander, 3 = Black or African American, 4 = White, 5 = other. The third variable included class standing 1 = freshman, 2= sophomore, 3 = junior, 4 = senior, 5 = graduate student, 6 = unclassified.

Table 9. Correlations among Independent and Dependent Variables

Correlations among Independent and Dependent Variables (N = 1921)

Independent and Dependent Variables	Contps Scale	Staq Scale	Faculty Scale	General Education Scale	Voc Scale	Sci Tech Scale	Per Soc Scale	Intellectual Skills Scale	Used computer/ word processor for paper	Used email to communicate with class	Joined in electronic class discussions	Searched Internet for course material
Contps Scale	1											
Staq Scale	.520**	1										
Faculty Scale	.392**	.408**	1									
General Education Scale	.426**	.362**	.405**	1								
Voc Scale	.202**	.201**	.314**	.607**	1							
Sci Tech Scale	.274**	.241**	.294**	.368**	.438**	1						
Per Soc Scale	.273**	.321**	.338**	.541**	.489**	.410**	1					
Intellectual Skills Scale	.314**	.319**	.400**	.595**	.526**	.534**	.749**	1				
Used computer/word processor for paper	.112**	.119**	.097**	.114**	.069**	.001	.116**	.141**	1			
Used email to communicate with class	.180**	.165**	.198**	.133**	.132**	.041	.192**	.189**	.480**	1		
Joined in electronic class discussions	.213**	.200**	.24**	.158**	.125**	.144**	.163**	.177**	.134**	.192**	1	
Searched Internet for course material	.230**	.192**	.199**	.169**	.152**	.129**	.211**	.232**	.346**	.412**	.279**	1

Data Analyses

Data analyses were conducted using SPSS Version 12. Frequencies, descriptive statistics, and distributions were examined for all variables. Histograms, normal probability plots, and scatter plots were also conducted to see if the assumptions of linearity, normality, and homoscedascity were met. Item level analyses were carried out prior to creating the composites, and reliability estimates for each composite were calculated.

For the analysis, the technique of multiple regressions was used to find the best predictors of the dependent variables of learning outcomes and student engagement activities. Regression was used to determine the contribution of the four interaction and technology use variables, above and beyond that of demographic factors, to the prediction of variation in the outcome variables (i.e., learning outcomes and student engagement).

The variables used in a regression equation were categorical measurements. To meet the assumptions of the model, the dependent variable must be quantitatively or continuously measured. Dummy coding is the most commonly used coding method to group data according to categories. In this method, association in a given group or category is assigned a 1, whereas non-association in the category is assigned a 0. Groups that were given a 1 were expected to have higher learning outcomes or engagement effects. For the purpose of the regression analyses, categorical variables such as student gender, race, class, were coded as dummy variables. The specifications and the coding of the independent variables are listed below:

Gender. Student gender variable was dummy coded as:

0 = Male

1 = Female

Race. The race variable is dichotomized into Whites and non-Whites because of the low percentage of minorities represented in the sample. It was dummy coded as:

0 =Non-White

1 =White

Class level. In this study, the class level variable is coded into two categories: Lower - mid level (freshmen, sophomores, and juniors) and seniors. The variables were coded as:

0 = Freshmen, Sophomore, Junior

1 = Senior

After the completion of the coding of the dummy variables, the independent variables were entered in two blocks for each regression analyses. First, the group of demographic variables was entered, and then the group of interaction and technology use variables was entered. Thus, the independent contribution of each of the interaction and technology use variables could be estimated

This study was based on two central assumptions, that is, the more frequently learners use computer mediated conferencing tools for collaborative interaction, the more likely greater learning outcomes will be achieved, above and beyond the effect of demographic factors. Second, the more frequent learners use CAI for class assignments, the more likely they will indulge in engaging learning activities, above and beyond the effect of demographic factors (i.e., gender, ethnicity, and class standing).

The following hypotheses guided the analyses:

1. Frequency of interaction via email with instructor makes a significant contribution to the prediction of student outcomes.

2. Frequency of online collaboration makes a significant contribution to the prediction of student outcomes.

3. Frequency of computer makes a significant contribution to the prediction of student outcomes.

4. Frequency of use of the Internet for course related information makes a significant contribution to the prediction of student outcomes.

5. Frequency of interaction with instructor makes a significant contribution to the prediction of student engagement.

6. Frequency of online collaboration makes a significant contribution to the prediction of student engagement.

7. Frequency of computer use makes a significant contribution to the prediction of student engagement.

8. Frequency of use of the Internet for course related information makes a significant contribution to the prediction of student engagement.

Regression models were developed to test the hypothesized relationships.

Summary

This chapter presented the research methodology to be used in this study. It included the instrumentation and sampling process, the instrument scales used, measures to collect the data, and the analysis of solicited data. A summary of the analysis and variables is presented in Table 10.

Table 10.

Research Variables and Analysis

Research Questions	Independent Variables	Dependent Variables
1) Do frequency of interaction with instructor via email, frequency of collaborative work online, frequency of computer use for course assignments, and frequency of Internet use for course related information explain a significant amount of variance in college student learning outcomes?	1. Frequency of Interaction with Instructor via email (Never, Occasionally, Often, Very Often) 2. Frequency of Collaborative Online Work (Never, Occasionally, Often, Very Often) 3. Frequency of computer use to prepare papers or reports (Never, Occasionally, Often, Very Often) 4. Frequency of Internet use for course related information (Never, Occasionally, Often, Very Often)	Outcomes 1. General Education 2. Personal Development 3. Science and Technology 4. Intellectual Skills 5. Practical and Vocational Competence
2)) Do frequency of interaction with instructor via email, frequency of collaborative work online, frequency of computer use for course assignments, and frequency of Internet use for course related information explain a significant amount of variance in student engagement?	1. Frequency of Interaction with Instructor via email (Never, Occasionally, Often, Very Often) 2. Frequency of Collaborative Online Work (Never, Occasionally, Often, Very Often) 3. Frequency of computer use to prepare papers or reports (Never, Occasionally, Often, Very Often) 4. Frequency of Internet use for course related information (Never, Occasionally, Often, Very Often)	Engagement 1. faculty interactions 2. diversity and social interactions 3. social, political, and scientific discussions

Chapter IV
Findings

This chapter reports the findings from this study, providing a summarization of the regression analyses for the dependent and independent variables. A total of eight multiple regression analyses were conducted to determine if the use of technology explains student learning outcomes and student engagement above and beyond student background variables, which include, gender, race, and college classification. More specifically, the following questions were used to guide the investigation of this study:

1) Do frequency of interaction with instructor via email, frequency of collaborative work online, frequency of computer use for course assignments, and frequency of Internet use for course related information explain a significant amount of variance in college student learning outcomes?

2) Do frequency of interaction with instructor via email, frequency of collaborative work online, frequency of computer use for course assignments, and frequency of Internet use for course related information explain a significant amount of variance in student engagement?

As expected, the findings reveal that the use of technology does assist to explain a significant amount of variance in learning outcomes and learning engagement, above and beyond the variance explained by background characteristics. The results for both learning outcomes and student engagement will be discussed in the next two sections. In each section, there is a review of the findings for each of the research questions, encompassing a synopsis of the results from the regression model equations. For the data analysis both the unstandardized and standardized regression coefficients will be reported in the tables. The interpretability of the unstandardized coefficients is somewhat challenging because the measures are truly not interval measures. Interval variables are equally spaced and have to represent equal magnitudes. It is unlikely that the understandardized coefficients from the scale used (1= never to 4 = very often) would yield equal magnitude (e.g., there could be more gains from moving from never to occasionally than from often to very often); therefore, the standardized coefficients will be used to gauge the relative importance of the independent variables in the explanation of student learning and engagement outcomes.

Regression Models for Student Learning Outcomes

The first research question addresses whether the use of technology explains student learning outcomes, above and beyond the explanation by student background variables. Five student learning outcomes were regressed on the background factors and technology use variables: general education gains, personal and social development gains, intellectual gains, science and technology gains, and vocational gains. The regression models for student learning outcomes are summarized in Table 11.

Table 11.

Regression Model for Technology and Student Learning Outcomes

Independent Variables	General Education Gains (*N*=1768)		Personal and Social Development Gains (*N*=1768)		Intellectual Gains (*N*=1779)		Science and Technology Gains (*N*=1790)		Vocational Gains (*N*=1791)	
	b	*B*	*b*	*B*	*b*	*B*	*b*	*B*	*b*	*B*
Gender	-.01	-.001	.09**	.07**	.14	.01	-.24***	-.14***	-.03	-.02
Race	-.19	-.02	-.03	-.02	-.07	-.05	-.12	-.06	-.04	-.02
Senior	.54*	.05*	.17***	.12***	.18***	.14***	.06	.033	.12***	.09***
R^2 Background Variables		.03		.02***		.02***		.02***		.08**
Gender	-.22	-.02	.05	.04	-.02	-.02	-.25***	-.15***	-.06	-.04
Race	-.08	-.07	-.02	-.01	-.05	-.03	-.11	-.05	-.03	-.02
Senior	.38	.04	.14***	.10***	.16***	.13***	.05	.02	.11**	.07**
Used computer / word processor for a paper	.44	.05	.01	.01	.05	.04	-.09	-.05	-.02	-.01
Searched the Internet for course related material	.64***	.10***	.11***	.13***	.12	.16***	.14***	.12***	.10***	.11***
Used email to communicate with class	.38	.05	.10***	.09***	.07	.07	.01	.008	-.02	.07
Join In electronic class discussions	.46***	.11***	.06***	.10***	.06***	.10***	.08***	.11***	.05**	.08**
Change in R^2		.04***		.06***		.07***		.03***		.04***
Total R^2		.05***		.08***		.09***		.05***		.04***

*p<.05, **p<.01, ***p<.001

The first regression model measures the contribution of the use of technology in relations to general education outcomes, revealing that background variables explain .003% of student learning. Contrary to expectations, the only background variable that makes a significant contribution to gains in general education is classification of senior student status. When technology variables are added to the model, there is an R^2 change of 4%. Of the technology use variables, frequency of participation in electronic classroom discussions provides the greatest effect in the explanation of general education gains (B=.11), followed by searching the internet for course material (B=.10). The background and use of technology variables together explain about 5% of the total variance in general education gains ($p<.001$).

The second model estimates the contribution technology makes in explaining student gains as it relates to students personal and social development. The multiple regression equation for the background characteristics only show that student background variables explain 2.20% of the variance in personal and social development ($p<.001$). As expected, being a senior is slightly more important than being a female in students personal and social development gains (B = .12, B =.07 respectively). Contrary to expectations, being White is not an important predictor and has a slightly negative association with students' personal and social development. When the use of technology variables are added to the equation, there is an R^2 change of 5.7 %, for a total R^2 of 7.9% ($p<.001$). The technology variables that is most important in the explanation of students' personal and social development gains are searching the Internet for course related materials (B = .13), followed by participating in electronic discussion (B = .10), and use of email (B = .09).

The third model measures the relationship between the use of technology and student intellectual gains. Student background variables explains about 2% of the overall variance (p<.001). As expected, being a senior (B =.14) is positively associated with intellectual gains. Opposite to expectations, neither race nor gender provides a significant explanation in the model. With the addition of technology variables, the regression model explains a total of 9.20% of the variance (p<.001) in student intellectual skill gains. Searching the Internet for course related materials (B = .15), followed by academic classification (B = .13) and participating in electronic discussion (B = .10) are the most important variables that explain students intellectual gains.

The next regression model explores the relationship between technology use and student gains in the areas of science and technology. When only student background variables are entered in the model, they explain about 2% of the variance in science and technology gains (p<.001). Interestingly, the only statistically significant background variable in this first block is being female (B = -.14); that is, being female is associated with lower gains in science and technology. With the inclusion of technology use, there is an R^2 change of 2.4% (p<.001), for a total R^2 of 5.4% (p<.001). The technology variables that provides the greatest magnitude of effect in the explanation of science and technology gains are searching the Internet for course related materials (B = .12) and participation in electronic discussions (B = .11).

The last analysis on student learning outcomes is in relations to predicting student use of technology and vocational gains. The background variables together explain .008% of student vocational gains. Of the background variables, only being a senior is positively associated with student vocational gains (B = .09). Somewhat surprising is that neither gender nor race revealed a significant association with student vocational gains. With the addition of technology variables, there is an R^2 change of 3.8%, for a total R^2 of 4.1%. There are only two technology variables that revealed significance. Of these, searching the Internet for course related materials (B = .11) proves to be slightly more important in explaining student vocational gains than participation in electronic class discussions (B = .08).

Summary of Effects on Student Learning Outcomes

When examining across learning outcome variables, the classification of being White and being a senior are fairly consistent. For each of the five models, background variables have a relatively small effect on explaining student learning outcomes (.008% - 2.0%). Being classified as White is slightly negatively associated with all of the learning outcome variables, though, none of the beta values are statistically significant. In contrast, being a senior has a positive association with all of the learning outcome variables, showing a positive relationships with four of the constructs (i.e., general education, personal and social development, intellectual gains, and vocational gains). When examining gender, being female has positive effects on gains in personal and social development. Also interestingly is to find there is a significant but negative relationship with being a female and gains in the area of science and technology.

When the technology variables are included in the models, the effects are fairly consistent across all of the learning outcome variables. Both searching the Internet and participating in electronic class discussions are important variables in the explanation of learning outcomes. In all five models, R^2 change is modest (3% - 7%) and statistically significant, indicating that the frequency of technology use does indeed contribute to the explanation of gains in student learning over and above background factors.

Regression Models for Engagement Outcomes

The second research question addresses if the use of technology explains student engagement above and beyond student background variables. There were a total of three regression analyses; one conducted for each of the engagement composite scales. A summary of the results for each model are shown in Table 12.

In the first regression model, the results reveal that student background variables explains about 2.20% of the variance related to faculty interactions ($p<.001$). As expected, the classification of being a senior is positively and significantly associated with faculty interactions (B = .14). Contrastingly, there is a negative and non significant relationship associated with being female and White. When the additions of technology variables are added to the model, there is an R^2 change of 8.0%, for a total R^2 of 10.2%. All of the technology variables, except for use of computer, show a positive effect in explaining student engagement relative to faculty interactions. Of the technology of use variables, students participation in electronic discussions (B= .18) has the greatest effect. Student use of email has the second greatest effect (B = .13) followed by searching the Internet (B = .10).

The next regression model measures the relationship between the use of technology and student engagement in social, political, and scientific discussions. Together, all the background variables explains .006% of the model variance ($p<.05$); a statistically but not practically significant amount. Contrary to expectations, being female is the only variable that is significant; however, there is a negative association with this groups interactions related to social, political, and scientific matters (B = -.05). After adding technology variables to the model, there is an R^2 change of 8.6%, for a total R^2 of 9.2% ($p <.001$). There are three variables that have relative effects on students' discussions of social, political, and scientific matters. The magnitudes of the effects are minimum in range. Student use of the Internet (B = .16) has the greatest effect, slightly above participation in electronic class discussions (B = .14) and use of email (B = .09). The last regression model explores the relationships between student use of technology and students' engagement in diversity and social related topics. Student background variables explains 3.0% of the variance in student participation in this area ($p<.001$). Contradictory to expectations, both the classification of being White (B = -.15) and a senior (B = -.08) is negatively associated with students' participation in diversity engaging activities. This means that students who are White or a senior are less likely to show gains in this area. When technology variables are added to the model, there is an R^2 change of 6.60%, for a total R^2 of 9.60%.

Table 12.

Regression Model for Technology and Student Engagement

Independent Variables	Faculty Interactions (*N*=1843)		Social, Political, and Scientific Discussions (*N*=1824)		Diversity and Social Discussions (*N*=1826)	
	b	*B*	*b*	*B*	*b*	*B*
Gender	-.02	-.01	-.07*	-.05*	-.03	-.02
Race	-.06	-.04	-.05	-.04	-.26***	-.15***
Senior	.21***	.14***	.06	.04	-.12***	-.08***
Background Variables R^2		.02***		.06*		.03***
Gender	-.05	-.04	-.11***	-.09***	-.07	-.05*
Race	-.04	-.03	-.04	-.02	-.24***	-.14***
Senior	.17***	.12***	.03	.02	-.14***	-.10***
Used computer / word processor for a paper	-.02	-.03	.006	.005	.03	.02
Searched the Internet for course related material	.09***	.10***	.14***	.16***	.11***	.12***
Used email to communicate with class	.14***	.13***	.10***	.09***	.11***	.09***
Join In electronic class discussions	.11***	.18***	.08***	.14***	.09***	.13***
Change in R^2		.08***		.09***		.07***
R^2		.10***		.09***		.10***

*p<.05, **p<.01, ***p<.001

Three of the four technology variables are recognized as important with a small magnitude in percentage separation. The technology use variable with the highest effect is participation in electronic discussions (B = .13), followed by searching on the Internet (B = .12) and use of email (B = .09).

Summary of Effects on Student Engagement

When examining across all the student engagement variables, the findings are fairly consistent for the group of background variables. Overall, background variables explain 2.0% - 3.0% of student learning engagement. Contrary to expectations, the background variable of gender has a negative effect on all three of the engagement constructs, though significant only for one engagement construct (i.e., social, political, and scientific discussions). When exclusively examining race, the classification of being White has a slight negative effect on participation in diversity related engagement. Of the demographic variables, the classification of being a senior displays the strongest relationship in explaining student engagement.

With the addition of technology variables, each engagement construct shows a positive relationship, except for when it coincides with the variable of computer use. Overall, there is an R^2 change of 7% - 9% when students use technology to support learning. The use of the Internet for course related materials shows a positive relationship with all of the learning outcome variables. Email use also shows a moderately strong relationship in magnitude accompanied with students' search of the Internet for course related materials.

Summary

This chapter presents the findings of the regression analyses. The results show that the use of technology does make a significant contribution to student learning outcomes, above and beyond the contributive explanation of background variables. The R^2 change ranges from 3% to 9% in student learning and student engagement when technology is being used, illustrating small but significant effects. Student classification is a noteworthy background variable that displays a small but modest relationship in several models. Being a senior in college is relatively important in the explanation of student learning (i.e., general education, personal and social development, and intellectual gains) and engagement in learning (i.e., faculty interactions and discussions about diversity).

In the regression models on student learning outcomes, the use of technology contributes significantly to the explanation of student gains for each of the dependent variables. The same held true for the second research question on student engagement. Technology use in academic studies is associated with positive gains on each of the dependent variables. Variables that displayed the strongest effect on learning are student use of the Internet and their participation in electronic class discussions. The positive relationship is perhaps due with how the technology tools facilitate active participation in the learning process, whereas background variables only provide descriptive information not fully displaying characteristics that support student learning. The closes characteristic that signifies a trait related to learning potential is being a senior.

Noteworthy is that computer use did not contribute significantly to explanation in any of the models. Perhaps this has to due with how computers are used today. A word processor primarily serves as a tool for writing and editing. However, today's computer can be used for more sophisticated functions such as saving, retrieving, and exploring information. The term of word processor is almost obsolete in today's scientific world. If the scale listed only the term computer or specific computer features that support learning (e.g., interactive software with diagnostic assessment) it is highly plausible that the results would show significance.

The next chapter will discuss how the present findings compare with previous research, implications for practice and future research, followed by a conclusion inferred from the investigation.

Chapter V
Discussion and Implications

In this chapter, an overview of the study will be presented followed by a summary of the findings. The findings will be compared with and contrasted to previous findings in this area of research. The last section of the paper will discuss the implications of the findings in relations to future research and practice.

Overview of the Study

Many questions have been raised about the influence technology has on learning. This study addressed some of the questions raised by investigating the use of collaborative learning tools (i.e., use of email and electronic discussions) and computer assisted instruction (i.e., use of a computer and the Internet) and their impact on learning. Though previous research has been done in this area, many of the studies are considered to be flawed because of methodological and theoretical errors (Clark, 1983). This includes oversight by researchers' in their attempts to compare technology's influence on learning rather than how technology serves as a mean to advance instruction. As a result, this study has attempted to capture theoretical underpinnings of constructivism that suggest that students learn best when they create meaning out of their own learning environment. From the constructivist view, the use of Computer Mediated Conferencing (CMC) and Computer Assisted Instruction (CAI) is recognized as a resource to assist learners in the acquisition of acquiring knowledge through collaboration and discovery.

The basic premise of this study was to explore the effects of computer mediated conferencing tools and their impact on learning outcomes and student learning engagement. More specifically, this study examined if the use of technology contributed to learning above and beyond student background variables. For the analyses, undergraduate students were randomly sampled from a national database of colleges and universities that agreed to participate in the College Student Experience Questionnaire. There were a total of 87,855 participants in the national sample. Of these, 2000 were randomly drawn for the analysis in this study. The College Student Experience Questionnaire was available for completion in two formats—paper and web-based. For the purpose of this study, only participants who completed their survey via web were chosen because this population was likely to be enrolled in web-enhanced courses. The methodological technique of multiple regression was used to answer the proposed research questions:

(1) Do the frequency of online interaction and frequency and duration of technology use for academic work explain a significant amount of variance in student learning outcomes for undergraduate students?

2) Do the frequency of online interaction and frequency and duration of technology use for academic work explain a significant amount of variance in student engagement for undergraduate students?

Summary of Learning Outcome Findings

The researcher assumed that the frequency of technology use would explain learning outcomes and student engagement above and beyond student background characteristics. The findings show that this assumption held true; in fact, the use of technology tools explained nearly four times as much of student learning than background variables alone. However, the relative effect of technology on student learning gains is not as great as assumed. Nonetheless, the learning outcomes percentage gain of 3-9 percent does provide a modest explanation of the effects of technology on learning and engagement within the context of educational psychology.

In the area of learning cognition, there are many factors that influence student learning, including teacher/instruction related variables (Bradley, et al., 2002), student-related variables (Winteler, 1986), personal characteristics (Ting, 1998), learning styles (Dunn & Dunn, 1993), and environmental elements (Outcalt & Skewes-Cox, 2002). Yet, by most standards, the ability of learning tools and/or resources to contribute to learning suggests that the regression model on learning gains and student engagement indeed deserves some attention. The effectiveness of learning technology tools combined with traditional instruction have typically contributed moderately to the overall gains in learning (Cotton, 2001; Kekkonen-Moneta & Moneta, 2002).

Technology and Its Influence on Learning Outcomes

Collaborative Learning Tools

When taking into account only the use of collaborative learning tools (email and electronic discussion), the findings in this study showed each were effective in explaining gains in both learning outcomes (i.e., general education, personal and social development, intellectual growth, science and technology, and vocational gains) and student engagement (i.e., faculty interactions, diversity, social, political, and scientific discussions). It is fair to say that the utilization of collaborative learning tools does modestly support learners in their learning process, facilitating discussion, and interaction among students and faculty.

The use of electronic discussion boards allows students to become active participants that encourage both reflection and interaction (Warschauer, 1997). Previous research on collaborative learning reflects a moderate to strong relationship between various modes of collaboration and student performance (Kwok & Ma, 1999; Teague et al., 2000). Some of the possible explanations of why there is a positive association with the use of CMC and learning gains stems from the effectiveness and ease of use it. Specifically, CMC allows discussions to be easily transmitted, stored, archived, reevaluated, edited, and rewritten. In addition, students enjoy a level of comfort in sharing and discussing personal information that they may not in a face-to-face format, thus improving the overall quality of discourse (Hinkle, 2002; Yu, 2002).

The contribution by the type of media has not shown strong evidence to support one over the other, though there appears to be a slight favoring for email. However, the findings from this study record only one significant relationship in learning gains through the use of email, and it was specific to personal and social gains. Both Haworth (1999) and Woods (2002) found the use of email to have positive effects on student academic and social integration. Though the methodologies of their studies are different, Haworth investigated online students and the types of messages sent while Woods examined online students and the frequency of messages sent and they both showed email having moderate effects as a learning tool. The results of this study showed that the use of email is not as effective in explaining learning gains in comparison to the use of electronic discussions. However, the use of email is slightly more effective when explaining student engagement gains. Both email and electronic discussion boards are modes of asynchronous communication with similar user control features. The major difference between the two is that electronic discussion boards are centralized and controlled by the sender while email is decentralized--typically remotely located on the end users personal computer though still controlled by the sender.

The use of email is a favored communication tool for students who scored an average mean score of 3.74 on a 4 point scale on the instrument used for this study. This score indicates that students very often used this method of communication, whereas the use of electronic discussion boards had an average mean of 2.05, showing that students occasionally used this method. Although students' demonstrated a preference for email, it is possible that email is being used more for social than for academic reasons. Additional support for this notion stems from this study's findings that students who use email show significant gains in the area of personal and social development and did not show gains in any other learning outcome area besides relatively small gains in science and technology. Though not much of a conclusion can be drawn from this one finding, it does show a possible pattern. Therefore, additional research is warranted to determine why there may be effectiveness differences between these two modes of electronic communication when examining learning gains.

Computer Assisted Instruction

The other two modes of technology investigated are classified as CAI tools (i.e., use of the computer/ word processor and the Internet).The use of CAI allows learners to discover knowledge at their own pace, which is considered an exploratory form of learning. The Internet is one facet of this, allowing learners' to search, retrieve, and evaluate information as it is displayed and permitting users to be in control of their quest for information. Findings from this study reveal that the use of the Internet is a moderate contributor to student learning outcomes and is an effective variable in explaining learning gains. Searching the Internet has the greatest effect for three of the five learning constructs and is the second most important variable on two of the engagement constructs.

Though the effect size is moderate, the findings suggest that the use of Internet can be a somewhat effective tool in facilitating student learning. This finding is fairly consistent with other studies where the use of the Internet allowed exploratory learning to occur that improved student academic performance (Flowers & Zhang, 2003; Hu & Kuh, 2001; Kekkonen-Moneta & Moneta, 2002). Positive effects are likely associated with the ease of access and retrieval of educational resources on the Internet (Hu, 2001). As the quality of resources on the Internet becomes more abundant, it is likely that more positive learning gains may be seen.

It is somewhat surprising not to find a significant relationship between the variable of computer use and learning, particularly since it is the most popular learning tool of all the technology variables. The use of a computer for projects or reports yielded the highest mean score (3.83 on a 4.0 scale) out of all the technology resources, showing that computers are frequently used learning resources for students. The impact computers can have on learning is further supported by other studies which have found that computers aided students in their cognitive growth (Flowers et al., 2000; Henke, 1997; Simon, 2000).

The lack of effect of computer use on learning gains is likely due to the association of the terminology of a “word processor.” Because an independent variable is associated with “word processor” and carried with it the suggestion that it enables learners to write papers for classes, the definition itself likely affected the response in which students perceived how a computer is used. Students may use a word processor to write on topics such as politics and diversity, but not necessarily use it to interact with faculty and other students, thus engaging in learning related activities. Students may use a computer/word processing system to write papers and not necessarily use it as an interactive learning tool.

Some of the questions that measure learning outcomes revolve around the actions of search, retrieval, or interaction. The use of a computer does not necessarily provide an outlet for interaction unless particular software is adopted to facilitate this process. For example, one of the questions that measures general education gains asked students to rate their efforts in developing an understanding and enjoyment of art, music, and drama. If students associated a computer with word processing, then it would be difficult for them to develop an appreciation for the arts because word processors are not used for this function.

Quite the opposite is true for using the Internet. The Internet provides the capability to explore, view, and listen to files associated with the arts. A computer can have these same capabilities if the software permits. Because students may have associated the computer as just a word processing tool, the responses were likely distorted.

A second reason the use of a computer did not play a significant role could be a reflection of the instructional design, though this is a speculative assumption. This study was not designed to examine how the use of technology is being used as an instructional strategy; however, it is known that simply providing learners with hyperlinks to various websites will not yield productive results (Zhao, 1998). There must be an incorporation of instructional design principles, such as content and learner analyses to determine what students should know and be able to do with the information (Dick, Carey, & Carey, 2001). Therefore, if proper instructional guidelines are not applied, it is unlikely that any learning will result.

Demographical Influences on Student Learning

Race

Race was not a prevailing variable in the explanation of student learning or student engagement. There is only one construct in which race had an effect, though the effect was modest. In particular, there is a slight negative relationship associated with White students and their participation in diversity related discussions. This is somewhat surprising since many institutions have placed more emphasis on diversity than ever before. Some colleges even have a diversity department or have implemented a diversity curriculum. The implementation of such intervening strategies has helped to reduce the gap of student participation in cultural and diversity related activities. Though such initiatives have been implemented, there is still a need to further enhance such programs. As this study shows, White students are not participating as much in diversity related topics as one would believe.

It has been argued that socializing with nonwhite students, in and of itself, provides a positive experience for all students. Socializing across racial lines and participating in discussions of racial issues have both been shown in other studies to be associated with widespread beneficial effects on students' academic and personal development, regardless of race(Astin, 1993; Terenzini et al., 2001). Specifically, socializing with someone of a different racial group or discussing racial issues contributes to students' academic development, satisfaction with college, level of cultural awareness, and commitment to promoting racial understanding.

Moreover, these same environmental characteristics have also been shown to have positive impacts on student retention, overall college satisfaction, college GPA, intellectual self-confidence, and social self-confidence (Astin, 1993; Maxwell et al., 2003).. The use of electronic communication tools can help to remove some of the communication barriers often associated with face-to-face interaction when engaging in opinionated dialogue among races, thus encouraging more interaction. Though the effect did not show a positive relationship, it is plausible that the negative effects were reduced as a result of using electronic communication.

Gender

The classification of being a "female" reflected moderate gains in the area of student learning in this study. There was a positive association with females' gains in personal and social development, and a negative association with their gains in the areas of science and technology as well as in participation in social and political discussions. The findings suggest that females feel fairly comfortable discussing social matters but are less inclined to partake and learn in topics related to social, political, and scientific matters. A strong conclusion cannot be drawn because of the small effect size although the apparent pattern in the subject areas that appear to draw their interests is intriguing. In support of other studies, females typically have not faired as well in the science and technology areas, though there is not a large disparity in aptitude between females and males in this area (Flowers et al., 2000).

Recently, there have been focused efforts to attract and recruit more women into the traditionally male-dominated fields such as science, technology, engineering, and mathematics. Some say that women are not being counseled early enough to prepare them for careers as scientific or technological researchers, and those who are counseled into such fields are likely to be confronted with both intellectual and emotional pressures during their academic and professional track (Anderson & Miezitis, 1999; Mullen & Grant, 2000).

Another reason why females have not made greater strides in these areas has to do with the lack of collaborative opportunities with students and faculty. It has been cited that in male-dominated areas such as science and technology some faculty members treat men and women differently in the classroom, to the point where women feel ignored and devalued (Kirkup & Prummer, 1990). Overt examples of this sort of discriminatory treatment include: sexist comments or jokes, a tendency to call on male students while ignoring the females, more encouragement or praise for males, the use of higher standards to evaluate work submitted by female students, longer waiting periods, and more patience while waiting for males to formulate a verbal response. These kinds of behaviors may partially explain why women seem to participate less often than men during interactive classroom and online discussions that can adversely affect their learning participation and performance. To increase female learning gains in the areas of science and technology, instructors should consider using intervention methods such as mentoring or collaborative learning to help increase engagement by females in these subject areas.

Senior Students

The other background variable that is relatively important in explaining learning outcomes is matriculation in the senior year of study. Of the five learning constructs, senior status is modestly important for four of them (i.e., general education gains, personal and social development gains, intellectual gains, and vocational gains). In each case, senior status has the greatest effect in explaining outcome gains than any other background variable. On the engagement scale, there is a moderate relationship in the amount of time students' spent interacting with faculty.

Though few studies appear to have examined the relationship of academic classification in relation to a technology based learning environment, research is fairly consistent in traditional learning environments showing that seniors produce greater learning gains than lower ranked academic groups. However, there is not a large disparity after students have surpassed their sophomore year.

Some of the likely reasons why seniors have achieved greater learning gains relate directly to a more intense focus on their academics. Because seniors are closer to obtaining their degree, they become more motivated to do well as they prepare to enter into the workforce. Another tendency of seniors is to work more with classmates outside of class in their preparation for class assignments or in the discussion of ideas and readings. This group also is more likely to spend more time than freshmen and sophomores engaged in interaction with their instructors about academic related matters (Flowers, 2002). Senior student behaviors and motivation seem to carry over regardless of the contextual environment in which they learn.

Somewhat intriguing was to find a negative association with senior students and their participation in diversity and social related topics. This finding suggests that seniors showed slightly less of an effort to participate in diversity related discussions. Because seniors' are more focused on career and job related concerns, their interest to participate in such discussion may not have as much practical value to them. Though, few would argue against the inclusion and participation in diversity related matters as it is seen as a social skill that would only aid them as they prepare to enter into the workforce.

Another possible reason for the negative association with senior students and their participation in diversity related discussions may be attributed to external motivational factors. Obviously, students must show a desire and willingness to participate; however, just as important is external influences to encourage student participation. Though many institutions have recently implemented diversity initiatives, perhaps more should be done to encourage student participation. In this case, it may mean that college instructors need to do more to encourage their students to discuss diversity and social related issues or that institutions need do more to integrate diversity as part of the curriculum. Technology mode is unlikely to play a huge role unless there is an emphasis to have course related dialogue around this subject area.

Implications of the Study

The focus of this study is on the use of technology and its contribution to student learning and learning engagement. More instructors in traditional types of classrooms are using some form of technology to either instruct or guide learning activities. With limited resources and higher priorities to maintain quality instruction, it is important that faculty members understand the best uses of technology to improve learning. Therefore, this study attempted to unveil some of the underlining issues that affect learning through the use of CMC and CAI technology tools.

The use of technology in traditional classrooms has been growing at a rapid pace. Though many instructors are using various modes of technology to communicate with and instruct their learners, it is important to understand that these various modes affect student performance. This is a major concern because the cost of technology infrastructures continues to absorb an increasing percentage of institutional budgets. Therefore, this study is timely and has implications for both practice and research.

Implications for Future Practice

The findings of this study have three immediate implications for instructional practice. First, the findings reveal that the use of electronic communication and computer based resources provides complementary learning activities that aid the learning process. There is great interest and potential in web-based flexible learning with over 60 percent of instructors incorporating some form of technology as a part of their instruction (Green, 2000). While instructors are the focal point in most course settings, it should be noted that complementary learning activities are just as important for practice, if not more so.

Research has proven that most learning occurs outside of the classroom environment and is strongly correlated to academic effort effort (Kuh & Shouping, 2001; Pascarella & Terenzini, 1991). Technology based learning resources are important to support and complement what is being taught in the classroom. Teachers should utilize technology-based resources to help learners be creators of knowledge through information research and content evaluation. These types of skills assist learners to be critical explorers rather than passive observers.

Implications for Instructional Design

A second implication is that the learning environment should provide an authentic context that reflects the way knowledge will be used in real-life that preserves the full context of the situation, invites exploration, and allows for the natural complexity of the real world (Applefield et al., 2000; Gagné, 1985; Greening, 1998). The design should incorporate suitable examples from real-world situations to illustrate and capture the objectives of the task. Allowing learners to be within a practical context provides purpose and motivation for them and offers a sustained and complex learning environment that can be explored in-depth. Real life learning environments also provide authentic activities that are nonspecific in allowing students to find as well as to solve problems. A situated learning approach to the design has learners exploring a media resource with all the complexity and uncertainty of the real world. The learners then have a role in determining the task and how it might be broken up into smaller tasks, selecting which information is relevant, and finding a solution which suits their needs. The emphasis is not only on the real world tasks that exist in the learners' lives but also on metacognitive processes that afford a holistic view of the task (Burton, 1995; Ewing et al., 1999; Offir & Lev, 2000; Thornburg & Pea, 1991).

Implications for CMC Delivery

This research employed two regression equations, encompassing a diverse range of topics, illustrating that CMC learning can make use of 'conversational' exchanges to assist in achieving greater learning outcomes. With email and discussion boards being extremely flexible, these tools allow many arrangements of interactions to take place including, but not limited to, voice, text, graphics, and time. This study reveals that discussion boards were the best 'conversational' choice for producing higher learning outcomes; however, the use of email is seen to be just as effective on the engagement scale. Instructors have the opportunity to promote engagement in rich 'conversations' between student-to-student and faculty-to-student partnerships through the use of these tools. It is recommended that designers and teachers establish the best combinations through monitoring and evaluation of their practices.

Implications for Infrastructural Design

Before colleges or universities make major investments in the use of CMC or CAI infrastructures, the decision makers of these organizations should assess which types of technology will afford a collaborative and CAI combination. Faculty members and academic administrators should use the findings of this study to assess infrastructural formations that best suit their learners' needs. As the results of this study show, the employments of both methods were factors in the explanation of engagement. Therefore, it is warranted that administrators investigate platforms that incorporate a combination of both modes.

Implications for Future Research

There are many opportunities for new studies on computer and web-based learning utilizing the constructivist theory as a general guideline. However, for the purpose of this study, three specific opportunities will be discussed. First, other variables should be considered to advance the research in this area. Though finding good fitting prediction models was not the intention of this study, the models used herein had a relatively low R-square; that is, the independent variables and the control variables together only explained a small portion of the variances in learning outcomes and engagement activities. This relationship suggests that there might be other variables that have significant effects on learning and engagement that were are not included in the models used.

A second study to follow up on some unanswered questions regarding the definition of computer use would clarify any misconceptions between a word processor and computer. A computer serves an electronic device that can access, store, retrieve, and process data. More important, perhaps, is to the need to clarify the differences in a computer and the software that can be used to complete certain tasks. Today, there are thousands of programs that enable computers to design, store, and manipulate data in a manner that makes it easy for an individual to see them as one unit. It is very rare to purchase a computer without any preinstalled software. Therefore, a follow up study would clarify any definitions or terms to ensure that there is a direct correlation between computer use and the task it enables users to complete.

This study was a survey investigation offering a broad view on the contributions that CMC and CAI tools make to student learning. A third study involving the use of a content analysis would provide a more in-depth elaboration about why some tools, such as email, produce higher learning gains, their frequent use notwithstanding. One assumption is that email is the communication tool of choice, but not always used for learning. There may be more social interactions occurring that methods of this study are not equipped to assess. A follow up content analysis study would aid in determining if learners are engaging in higher social interactions by actually viewing learners' threaded discussions and emails. This procedure, in turn, may explain the difference in the use of email and electronic discussion learning performances.

A fourth study worth investigating is how the use of technology and learning style preference influences learning outcomes. A study such as this would aid in the selection of CMC and CAI technology tools based on learning style preference. A study such as this would provide additional insight on how students' best learn within certain environmental conditions. Understanding the affects of learning style preferences would assist instructors to better pair students in collaborative learning environments according to media preference. For example, if students learn best using graphical images linking to concepts to practice, then specific instructional strategies can be created to foster this type of learning environment.

Conclusion

The growth and use of technology in academia has changed the ways teachers teach and students learn. Traditional lectures are being supplemented with computer aided resources and computer aided communication. However, little is known how these tools aid in the learning process, if at all. Therefore, this study attempts to investigate if the use of CAI and CMC tools contributes to student learning. Constructivist theory was the framework to guide this study. Constructivists believe that students learn by making meaning and understanding from their environment and by being active participants in the learning process. The use of CMC and CAI allows users to become active participants in the learning process. Specifically, CMC allows collaborative learning to take place through the use of threaded discussions and email while CAI allows learners to become discoverers and examiners of knowledge through the use of computers and the Internet.

Utilizing the constructivist framework, this study attempted to examine if the use of CMC and CAI tools contributes to student learning outcomes and learning engagement activities, above and beyond student demographic variables. The findings from this study reveal that the use of CMC and CAI explain a statistically significant proportion of student learning. The use of threaded discussions contributed to learning in four of the learning outcomes variables (i.e., general education, personal and social development, intellectual gains, and vocational gains), while the use of email contributed to all of the engagement variables (i.e., faculty interactions, social, political, and scientific discussions). The use of CAI via Internet contributed to all of the learning outcomes and engagement scales.

The findings suggest that, in combination with traditional classroom teaching, the use of technology-based out-of-class instruction can provide a slightly richer learning environment. The use of CMC allows two-way interaction, asynchronously and synchronously, to take place and build upon in-class lecture notes and instruction while the use of CAI provides a richer media environment allowing the users to search, analyze, and create knowledge. Though these media formats can assist with enhancing students' learning environments, it is necessary to provide learners with a sense of direction. Therefore, in combining the use of technology tools with instructional design principles, it is conceivable that greater learning outcomes will be achieved.

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Appendix A

Sample CSEQ Invitation Letter

Dear Michael,

State University would like to know about your experiences as an undergraduate student. You are one of about 3000 students invited to complete "The College Student Experiences Questionnaire." What you tell us will help us improve our programs and services. Completing the survey will take only about 20-25 minutes.

Here is what to do:
Go to **www.cseq.org** to access the survey.
In the Login ID box, please type **$LOGIN_ID.**
If you have any difficulty logging in, please email localadministrator@state.edu for assistance.

Your participation in this survey is voluntary. The information collected will be absolutely confidential, and no references to individual data will be made in any written or oral reports. If you have questions about the study or about your rights as a participant in this survey, please contact Local Administrator at (123) 456-7890.

Thanks in advance for your help. We look forward to using your input to make constructive changes to improve the undergraduate experience at Wake Forest!

Sincerely,

Local Administrator
Dean of Students

Appendix B

Sample CSEQ Reminder Letter

Dear Student,

This is a reminder notice requesting your participation in the CSEQ survey. State University would like to know about your experiences as an undergraduate student. You are one of about 3000 students invited to complete "The College Student Experiences Questionnaire." What you tell us will help us improve our programs and services. Completing the survey will take only about 20-25 minutes.

Here is what to do:
Go to **www.cseq.org** to access the survey.
In the Login ID box, please type **$LOGIN_ID.**
If you have any difficulty logging in, please email localadministrator@state.edu for assistance.

Your participation in this survey is voluntary. The information collected will be absolutely confidential, and no references to individual data will be made in any written or oral reports. If you have questions about the study or about your rights as a participant in this survey, please contact Local Administrator at (123) 456-7890.

Thanks in advance for your help. We look forward to using your input to make constructive changes to improve the undergraduate experience at Wake Forest!

Sincerely,

Local Administrator
Dean of Students

Appendix C

In the data analysis, inter-item correlations were conducted on the independent and dependent variables. The results showed that there were significant correlations among the variables for each of the scales ($p<.05$). Correlations for the dependent variables were conducted first. The first group of correlations measured learning outcomes, a total of 5 in all.

General education outcomes were measured with all of the items reporting statistical significance. The correlations were moderately related with gains in knowledge about the world and awareness of other philosophies rated the highest ($r =.569$). The scale related to vocational preparation showed the lowest correlations score with gains in knowledge about the world and gains in vocational preparations reporting a modest but significant correlation ($r= .091$).

General Education Learning Outcomes Correlations (N= 2000)

	Gain: Vocational preparation	Gain: Skills for professional career	Gain: Broad general education	Gain: Enjoyment of art, music, drama	Gain: Acquaintance with literature	Gain: Understandi ng history	Gain: Knowledge about world	Gain: Awareness of other philosophies
Gain: Vocational preparation	1.00							
Gain: Skills for professional career	.518**	1.00						
Gain: Broad general education	.199**	.358**	1.00					
Gain: Enjoyment of art, music, drama	.189**	.180**	.263**	1.00				
Gain: Acquaintance with literature	.157**	.214**	.336**	.527**	1.00			
Gain: Understanding history	.117**	.221**	.366**	.326**	.506**	1.00		
Gain: Knowledge about world	.091**	.239**	.398**	.337**	.417**	.554**	1.00	
Gain: Awareness of other philosophies	.148**	.283**	.417**	.337**	.392**	.430**	.569**	1.00

** p< .01

The second correlation measured learning outcomes related to intellectual skills. All of the correlations were statically significant. The r-square values ranged from 24% - 50%, indicating a sound relationship among the scale items. The items of thinking analytically and synthesizing ideas reported the highest correlation ($r = .622$).

Intellection Skills and Learning Outcomes Correlations (N= 2000)

	Gain: Writing effectively	Gain: Speaking effectively	Gain: Using computers, other info tech	Gain: Personal health habits and fitness	Gain: Thinking analytically	Gain: Synthesizing ideas	Gain: Learning on one's own
Gain: Writing effectively	1.00						
Gain: Speaking effectively	.608**	1.00					
Gain: Using computers, other info tech	.308**	.381**	1.00				
Gain: Personal health habits and fitness	.228**	.281**	.299**	1.00			
Gain: Thinking analytically	.390**	.404**	.307**	.260**	1.00		
Gain: Synthesizing ideas	.418**	.436**	.295**	.253**	.622**	1.00	
Gain: Learning on one's own	.407**	.457**	.301**	.291**	.484**	.607**	1.00

** p< .01

The third correlation showed a positive relationship among the scale items on personal and social development. The r - values ranged from 38% - 64%, indicating a moderately strong relationship. Students' ability to function as team members and their ability to get along with others showed the strongest relationship (r. =64).

Personal and Social Development Learning Outcomes Correlations (N= 2000)

	Gain: Values and ethical standards	Gain: Understanding self	Gain: Getting along with others	Gain: Functioning as a team member	Gain: Adapting to change
Gain: Values and ethical standards	1.00				
Gain: Understanding self	.535**	1.00			
Gain: Getting along with others	.468**	.593**	1.00		
Gain: Functioning as a team member	.384**	.465**	.638**	1.00	
Gain: Adapting to change	.428**	.457**	.467**	.412**	1.00

** p< .01

The fourth correlation showed a high positive relationship among all the variables listed on the science and technology scale. The correlations were all significant. The r - values ranged from 56% - 80%, signifying a strong relationship. The strongest relationship was between the understanding of science and technology (r. = 80) while the smallest relationship was between analyzing quantitative problems and understanding the consequences of science and technology (r. =56).

Knowledge Learned in Science and Technology and Learning Outcomes Correlations (N= 2000)

	Gain: Understanding science	Gain: Understanding new technology	Gain: Consequences of science, tech.	Gain: Analyzing quantitative problems
Gain: Understanding science	1.00			
Gain: Understanding new technology	.804**	1.00		
Gain: Consequences of science, tech.	.671**	.730**	1.00	
Gain: Analyzing quantitative problems	.582**	.604**	.561**	1.00

** p< .01

The fifth correlation showed a positive relationship among all the variables in the vocational and preparation scale. The r - values ranged from 52% – 57%, demonstrating a fairly strong relationship. Gains in career information and vocational preparation showed the highest correlation ($r=.52$). All the variables were significant ($p<.05$).

Correlations for Learning Outcomes Associated with Vocational Preparation (N= 2000)

	Gain: Vocational preparation	Gain: Skills for professional career	Gain: Career information
Gain: Vocational preparation	1.00		
Gain: Skills for professional career	.518**	1.00	
Gain: Career information	.571**	.546**	1.00

** p< .01

The next group of correlations examined the relationships of the variables related to learning engagement. There were three composite scales that were measured, which included: faculty interactions, social, political and scientific discussions, and diversity and social interactions. The first set of engagement correlations measured the variables related to faculty interactions. The r-values for this scaled ranged from 28% - 66% with the majority falling between the 40% – upper 50%, indicating a positive and fairly strong relationship. The variables which signified the strongest relationships were between students asking their instructors for course information and students discussing their academic program with their instructors (r=.66).

Correlations for Faculty Interaction (N= 2000)

	Asked instructor for course information	Discussed academic program with faculty	Discussed term paper with faculty	Discussed career plans with faculty	Worked harder due to instructor feedback	Socialized with faculty outside of class	Discussed with others outside of class	Asked instructor about performance	Worked to meet faculty expectations	Worked with faculty member on research
Asked instructor for course information	1.00									
Discussed academic program with faculty	.663**	1.00								
Discussed term paper with faculty	.599**	.615**	1.00							
Discussed career plans with faculty	.549**	.650**	.579**	1.00						
Worked harder due to instructor feedback	.539**	.524**	.547**	.557**	1.00					
Socialized with faculty outside of class	.373**	.413**	.421**	.477**	.338**	1.00				
Discussed with others outside of class	.420**	.455**	.460**	.492**	.421**	.620**	1.00			
Asked instructor about performance	.527**	.556**	.583**	.546**	.549**	.480**	.576**	1.00		
Worked to meet faculty expectations	.434**	.429**	.442**	.431**	.547**	.317**	.418**	.530**	1.00	
Worked with faculty member on research	.282**	.323**	.386**	.411**	.309**	.445**	.431**	.400**	.305**	1.00

** $p < .01$

The second correlation on student engagement measured the relationships of student discussions related to social, political, and scientific matters. The r-values ranged from the 21% - 65%, indicating a moderate to strong relationship. Discussion topics involving current events and social issues showed the strongest relationships ($r = .65$), while discussion topics related to social issues and technology exhibited the lowest relationship ($r = .21$). All the items reported statistically were significant ($p < .01$).

Correlations for Social, Political, and Scientific Discussions (N= 2000)

	Topic: Current events in the news	Topic: Social issues--peace, justice, etc	Topic: Different lifestyles, etc.	Topic: Ideas of writers, etc.	Topic: The arts--painting, poetry, etc.	Topic: Science--theories, etc.	Topic: Computers and other technologies	Topic: Social/ethical issues re: science	Topic: The economy--employment, etc.	Topic: International relations
Topic: Current events in the news	1.00									
Topic: Social issues--peace, justice, etc	.648**	1.00								
Topic: Different lifestyles, etc.	.477**	.651**	1.00							
Topic: Ideas of writers, etc.	.403**	.542**	.586**	1.00						
Topic: The arts--painting, poetry, etc.	.281**	.367**	.415**	.517**	1.00					
Topic: Science--theories, etc.	.238**	.257**	.270**	.354**	.269**	1.00				
Topic: Computers and other technologies	.248**	.212**	.249**	.266**	.235**	.512**	1.00			
Topic: Social/ethical issues re: science	.391**	.488**	.426**	.467**	.300**	.457**	.364**	1.00		
Topic: The economy--employment, etc.	.500**	.504**	.447**	.470**	.249**	.249**	.351**	.533**	1.00	
Topic: International relations	.585**	.618**	.509**	.513**	.319**	.261**	.252**	.532**	.636**	1.00

** p< .01

The last correlation involving student engagement measured students' discussions involving diversity and social topics. The r-values showed a positive and strong relationship among the variables within the composite scales, ranging from 28% – 74% with the majority falling in between the 30% - 50% range. The variables that showed the strongest relationship were between students becoming acquainted with others from different countries and having discussions with students from dissimilar nationalities (r =. 74), while the lowest relationships were between students having discussions with students from other countries and becoming acquainted with students of different ages (r = .28).

Correlations for Social and Diversity Discussions (N= 2000)

	Acquainted: students of diff. interests	Acquainted: students of diff. background	Acquainted: students of diff. age	Acquainted: students of diff. race	Acquainted: students from other country	Discussions: students of diff. values	Discussions: students of diff. political	Discussions: students of diff. religious	Discussions: students of diff. race	Discussions: students of diff. country
Acquainted: students of diff. interests	1									
Acquainted: students of diff. background	.709**	1								
Acquainted: students of diff. age	.522**	.561**	1							
Acquainted: students of diff. race	.564**	.650**	.485**	1						
Acquainted: students from other country	.454**	.495**	.334**	.606**	1					
Discussions: students of diff. values	.509**	.509**	.416**	.479**	.435**	1				
Discussions: students of diff. political	.417**	.409**	.371**	.359**	.334**	.710**	1			
Discussions: students of diff. religious	.448**	.460**	.361**	.428**	.394**	.706**	.656**	1		
Discussions: students of diff. race	.492**	.515**	.360**	.650**	.535**	.633**	.561**	.628**	1	
Discussions: students of diff. country	.409**	.424**	.288**	.491**	.737**	.536**	.487**	.528**	.690**	1

** p< .01