

Blogging: An Inquiry into the Efficacy of a Web-based Technology
for Student Reflection in Community College Computer Science Programs

by
Jane W. Perschbach

A dissertation submitted in partial fulfillment of the requirements
for the degree of Doctor of Philosophy

Graduate School of Computer and Information Sciences
Nova Southeastern University

2006

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Nova Southeastern University

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An Abstract of a Dissertation Submitted to Nova Southeastern University
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January 2006

Reflection in learning is a pedagogical technique used to promote the higher order cognitive skills of analysis, synthesis, and evaluation that constitute the concept of critical thinking. To foster reflection in learning, the Internet technology of online journals known as blogs was employed in a two-semester, four-course investigation of the efficacy of this educational technology for vocational computer science students in a community college. The process involved an instructor-designed and maintained course blog containing suggestions for student reflection as well as hyperlinks to individual student peer blogs. Students were required to read both the course and peer blogs, and to contribute to a personal reflective blog.

The methodology used for the research was an exploratory hybrid of quantitative and qualitative techniques using three instruments: a survey of student demographics, a reflective essay, and the body of blog postings. A content analysis of key words and phrases culled from the postings and essays was computer generated. Descriptive statistical analysis of the frequency and duration of blogging evolved into an author-defined classification of emergent student blogger types.

The primary goal of the investigation was an exploration of any resultant evidence of student critical thinking and a subsequent evaluation of the emergent blogging technology in providing a mechanism for reflection. Paralleling the dual private and public nature of blogging, research by Henri (1991) and Garrison (2001, 1992) benchmarked the collaborative or public nature of the technology while Bloom's taxonomy (1956) served as the standard for measuring individual critical thought. The results indicated that the uniqueness of blogging technology effectively recorded critical thinking and furthermore provided the learner with a personal voice that created a sense of ownership of ideas, active participation and empowerment in personal learning, and a contribution to the collaborative learning effort.

Through the use of learner-centric critical reflection on experiential, explorative, and social learning events, learning changed from a passive, static accumulation of teacher-centric facts and skills to an engaged, dynamic comprehension of concepts by the learner. The exploratory investigation incorporated technology with learning as both an individual learning mechanism, and as a collaborative repository for course enrichment.

Acknowledgments

This has been a decades-long journey of discovery in my own learning process. As a student I learned from the gentle nuns of my earliest education to the scholarly professors of graduate school. I am particularly grateful to my dissertation committee, Dr. Steven Terrell and Dr. Laurie Dringus, and especially honored by the guidance so generously given to me by my dissertation advisor, Dr. Trudy Abramson. As a teacher I gained knowledge and insight from the determined, talented, and fearless students in every class and the dedicated faculty who taught with me. As a daughter, I am forever grateful to my wonderful parents, especially my mother who witnessed my start in the program, but passed away before she could see me finish. As a parent I learned the unvarnished meaning of multitasking. During the years of the doctoral program, I saw all three of my children marry and continue their own journeys of discovery. Most importantly as a wife, I experienced the comfort of continuous encouragement, the joy of shared triumphs, and the peace of unfailing loyalty. It is to my husband Peter that I dedicate this work.

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Chapter 1

Introduction

Background

Reflection in learning is a pedagogical technique used to promote the higher order cognitive skills of analysis, synthesis, and evaluation that constitute the concept of critical thinking (Brockbank & McGill, 1998). Historically, it has been an effective strategy in higher education, although its use has been restricted to the academic, rather than vocational, fields. Recently, the trend to consider higher order critical thinking skills in post-secondary education has exerted an influence on all levels of educational institutions including two-year community colleges. Since the 1990s, instructional priorities in community colleges have been moving away from the historical separation of vocational and academic courses (Prentice, 2001; Rojewski, 2002). Prior to that time, vocational programs were designed solely as preparation for work (Badway & Grubb, 1997). This contrasted with the purpose of academic courses as an entry to the baccalaureate (Dare, 2001).

Despite the current trend to address the learning needs of all its diverse student population, higher education computer science courses at the community college level continue to perpetuate the bifurcation of purpose by offering a series of independent, hands-on vocational classes where there is minimal emphasis on the learner-centered, constructivist environment (Ben-Ari, 2001; Gokhale, 1997) that is prevalent in the academic side of the institution. The use of new technologies, such as the convenient,

immediate online tool of weblogs, or “blogs” for personal publishing, can facilitate a learner’s reflective critical thinking through a nearly transparent use of the Internet to publish relevant student work for self-reflection as well as for peer consideration.

The mechanism for reflective journaling in the research effort was a self-publishing web-journaling program, or blog. Students accessed the blogs through any Internet connected computer. For the summer 2004 semester, 28 students from an Introduction to the Internet class and an Operating Systems class participated in the blog case study. In the following fall 2004 semester, 39 students in an Introduction to the Internet class and a Fundamentals of Networking course participated. Each of these classes has a prerequisite of eight semester hours in computer science courses. Therefore, all members of the studied population had a similar basic level of computer literacy and competency although as community college vocational students, these individuals possessed a disparate set of educational qualifications, life skills, and work experiences not found in the traditional university undergraduates.

Problem Statement

An introduction to the field of computer science must extend beyond the surface learning (Newman, Webb, & Cochrane, 1995) of basic terminology recognition and sequencing of primitive steps (Reichgelt, Zhang, & Price, 2002; Stein, 2001; Tucker 1996). The community college vocational student, in particular, needs a conceptual understanding of the functions and theories of computer science (Phelps, Ellis, & Hase, 2001; Gal-Ezer & Harel, 1998; Warren, 2003) and the critical thinking aspects of information technology as nationally codified in the 1991 Secretary of Labor’s Commission on Achieving Necessary Skills (SCANS). The knowledge facilitates the

vital problem-solving skills that are valued by employers in the rapidly changing information technology field (Roman, 2001; Stein, 1996).

As the evolution in teaching computer science progresses toward incorporating the use of the higher level thinking skills (Herschbach, 1998; Reichgelt et al., 2002), textbooks and other instructional ancillaries lag behind by containing a preponderance of factual and motor-based skill exercises that test the retention of facts, the comprehension of terminology, and the application of syntax and other procedures (Stahl, 1987). In contrast, critical thinking is a higher-ordered skill involving the analysis of current and past events or concepts; the synthesis of elements of those events or concepts; and the evaluation of arguments (Astleitner, 2002) that might consist of opposing or even conflicting concepts or processes. One means of providing a platform for a personal review of critical thinking is reflective journaling (Fisher, 2001; Garrison, 1992). Furthermore, Newman et al. (1995) contend that a clear link exists between critical thinking and social interaction. The use of publicly accessible reflective journals creates a collaborative environment potentially conducive to the interaction of social learning.

Goal Statement

The goal of the investigation was to use blogging technology for student reflective learning. Evidence of effective use was defined as an observable change in student reporting from the lower cognitive skills of knowledge, comprehension, and application to the higher order skills of analysis, synthesis, and evaluation according to Bloom's taxonomy (1956). Through the use of learner-centric critical reflection on experiential, explorative, and social learning events, learning changed from a passive, static accumulation of teacher-centric facts and skills to an engaged, dynamic comprehension

of concepts by the learner. The goal focused on the use of the relatively new Internet technology of weblogging, which is commonly contracted to the term, blogging. It specifically examined how the unique characteristics of blogs, as both a personal journal and a public forum, influenced student learning.

Three instruments were used for data collection: (a) the collection of student blog postings, (b) demographic data from an author-created student survey; and (c) a reflective essay. The survey and essay were combined during an in-class exercise termed a “blogathon” that took place during the 10th week of each semester. By identifying the specific variables of frequency and interaction of blog postings throughout the duration of the two semester case study, data were collected for quantitative analysis. Qualitative data emerged from computerized content analysis of blog and blogathon essay comments. The resulting data were collected and codified in multiple ways to reflect the dual private and public nature of blogs. Using the five dimensions of computer mediated communication classified by Henri (1991) the public, collaborative, and social nature of blogging were investigated. Furthermore, Garrison’s (1992) five stages of critical thinking exhibited evidence of critical thinking that was identified in the blog postings.

A system of multi-method triangulation was employed to interpret the data, including a computer generated content analysis to identify keywords in context (KWIC) (Krippendorff, 2004; Neuendorf, 2002) and a simplified cluster analysis of author-defined blogger types to further extract general concepts that emerged from the inductive study. Triangulation is a form of validation for qualitative research. It can be employed in various ways including the use of multiple methods of data analysis; the use of multiple investigators; and the comparison of multiple sources of data involving

participants, time periods, and locations (Denizin (1978) in Gay & Arasian, 2000). Neuendorf (2002) advocates the use of multiple methods of data analysis such as surveys and experiments to improve the generalizability or external validity of qualitative research. Furthermore, researchers assume that biases inherent in a single data method will be countered balanced by using more than one method to analyze the same data for (a) a convergence of results, (b) a discovery of overlapping and complementary elements, (c) an explanation of contradictory perspectives, and (d) an increased scope to the investigation (Creswell, 1994).

The investigation relied on the work of established theorists of Bloom (1956), Petress (2004), Henri (1991), and Garrison (1992, 2001) to provide the core concepts of higher level reasoning. Computer software was used by a single rater to identify instances of critical thinking (WordSTAT ®) and to analyze the data according to these theories (QDA Miner ®).

Research Questions

Students blogging throughout the course of a semester participated by writing personal reflective comments on a public forum. Evaluation of the efficacy of the new technology included both its personal reflective nature, and its publicly social collaboration capabilities.

The investigation planned: (a) to identify instances of critical thinking by vocational computer science students as a demonstrated in their frequent and persistent use of the journaling mechanism of Internet blogging as a reflective tool, and (b) to

determine the effectiveness of the unique technology in their learning process as it was perceived by the students.

The investigation was guided by four major research questions:

1. What was the observable outcome, specifically related to evidence of reflective critical thinking in student learning, that was uniquely attributable to the technology of blogging?
2. How did the use of blogging technology facilitate student collaboration to provide a viable forum for social learning?
3. On an individual level, how did the use of blogging technology encourage and document the progression of student critical thinking?
4. What elements of blogging did students report provided motive to continue the reflective journaling process in future courses? As a subset of the research question, patterns were sought to see if student perceptions and behaviors could be codified into types of bloggers.

Relevance

Blogging, a relatively new concept that provides a platform for publishing publicly accessible personal journals, is becoming a mainstream Internet technology (Gates, 2004) with multiple projects in new research focusing on educational uses of blogging (Wrede, 2003; Downes, 2004; Williams & Jacobs, 2004; Fiedler, 2003b). The term “blog” is a contraction derived from the words “web” and “log” that describes both an online technology as well as a process. Its origins have been traced to 1997 when the authors of traditional web sites began linking to other sites with similar interests. The trend toward linking to commonalities of content available in remote sites grew until

1999, when software companies launched web-based tools to provide Internet based programs and sites for creating and hosting weblogs or “blogs” (Blood, 2000; Stauffer, 2002).

As a technology, blogging characterizes both the process of publicly publishing over the Internet as well as the software needed to create a blog. The blog is a web-enabled format for online personal publishing that has been defined as a website with public diary entries in reverse chronological order, created by an identified author (Siemens, 2003; Knollenberg, 2002; Paquet, 2002). Another defining characteristic of a blog is the expected use of hyperlinks. By linking to other electronic journals or online sites, a blog creates a common repository of knowledge for its blogging community.

Blood (2000) defines web log publishing as writing for a participatory public as opposed to the established media, which writes for a passive audience. Although other, older online technologies, such as bulletin boards, threaded discussions, automated emailing services known as LISTSERVs, and conference portals have been studied as platforms for collaboration (Jeong, 2001; Schrire, 2002; Rose, 2002; Abdullah, 1999; Medley, 2001; Fairholme, Dougiamas, & Dreher, 2000), web journaling is a relatively recent technology whose nature was examined to identify any unique elements in its design, use, and function that contribute to learning (Nilsson, 2003; Wrede, 2003).

The infusion of technology for the purposes of fostering student learning has increasingly been the subject of educational research (Kuiper, 2002; Fiedler, 2003b; Wepner, Ziomek, & Tao, 2003; Wrede, 2003). Furthermore, computer technology is a rapidly evolving field, requiring the computer science student to cope with constant

change. Indeed, Tapscott (1998), Brown (2000), and Prensky (2001) concluded that there is a student expectation of current technology use in education. As new elements of online capabilities provide a digital means of personal knowledge publication, the computer science student who concentrates on computerized methods, should accept and participate in the innovation in learning strategy. However, Altun (2003) indicates that students vary in experience, attitude, and skills in their reading comprehension of hypertext, and require preliminary instructions in the technology that must be carefully structured to minimize its potential for disorientation through non-linear information.

By studying blogging innovations in technology, the community college computer science faculty were encouraged to design and include constructivist, reflective, critical thinking components in their courses that are currently lacking in the existing curriculum. Community college computer science programs limit student learning when they fail to go beyond the teaching of immediate hands-on skills. The evaluation of student reflections of critical thinking in the learning methodology (Phelps et al, 2001; SCANS, 1991) was an outcome of the research. Specifically, the study investigated the efficacy of online journaling in fostering reflective critical thinking. It sought to locate patterns of effectiveness and uniqueness of blogging as both a self-reflective and collaborative aggregate resource in the computer science programs.

Reflection, as recorded in a permanent journal, documents the learner's discovery in the learning process. In an interest to supplement the available resources with current technology, the study investigated observable incidents of critical thinking both manifest and latent in student learning that could be identified as a result of the use of a web-journaling application program to implement and enhance the higher order skills of

analysis, synthesis, and evaluation (Bloom, 1956). Recently, educators have proposed that these critical thinking skills extend beyond the subject taught into a transforming learning process that is influenced by prior knowledge (Dochy, DeRijdt, & Dyck, 2002). Such cumulative benefits of learning can be documented in a reflective journal.

The basis of reflection as a means of learning has its roots in constructivist theory as advanced by Piaget (1896-1980) who promoted the concept of abstract symbolic reasoning (Piaget, Gruber, & Voneche, 1995; Maypole & Davies, 2001). Schon (1983; 1987) advocated reflection as a problem solving technique, valuable in the professions including those in the information technology field. The concept has been extrapolated to the problem-solving requirements expected of a vocational computer science graduate. Piaget's contemporary, Vygotsky (1896-1934), regarded social interaction as the primary source of cognition (Ormrod, 1995; White, 2002). These philosophies and their derivations evolved into the contemporary educational concept of collaborative learning through communities of practice (Wenger, 1998). The study focused both on finding further evidence in the field of constructivist collaborative learning as a transformational, cognitive, and social process as well as on identifying incidents of personal reflection that demonstrated both manifest and latent indicators of individual critical thinking.

Current research indicates that although the relatively new adoption of blogging in higher education made this is a unique investigation, similar studies have been conducted on elements involved in the research. Robertson (2000) used computer technology for collaborative student research to examine the critical thinking curriculum model (CTCM). While Robertson's work involved secondary school students, its conclusion that CTCM increased content understanding and problem solving skills to

affect critical thinking was extrapolated to the community college environment (Boroni, Goosey, Grinder, & Ross, 1998). Reed (2001) used content analysis methodology to investigate community college student perceptions of online courses, a factor in the study.

Acknowledging the benefits of reflection in learning, a 2000 Australian investigation evaluated the efficacy of online journals in stimulating reflective thinking (Fairholme, Dougiamas, & Dreher, 2000). Within two years, the technique of reflective journaling had been applied specifically to computer science programs as a rationale for developing the generic skills of problem solving, communication, and technical currency in the information field that is replicated in the computer industry (George, 2002).

Parsons (2000) addressed the use of technology-enabled reflection in distance education. She recommended promoting critical thinking through student reflection. Hyman (2003) chronicled LISTSERV technology and its impact on scholarly discourse and research. Similarly, Johnson, Bishop, Holt, Stirling, and Zane (2001) evaluated student knowledge construction and collaboration in a web-delivered course using content analysis on the web-conference postings, while Schrire (2002) examined learning interactions evidenced in asynchronous online conferencing, an analogous, yet distinct, technology.

Barriers and Issues

Although a large body of research on the efficacy of self-reflection in learning exists, the relative newness of blogging technology limited prior investigations of the impact of the Internet tool on student learning. Through a qualitative analysis of content

and quantitative analysis of activity, blogging was interpreted as effective by identification of incidents of critical thinking and perceived student value as recorded in the required student evaluative essay and its associated survey.

A conspicuous limitation to the validity of the study may be the personal characteristics of gender and age. Peterson (2001) indicated that women are more inclined to benefit and participate in reflective journaling than men. In the fall 2003 semester, approximately 54% of the students in these classes were women (Thomas, 2004). Age also is more variable in the community college classroom than in traditional colleges whose population ranges from 18 to 22-year old students. In fall 2003, approximately 50% of the students in these courses were older than 25 (Thomas, 2004). However, the study concentrated only on the community college computer science student; the variance in ages will not be considered as a factor since these percentages are typical of the overall community college statistics.

Change itself can be an obstacle. Both research literature (Underwood, 2003; Sapp & Crabtree, 2002; Speck, 2002; and Kynigos & Theodossopoulou, 2001) and personal observation by the author in past semesters, indicate that some students resist all attempts at collaborative learning efforts from team projects to participation in class discussions. Peer learning through interactive team work also has been studied as a factor in student thinking, as has the shift toward the value of individual expression, rather than instructor-directed learning (DeLisi, 2002). The Internet-accessible blog is both a mechanism for recording individual student thoughts as well as peer reaction to those thoughts. Recent innovations in education indicate a growing acceptance toward

the use of web logs in the process (Fiedler, 2003a) and the need to design an instructional site to augment student learning (Moallem, 2001).

The selection of blogging software was critical toward the success of the study. By specifying the publicly hosted Blogger (<http://www.blogger.com>) software, a consistency in blogging procedures and technology learning level was achieved for all students. Blogger has the advantage of providing free, Internet hosting for all blogs that made the technology available to all students whenever and wherever they had Internet connectivity.

Limitations and Delimitations

The exploration of blogging as a mechanism for reflection was confined to sixty seven students in four courses who participated in the investigation which lasted for ten weeks in two consecutive semesters. The gender, age, and inclination to participate in an atypical instructional innovation were factors in each student's perception of the blogging experience. Of the total population, 38 were males, and 29 females.

Table 1 (Population by Gender) shows the population with gender demographics for each semester. Gender was recorded in the database as a link to the student identification. The influence of gender on reflective journaling will be discussed in the conclusion of the report.

Table 1: Population by Gender

Population	Gender	Percentage
Male	38	57%
Female	29	43%
Total over two semesters	67	
Gender by Semester		
Summer 2004		
Total Summer Population		
Summer male	19	68%
Summer female	9	32%
Fall 2004		
Total Fall Population		
Fall male	19	49%
Fall female	20	51%
Total Population	67	

The undertaken investigation was confined to the four courses delivered over two consecutive semesters. In the instructor designed and maintained course blog, a major adjustment was the appearance of comments. Blog technology can be configured to incorporate reader comments within each blog. Although this is a convenience for the blog reader that provides a continuity of the topic, any data from the capability was deliberately omitted from the investigation. For the purpose of isolating interaction, blogging frequency, and content, only the data from individual student blogs were tracked.

Several factors limited the research. The investigation was limited to the participating classes. As an exploratory examination, no attempt was made at quantitative sampling. The unique cases of individual students and variables concerning messages and conditions made this a qualitative investigation. Strauss and Corbin (1998)

state that qualitative research result in findings that are basically interpretative. These findings, while not generated through traditional quantification, can be statistically analyzed as a means of quantifying qualitative data. Qualitative methods are commonly used to explore the nature of personal experiences, including thoughts and emotions that are difficult to extract from quantitative data.

Additionally, the data were compiled, analyzed, and interpreted by a single rater who served also as the participating instructor. The delimitation of the active and multiple roles of the researcher are discussed in the methodology section. The ultimate goal of the qualitative procedure was to discover emerging characteristics of blogging technology in computer science education relative to student reported incidents that may not be generalizable to greater populations and could be interpreted differently by other researchers.

Definition of Terms

A *blog* is defined as an Internet website traditionally containing personal commentary in descending chronological order with hyperlinks to other web sites. The term *blog* is also used as a verb meaning the action of writing a blog (Blood, 2002; Doctorow, Dornfest, Johnson, Powers, Trott, & Trott, 2002).

A *blogger* is the accepted term of an individual who self-publishes a blog (Blood, 2002). *Blogger* is also the name of the blog creating software program (<http://www.blogger.com>) that was used in the investigation.

The *blogosphere* is a newly coined term to define the population of bloggers on the Internet. In January 2005 the Pew Internet and American Life Project estimated the

number of American bloggers was in excess of eight million, with an additional four million who read, but did not create blogs (Rainie, 2005). Statistics for the world-wide blogosphere are more difficult to define, but Technorati, a technology watch site at <http://www.technorati.com/>, estimates that the number of blogs on the global Internet doubles every five months (Technorati, 2005).

The term *host* as a verb means to contain the data and/or computer programs. As a noun, it identifies the network server containing the data (<http://www.webopedia.com>).

The *hyperlink* is a defining technology of the World Wide Web. This is a term for the text or image on a webpage that automatically opens a referred site when selected by the mouse. Traditionally hyperlinks are displayed on the browser screen as underlined text (Fiedler, 2003b).

The term *LISTSERV*, described as an automated distribution of electronic mail, is used both to describe the software and to identify the mail distribution service. *LISTSERV* is also a user name on some computers that process automated mail distributions. As a precursor to blogging, the *LISTSERV* technology, developed in 1985, was one of the first Internet technologies that allowed individuals to publish to a global audience (<http://www.lsoft.com/products/default.asp?item=listserv-history>).

The *schema* refers to the structure of a database, including the fields and tables that create the relationships (<http://webopedia.com/TERM/s/schema.html>). For the purposes of the investigation, the term was interchangeable with the data coding dictionary or concordance included in the content analysis software to codify keywords

and phrases that resulted in an interpretation of the large amount of data generated through student blogs and essays.

Linking of blogs is a major feature of the technology. The connectivity is accomplished through a variety of functions, including the *permalink*, the *trackback*, and *syndication*.

Within a blog, many authors use a *permalink* that is defined as the permanent location of the specific blog post. This feature counters the volatility of blogging by creating a specific site that may be referenced by others, rather than simply providing a reference to the blog itself which updates frequently. Winer (2003) contends that a *permalink* feature, in conjunction with the archive feature, contributes to the persistence of blog content.

Another feature unique to a blog is the *trackback* that sends an automatic alert between blogs. This creates a means by which a blogger can determine who has seen the original blog post as well as whether anyone has written another entry concerning it (<http://en.wikipedia.org/wiki/TrackBack>). By convention a *trackback* appears at the bottom of a blog posting along with a summary.

Syndication also provides information links although these are automatically generated through a set of protocols collectively known as the Rich Site Summary or RSS. News sources in particular use RSS feeds to provide constant updating of information, but the technology can be inserted into many blog sites to provide data from other blog sites as well as news sources. This is a software method of making blog data

simultaneously available to multiple sites (Doctorow, Dornfest, Johnson, Powers, Trott, & Troot, 2002; Stauffer, 2002).

As rapidly as blogging technology expands, blogs as a technology are rapidly becoming specialized. Journalists specialize in *newsblogs*, with firsthand entries from the Middle East termed *warblogs*. Businesses are dealing with blogs, both authorized and unauthorized, from within their organizations. The research however, focused solely on blogs in education, known colloquially as *edublogs* although in the investigation many students commented on and used *newsblogs* and other organizational blogs.

Summary

Although the vocational computer science student completes his or her community college experience with an associate degree geared toward immediate employment in the technology field, the need to inculcate the critical thinking skills of analysis, synthesis, and evaluation is a valuable educational advantage for all life-long learners whether his or her formal education ends at the associate level or continues through the baccalaureate and beyond. Information technologists in particular must adjust to a rapidly evolving field with skills that can be improved through self-reflection of personal learning experience. The investigation explored any change in student learning outcomes that were identifiable as the result of the element of reflective learning through blogging in the computer science curricula.

The methodology primarily used in the two-semester effort was a qualitative content analysis, although in an effort to quantify some data, more traditional quantitative measures of descriptive statistics were used. Mayring (2000) distinguishes qualitative

content analysis from the more traditional quantitative form of text by applying interpretation of the data to develop insight into the categories that emerge from the statistics. Like quantitative content analysis, the qualitative model of content analysis uses a structured system of rules. Unlike the more traditional format of content analysis, iterative qualitative analysis formulates criteria derived from theory and pertaining to the research questions that determine categories. This extends and supplements the function of quantitative analysis with interpretation to address the definition of categories, a flaw view by Krippendorff (2004) as an intrinsic weakness in quantitative content analysis.

To evaluate the efficacy of blogging as a tool for social learning in its collaborative aspect and as a catalyst for critical thinking in its individual facet, a third method of analysis, cluster analysis was employed as a tool for classification of student blogger types. The criteria used in these classification were based on content analysis of attitudes and both manifested and latently implied relevance to topic in individual blog postings; the actions of frequency, interactivity, and persistence over the time of the investigation, which is defined as the duration of the first ten weeks of each semester; and the evaluation of blogging technology as, expressed in a culminating essay. The intent of cluster analysis was to identify systematically types of student bloggers. Once categorized as a blogger type, incidents of critical thinking reported by student types could be analyzed. The emergent types of bloggers would expose commonalities and differences among types. Although data were collected on gender, types were not gender-specified. Typical of a qualitative study (Creswell, 1994), the exploratory investigation evolved with each iteration.

At the start of the two-semester case study in the summer of 2004, blogging was a new learning tool for the majority of the course students. In the semesters since, blogging has become a mainstream technology for both students and general Internet users. The investigation captured the introduction of a new educational technology as it affected student learning in the observed computer science courses.

Chapter 2

Review of Literature

Introduction

This chapter reviews four distinct bodies of literature for the purpose of discovering the efficacy of blogging in education. First, references to the unique characteristics of blogging technology are explored. Blogging as an emerging technology has a relatively sparse research base; however its growing presence in educational use is creating more interest in examining its influence on teaching and learning.

Following the examination of blogging technology, the literature is examined concerning the two elements that can be fostered in a blog, namely reflection as (a) a means of critical thinking and (b) as collaboration in learning. The concepts of reflection, critical thinking, and collaborative learning have been the focus of vast educational research, but for the purposes of the investigation each must be logically linked to the specific form of educational technology.

Finally, the interaction of multi-method analysis is detailed as it was used to analyze the data findings and to create a research design. Multi-method analysis is a form of triangulation used to supplement single models of investigation for the purpose of providing increased credibility of the research (Creswell, 1994; Brewer & Hunter, 2005; Tashakkori & Teddlie, 1998). Qualitative research can lack the rigor of quantitative studies. For this reason, multiple analyses were performed as a form of triangulation of methods to provide greater validity to the investigation.

Relevance of Research

The investigation was confined to the efficacy of journalistic blogging for the vocational computer science student in a two-year community college program. The community college prides itself on its reputation as a teaching institution. Accordingly, its faculty is normally freed from institutional requirements to research and publish (Grubb, Worthen, Byrd, Webb, Badway, Case, Goto, & Villeneuve, 1999). However, as a teaching institution, the community college must focus its instruction on successful student learning outcomes (Weiner, McVeigh, Clever, Brasington, & King, 1997, Bragg, 2000).

Permanent and meaningful learning must be active, constructive, cumulative, goal-oriented, and self-regulating for the student (Fardanesh, 2002; Knowles, 1990; Shuell, 1988). Meaningful learning is more than the acquisition of facts. It is a cumulative process that is quantitative in knowledge and qualitative in substance as the learner builds on accumulated knowledge to make decisions and judgments from a personal knowledge base (Shuell, 2000; Brown, 1990). In the field of computer science in particular, the current instructional trend is toward constructivist problem solving which mimics the real-life application of the field for current students training to be effective employees (Booth, 2001; Gruba & Sondergaard, 2001; Stein, 1996).

Anticipated Contribution to Computer Science Curricula

On a personal level, journalistic blogging documents the progression of individual learning. Brockbank and McGill (1998) advocate self-reflection as the basis of learning, citing within their body of work the theories of behaviorists and cognitive psychologists who employed categorizations to define individual learning growth. The concept of

public blogs as both personal documentation of a student's learning progress and as a collaborative tool for course learning was examined as factors in content mastery and as components of student perception of the technology's value. The dual role of personal growth and social networking parallels the technology of the blog's self-publishing and public natures.

By incorporating a mechanism for continuous personal research and reflection, the student created a documented journey of progress through the course. The linking of peer blogs, a unique characteristic of the technology, provided a collaborative environment for the class. The impact of reflection as incorporated into the community college computer science curriculum has become a unique and innovative element that can potentially increase quality in the college programs through the implementation of highly significant learning experiences for the students (Fink, 2003).

Blogging Technology

Many researchers contend that by design, blogging existed from the inception of the hyperlinked World Wide Web as a subset of the Internet as it was created by Tim Berners-Lee of the European Organization for Nuclear Research (CERN) in 1991. (Doctorow et al., 2002; Blood, 2000; Blood, 2002; Bausch, Haughey, & Hourihan, 2002). To understand this contention, a distinction must be made between the technology of web logging as the journaling process automatically created on computer servers hosting web pages, and the weblogging, contracted to blogging, as the process of creating and maintaining a frequently updated website for the purpose of pointing to other websites of interest. The earlier confusion of terms was the reason for contracting the term weblog to the currently used term of blog (<http://en.wikipedia.org/wiki/Weblog>).

The identify of blogs as author created and dated entries containing links to other relevant sites had been established with release of free blogging software, Blogger, by Pyra Labs in 1999 (Blood, 2000). Blog freeware was employed exclusively in the research project. Other software for creating and hosting blogs soon followed. However, Blogger became a prominent force in blogging software after it was acquired by the Internet giant Google in 2002. With the availability of free tools to create and host blogs, individuals, groups, businesses, and academia soon implemented the technology.

Educational implications of blogging grew exponentially with the availability of freeware blogging software through Blogger and others. Paquet (2003), along with Mortensen and Walker (2002) saw blogging as personal knowledge publishing with uses in collaborative scholarly research. Wrede (2003) envisioned weblogs as a transformational technology in higher education. The literature is rapidly adding new material based on educational uses of blogging as a collaborative means to create a learning community (Baggaley, 2003; Glenn, 2003; Kennedy, 2003; Long, 2003; Downes, 2004; Schroeder, 2004; Williams, & Jacobs, 2004; Du & Wagner, 2005). The collaborative aspect can be directly attributed to the public nature of online blogging. However, equally critical to the investigation is the private or reflective journaling aspect of the technology (Fiedler, 2003b). To see how blogging serves the dual function of public and private reflection, the unique characteristics of the technology were identified.

Through the data culled from the investigation, the distinctive characteristics of a blog were determined to relate to three elements: (a) time, (b) links, and (c) collaborative comment. Although blogs are asynchronous media, they are highly time related. Each entry is date stamped and posted in reverse sequential time order (Stauffer, 2002; Blood,

2002). This construct creates a linear path of entries that chronicles the author's thoughts. Other communications environments such as discussion forums, bulletin boards, and recorded chat may be configured to show "threads" of posts related by topic, but by definition, the blog is designed as a time specific tool.

Immediacy is also a time-related characteristic of blogging technology. With the availability of user-friendly blogging tools, bloggers can publish their posts in the Internet without any delay that is inherent in older technologies of web hosting and their required uploading of HTML files. The quality of immediacy provides an additional time-related factor of blogging, spontaneity.

Further time elements found exclusively in blogs are the *trackback*, *permalink*, and *archives*. These elements provide persistence in the blog posts that are retrievable for researching at a future time. Student comments throughout both semesters indicated that student used the course and peer blogs for exactly the purpose of research of blog postings. Additionally, a currency not normally associated with web learning environments has become standardized in *RSS*, a method of syndication that automatically feeds news of specified topics or sources to a blog page. Automatic syndication, in combination with manually inserted hyperlinks, creates a center of current information in a blog unparalleled by any other technology (Doctorow et al, 2002).

Linking itself is another defining characteristic of blogging. Through the inclusion of relevant links, a blog author can direct his or her readership to information outside the blog. Gumbrecht's 2003 research explored the aspect of linking as content control over the blog. She found that bloggers exercise self-control over how they

present their material, and suggested that linking establishes the control as a buffering mechanism to present content in a non adversarial way. This factor of presentation of material was evidenced in student blogging activity in the study. In addition to inserting specific links, the use of syndication as mentioned above includes the automatic features of sharing and distributing web content. Although this is a software utility that requires a reader called a “news aggregator,” it can still limit or control content by defining the source, or “feeds,” of the information. Control of blog content then, is both desirable from the perspective of the author and as a mechanism to control *infoglut* (Koski as quoted in Marttuen, & Laurinen, 2002, p.99) from overwhelming the readers.

As an online diary, blogging can be a conveniently available but exclusively private medium, protected by password and other authentication processes. Virtual Private Networks (VPNs) use elaborate tunneling protocols to exploit the Internet as a networking medium, while simultaneously maintaining data security. This may be a factor in the business blogs that are concerned with intellectual property (Bricklin, 2003). However, as a publicly available document, an online blog traditionally invites comments from its readers. The public aspect introduces collaborative interaction into the blog. As both a personal journal and a public forum, a blog functions as a mechanism for critical thinking by an individually identifiable blogger who invites comments from Internet readers. These dual aspects of private reflection coupled with public interaction are unique to blogging technology, and these are the factors critical to the investigation of blogging as a fosterer of student reflection.

Reflection as a Means to Foster Critical Thinking

Previous investigations within the past decade have addressed the use of technology to enhance learning (Abdullah, 1999; Astleitner, 2002; Dalgarno, 2001; Deal, 2002; Phelps, Ellis, & Has, 2001; and Schrire, 2002), the influence of reflection in constructivist learning (Ben-Ari, 2001; Bragg, 2001; Brockbank & McGill, 1998; Fiedler, 2003b; and Maypole & Davies, 2001), and journaling as a means of reflection (Blood, 2002; Fiedler, 2003a; Pollard, 2004; and Powazek, 2002). It was the intention of the research to associate reflective journaling with the emerging online technology of blogging and to evaluate the new technology's influence on student constructivist learning.

Publishing blogs has been described as both a social and a personal activity. In a social context, Petric (2003) cites the purpose of the original architects of the modern Internet World Wide Web (WWW), including Berners-Lee's original proposal (1989), in designing the web to serve as a structure for users to publish ideas, opinion, knowledge, and experience to a universal audience. Recent researchers have noted the elements of immediacy, informality, spontaneity, and chronology that set web journaling apart from other Internet technologies (Blood, 2000; Weinberger, 2002).

Blogging technology archives old entries, while displaying current posts in reverse chronological order to display the most recent at the topmost, highly accessible, section of the computer screen. All of these components combine to create a traceable path of thought that becomes a virtual journey of discovery through exploration, analysis, synthesis, and evaluation of previous blogs and links. Continuing the social aspect of weblog technology, by structure and expectation, blogging invites commentary and

feedback from its readership. The Blogdex site at M.I.T. (<http://blogdex.net>), indexes links between weblogs. It is a source for future research concerning collaboration and community fostered by the blogging technology, although students participating in the current investigation were both fascinated and in some cases dismayed to realize that outsiders were reading and commenting on their course blogs. Blog comments by non-student participants were encouraging and unexpected.

Another aspect to blogging usage is its social function as the evolutionary technology of knowledge management (Pollard, 2003; Gates, 2004). The social networking was investigated as a specialized facet of the blogging technology that enables student discourse through the publication of links relevant to the course content.

Reflective Social Critical Thinking

Educational investigations into the task of assessing learning include the use of Bloom's Taxonomy for the Cognitive Domain (1956) which delineates thinking skills; Vygotsky's Socio-cultural Theory (Tomasello, Kruger, & Ratner, 1993) on learning, collaboration, and self-regulation in learning; and Schon's contribution on the use of reflection in the learning society (Schon, 1987; Schon, 1983). Using these fundamental theories, the investigation sought patterns in use and content of student online blogs by employing a research design that is more thoroughly described in the next section on methodology.

As a means of establishing the relevancy of the research, Bloom's taxonomy (1956; Appendix A), which is widely referenced at all educational levels, forms the basis for the SCANS (1991) systems which regulates vocational instruction for two-year

colleges in the State of Texas (<http://www.thecb.state.tx.us/ctc/>), the population of the focus of the investigation. The taxonomy's top-level classifications of analysis, synthesis, and evaluation were the components tracked by content analysis software.

Analysis is the first of the higher level cognitive skills. Bloom (1956) defined this aspect as the act of separating concepts into component parts for the purpose of understanding the underlying organizational structure. The student skilled in analysis can distinguish between facts and inferences. Additionally he or she can provide evidence to support generalizations and to make distinctions among concepts.

Building on analysis, the next cognitive skill is synthesis which involves the construction of a pattern. Evidence of mastery of the skill involved combining concepts and experiences to form a new concept or alternate solution. This is a creative element that concentrates on a student's ability to develop original ideas and/or modify existing ones.

The highest level cognitive skill was described by Bloom (1956) as evaluation or the ability to make judgments. This was the most surprising and empowering aspect of blogging as reported by the participating students. Conditioned by previous classroom practices, many of them found the freedom to evaluate a liberating educational concept.

Keywords associated with these three top-level classifications were incorporated into the data dictionary of content analysis software to codify the resulting data (Appendix B). Beyond the simple counting of keywords, educational researchers suggest that larger units should be used to identify the meaning of the content (Gunawardena, Lowe, & Anderson, 1998). The controversy involving the unit of content to measure

ranges from single words to phrases or keywords in context (KWIC) to entire message units (Krippendorff, 2004). Decisions based on the limits of units evolved during the iterative data collection period of the case study and are detailed in the methodology section of the report.

Although Bloom's taxonomy (1956) is a standard in educational theory, the categories can be broadly interpreted. To clarify the evidence of critical thinking, an updated and extended definition of Bloom's taxonomy proposed by Petress (2004) includes the concepts of sufficiency, reliability, relevance, consistency, recency, and objectivity as observable characteristics of critical thought. The first, sufficiency, eliminated the shallow agreement sometimes posted in blogs as a form of interaction among students. Sufficiency in this context meant adequate support for statements of analysis, synthesis, and/or evaluation.

Relevance to the topic is the second of Petress' characteristics. Interpretative decisions must be made to determine the relevance of the data to the topic discussed. In these instances word counts would not adequately define relevance. This aspect was particularly problematic when determining the relevance of experiential learning incidents.

Petress posed reliability as a characteristic of a critical thinker. This characteristic also requires an interpretative determination. Reliability as a characteristic is based on information provided by the individual in the form of supporting statements. Verifying the provided supporting statements is a necessary component in attributing this characteristic to learner.

Petress' concept of consistency of statements created the methodological necessity to plot each blogger's posts. Consistency as defined by Petress must exist both in the internal statements of the critical thinker and externally from the learner's reporting on his or her experiences or observations.

The topic content of each of the four classes focused on the study of information technology, a field that changes daily. This made the fifth characteristic that Petress termed *recency* very pertinent. Undated or out of date sources invalidate a position or concept. Petress stresses the use of current justification of sources.

Finally, the concept of objectivity of statements is apparent in the Internet environment where corporate sponsored white pages or advertisements proliferate. The subtle distortions of marketing may not be apparent to online visitors who are unaware of the inherent bias prevalent in website resources sponsored by technology authorities such as Microsoft, Cisco, and other vendors whose objectivity is questionable.

Along with Bloom's (1956) higher order cognitive skills, these six characteristics of critical thinking as listed by Petress were also used as keywords in context (KWIC) for the current investigation. In addition to its focus on the individual learner, critical thinking has also been investigated as a social activity. Like Bloom, Vygotsky stratified mental functions as elementary and higher (1986). Within these genetically derived classifications, he differentiated domains including a socio-cultural domain that generated a theory of cultural learning which Tomasello, Kruger, and Ratner (1993) distinguished from general social learning into three basic types: 1) imitative learning, 2) instructed learning, and 3) collaborative learning. All of these are constructed through a social

awareness that recognizes that others are similar to the learner's self. Interpretations of Vygotskian theory combine the social environment with thinking and behaviors.

Although Vygotsky's work and much of the research derived from it centered on the child, the influence of peers' collaboration within a virtual social environment of a blog was based on the social learning concept.

Social learning is also addressed by other theorists. Analysis of the collaborative value of blogging used Garrison's five stages of critical thinking (1992) as part of his concept of online cognitive presence (2001). Garrison sees problem identification, or the instance that triggers awareness of a problem, to be solved as the first critical thinking stage. He next defines the limits of the problem as a further exploration to identify and isolate the root of the situation. In this process a learner experiences an emergence of solutions and alternate solutions to the problem, and finally, takes action to validate what was learned. These stages of problem resolution are listed by Garrison as identification, definition, exploration, applicability, and integration and coded in the study as GID, GD, GR, GA, and GI respectively.

Although Garrison initially defined these stages as steps in an individual's problem solving process, Newman et al. (2000) point out that Henri (1991) aligned a critical reasoning skill on the social level for each of Garrison's stages in her five dimension of computer mediated communication (CMC) theory in the cognitive, the fourth dimension of her five dimension classification of participative, social, interactive, cognitive, and metacognitive. These cognitive skills closely parallel Garrison's five stages. The first, elementary clarification is defined by Henri as identifying the problem elements, with specific attention to the linkages of the problem's elements. The blogging

technology of hyperlinking facilitates original source linking to identify the origins of problem elements. In the second of Henri's cognitive skills, the problem is analyzed in depth. Next the concept of inference is aligned by Newman et al to Garrison's problem exploration, which is followed by judgment in applying decisions or evaluations to the situation, which Garrison defines as applicability. Lastly, Henri defines the final critical thinking skill of strategies or applying a solution to the problem.

The case study on blogging focused on vocational computer science students. Accordingly, Schon's body of work on the impact of society and culture on the learning society provided the final aspect of investigation, namely the value of reflection in the continuous, dynamic education of the life-long learner, both as students and as working professionals who must deal with continuously and rapidly changing technology (1983). In addition to agreeing with the social learning theorists, Schon extends learning theory by introducing the concept of reflection on personal experiences as an alternative to standardized passive learning. It is the element of personal engagement in learning that was investigated as students created and maintained learning blogs as well as commented on the instructor-provided course blog.

Critical Thinking as a Component of Synthesis, Analysis, and Evaluation

Critical thinking has been defined as a tri-part combination of an attitude of enquiry; a knowledgebase of inferences, abstraction, and generalization; and the skills of applying both the attitude and knowledge (Bond, 1993). In 1996, the National Science Foundation released a report indicating that few high school graduates are able to apply higher-order thinking skills in real life situations (Leshowitz, DiCerbo, & Syminton, 1999). As these high school graduates enter college, this skill deficit becomes a cause for

educational concern. Arburn and Bethel (1999) cite the unique population of community college students as requiring teaching strategies that incorporate critical thinking skills within discipline-specific courses, since the often economically disadvantaged community college students do not have the luxury of taking elective classes focused on critical thinking.

Reflection is a means of enhancing critical thinking skills by engaging in a dialog with one's self in a journal, or with others (Ramasamy, 2002; Schon, 1987; Robbin, 2001; Brockbank & McGill, 1998; Feenberg, 1989) in a physical classroom discussion setting or online in an electronic forum. Learners demonstrate critical thinking skills by making inferences, relating course content to prior knowledge and experiences, and interpreting content through the analysis, synthesis, and evaluation of information (Gilbert, 2002; Bloom, 1956).

Both Ramasamy (2001) and Dirks (1998) cite obstacles in reflective practice for college students including the environment in which learning takes place. Although constructivism has become a standard pedagogy in most higher education institutions, the authority of the instructor as the deliverer of knowledge remains in the lecture format, both on campus and online. Widespread use of modern communication technology, however, has altered the model of teacher-led instruction to include a deeper value to individual and peer knowledge (DeLisi, 2002; Palincsar & Herrenkohl, 2002).

Journaling as a Tool for Reflecting Personal Critical Thought

Journals have long been used as a means for recording personal reflection (Kerka, 2002; Salmon, 2002). Haigh's work (2001) found that students indicated that reflective

journaling as a technique was beneficial in promoting their introspection and self-awareness of their learning processes, particularly concerning the adoption of learning strategies. George (2002) found the reflective journaling in computer science programs is an effective, if unorthodox, method to stimulate the problem solving skills requisite in software programming. Reflective journals challenged students to think critically about previously held knowledge and beliefs (Chase, Germundsen, & Distad, 2001).

Recently, college courses have incorporated journaling into standard requirements as a constructivist pedagogical tool for measuring critical thinking (Barkley, 2000; Imel, 1998; Lewis, Spector, & Burkett, 2001). Moshman's 1982 classification of constructivist interpretations as endogenous which stresses learner exploration, exogenous which recognizes the importance of direct instruction, and dialectical which focuses on interactions among learners, peers, and instructors, has been extrapolated into a framework for investigating the efficacy of computers in instruction (Delgarno, 2001; Kennedy, 2003). Furthermore, research indicates that reflection is a transferable skill that serves the learner throughout life (Race, 2000).

In Texas, the State Higher Education Coordinating Board (THECB) has instituted Techniques to Enhance Adult Learning (TEAL) modules to assist community college faculty in incorporating principles of critical thinking and collaborative learning as outlined in the national Secretary's Commission on Achieving Necessary Skills (SCANS) report (Barkely, 2000). Using SCANS as its basis, another Texas mandate is the Workforce Education Course Manual (WECM), a statewide compendium describing all vocational courses taught in community colleges (<http://www.thecb.state.tx.us/ctc/ip/wecm2000/index.htm>). Accordingly, all current

syllabi in the studied computer science curricula must include references to these SCANS skills.

In the computer science department, electronic communication is provided through intranet, Internet, and extranet technologies that link students, faculty, and online course resources. Paralleling the works of Greenlaw and DeLoach (2003) that explored the success of teaching critical thinking through electronic discussion groups of undergraduate economic students and Angeli, Bonk, and Hara's (1998) content analysis of online discussion, the study examined the efficacy of the Internet technology of blogging as a means of documenting critical thinking skills mastered by undergraduate computer science students.

Public Journaling as a Tool for Collaborative Discourse

By design, the blogging technology used in the investigation was publicly accessible over the Internet. Lin, Hmelo, and Kinzer (1999) examined ways in which technology can support student reflection. Their research demonstrated that technology provides a beneficial forum for community-based discourse of multiple perspectives that can serve as a basis for individual reflection. Socially constructed learning stems from comparison and reflection on the findings of others (Dewey, 1933; Schon, 1987). Schrire's research (2002) interpreted patterns of interaction within computer conferencing discourse.

One identified goal of a collaborative discourse structure is the creation of a standardized format that provides for capture of valid, relevant data from a group (Turoff,

Hiltz, Bieber, Fjermestad, & Rana, 1999). The blog sites established for each course in the investigation, served that purpose.

Journaling itself has been cited as a beneficial method of learning (Eaton, 1997; Loke, Wong, & Wong, 1997; Andrusyszyn & Davie, 1997; Robbin, 2001). With the introduction of online journaling, however, a public aspect was introduced into the private reflective journal, making the journaling concept both open for critique by peers, and as a catalyst for topical collaborative discourse. In fact, Gokhale's (1995) research into the effectiveness of individual learning versus collaborative learning in higher education cited improvement in both drill and practice skills as well as critical thinking skills through collaboration. Her investigation indicated that critical thinking skills showed greater improvement when collaboration was employed. These conclusions were the result of the use of discussion, clarification of individual ideas, and evaluation of peer ideas that is only attainable through a collaborative environment.

Literature on Multiple Method Research

The unstructured nature of blog postings, combined with the researcher's active participation in establishing and maintaining the course blogs, necessitated a qualitative research design to deal primarily with words rather than numbers. The exploration of the impact of a web-based technology on student learning was an inquiry into an existing situation within a college classroom that sought to find emerging patterns of critical thinking. It was an inductive process involving a real world situation, using descriptive data in the form of essays and blog postings that focused on the blog technology process as well as the resulting data (Creswell, 1994; Strauss & Corbin, 1998), and ultimately resulted in interpretation of the result, namely the effectiveness of blogging, from the

participants. These are the defining elements of qualitative research which uses iterative processes of organization, categorization, synthesis, and interpretation of data (Gay & Airasian, 2000).

The research design used triangulation to overcome any intrinsic biases inherent in the researcher-created and single-observer subjective study. Triangulation is a form of research validation used in qualitative methodology that has been identified by Denzin (1978) as consisting of at least three types: 1) data triangulation in which comparisons are made among multiple sources of data involving time, space, and participants, 2) investigator triangulation which uses multiple independent observers, and 3) methodological triangulation which uses more than method of data analysis (Denzin as cited in Gay & Arirasian, 2000). Although the research used only a single observer, the investigation used both data triangulation in its use of multiple instruments for data collection and methodological triangulation in its use of quantitative cluster analysis and a qualitative version of content analysis.

A multimethod research approach has recently attracted investigators of online learning (de Laat, Laly, & Lipponen, 2005; Esteves & Pastor, 2005; Tashakkori & Teddlie, 2003; Brewer & Hunter, 2005). De Laat et al suggest that the nature of electronically networked learning has substantially changed teaching and learning necessitating the use more than one means of analyzing the relevant data to create a holistic investigation. Brewer and Hunter (2005) concur, adding that the synthesis of multiple research techniques results in an improved conceptualization of the environment in which learning takes place.

Some disagreement appears in the terminology of multiple method research surrounding the terms *multimethod*, *mixed method*, and *mixed model*. The distinctions appear to focus on the time and sequence used in employing each method. Using both quantitative and qualitative techniques within or across the stages of a research investigation is termed a *mixed model* in contrast with the *mixed method* paradigm that uses only one technique per separate stages of the entire investigation (Johnson & Christensen, 2003). Generally, the term *multimethod* research encompasses both mixed model and mixed method paradigms and essentially includes the concept of triangulation of qualitative and quantitative methods to accomplish an increased validation of the findings (Kelle, 2001; de Laat et al., 2005; Brewer & Hunter 2005; Esteves & Pastor, 2005; Wood, Daly, Miller, & Roper, 1998).

The specific quantitative analysis used on the survey data was cluster analysis, a statistical multivariate analysis, which is defined as a simultaneous analysis of relationships among three or more variables. In the investigation the variables were data from the survey question one on blogging experience; the student responses to survey questions three and four on their reading of course and peer blogs; and their intended blogging action at the end of the course which is addressed in survey question five. Cluster analysis does not have predefined groups. Rather, in cluster analysis, the groupings emerge from the technique. The methodology was the traditional quantitative process used to answer the research questions on which students, if any, benefited from blogging.

Prior to using cluster analysis, a qualitative content analysis was used to infer meaning from both the blog postings and the reflective essays to determine, if in fact,

instances of higher order cognitive skills were exhibited through reflection in the blogs and essays. Qualitative research uses induction to determine patterns that emerge from the data. Once the instances of critical thinking were identified, the classification of blogger types through cluster analysis examined student types, rather than individuals. The multi-method was an integral form of validation through triangulation of methodologies (Creswell, 1994).

The application of blogging technology to teaching and learning has recently become the topic of discussion in education (Oravec, 2002; Fiedler, 2003b) and knowledge-sharing research (Paquet, 2002). Siemens (2002) cites the unique qualities and implications of blogging not as a lecture, but rather a conversation where knowledge is shared socially. Mortensen and Walker (2002) note the lack of published research on the topic of web logging. As early adopters of the new technology, they cite the current popular perception of blogging as a digital outgrowth of folk journalism. Additionally, Reason and Bradbury (2001) define blogging in their description of action research that combines reflection with action and theory with practice. The definition could be applied also to the purpose and practice of the community college computer science vocational curricula.

This chapter reviewed multiple areas of literature concerning: the unique characteristics of blogging; the use of blogs for student personal and collaborative reflections; and the connection between reflection and critical thinking. As an exercise in inductive research, triangulation of both data collection instruments and multi-method analyses was used to explain the data findings and to create a research design.

Aligning the Research Investigation in Relation to the Literature

The recent implementation of Internet technologies such as blogging has transformed the traditional and online classroom (Wrede, 2003; Carlson, 2003). Barriers of time and place no longer limit learning and the student has become an active participant in his or her personal learning process. Additionally, the blogging student provides and receives comments and links from others, creating a virtual community for knowledge gathering. Access to the resources of the world is revolutionizing the paradigm of learning.

Chapter 3

Methodology

Definition of Terms

Terminology concerning the concepts of the multiple analysis research methods is repeated throughout the chapter. One of the most obscure is the term *blogathon* which was used by the author to describe the in-class exercise at the end of the ten-week period. At that time all students completed a short survey from which specific quantitative data were extracted, and wrote a reflective essay on their perception of blogging that served as a basis of qualitative analysis.

Data mining is a term applied to the use of computerized statistical algorithms to search databases with the intention of discovering patterns and clusters in a humanly comprehensible form (Krippendorff, 2004; Frawley, Piatetsky-Shapiro, & Matheus, 1992). Data mining (<http://www.provalisresearch.com/QDAMiner/QDAMinerDesc.html>) is a software-driven process, and its interpretive focus on words and phrases classifies it as a qualitative tool. The use of multiple analyses within an investigation was selected to explore the qualitative data codified from student blogs and essays with the quantitative approach of analyzing student data of blogging experience, number of submitted blogs, and duration of blogging effort. These methods complemented each other in data analysis and created a fuller picture of the research results.

Research Methods: Use of Multi-method Triangulation

The mixed methodology of the research was necessitated by the need to explore the unknown value of blogging technology in vocational computer science education (Mayring, 2000). An iterative multi-step process of quantitative analysis employed through the use of the researcher-designed survey was followed by qualitative content analysis. Ultimately the categories of student blogger types emerged from a cluster analysis (Morton, 2004). The multi-method triangulation was the basis for demonstrating credibility of the data.

Triangulation is a combination of quantitative methods with qualitative methods for the purpose of complementing the findings of each type. Brewer and Hunter (2005) view triangulation as the method of using multiple sets of data to explore the same research questions from different perspectives. Researchers, particularly in the social sciences and medical fields, have found that one method may generate ideas that can be tested by a second method (Risjord, Dunbar, & Moloney, 2002). Furthermore, by using more than one method, researchers build a higher level of reliability and validity into the aspect under analysis (Holtzhausen, 2001; Hammond & Wiriyapint, 2004). For the reasons of validity, triangulation was an intrinsic part of the research design used for the explorative inquiry.

The Qualitative Research Model

Qualitative methodology is an exploratory approach to interpreting meaning from the collected non-numeric data (Creswell, 1994). Qualitative data were culled from the writings in student blogs and essays. Validity of the investigation demanded precise definition of the codes as well as relatively objective interpretation by the code raters.

The coding schema relied on the established theories of learning. Theory-based research has been used to provide a deeper insight into the complexities of learning beyond the more traditional quantitative investigations (Saba, 2000). Bloom's taxonomy (1956) defined the elements of synthesis, analysis, and evaluation. Petress (2004) expanded Bloom's theories to characterize the critical thinker whose reflective reporting formed the basis of the research question (RQ3) on the progress of individual learning. which states, "On an individual level, how did the use of blogging technology encourage and document the progression of student critical thinking?"

The work by Henri (1991) and Garrison (1992, 2002) explored the social side of Internet-based communication. Literature from these theorists addressed the first research question (RQ1) which states, "What was the observable outcome, specifically related to evidence of reflective critical thinking in student learning, that was uniquely attributable to the technology of blogging?"

Iterative reading of the student writings in the blogs and essays generated a set of codes that were electronically analyzed through data mining software. The use of single rater who was actively involved in the process required the use of multiple types of software for computerized analysis to avoid introducing inconsistencies in coding.

Coding of data is often accomplished through the statistical agreement of multiple investigators (Krippendorff, 2004; Neuendorf, 2002; MacKinnon, 2003; Schrire, 2002). Single-rater coding risks the inclusion of inherent bias, however, care was taken in the investigation to explore and rate the data iteratively throughout the semester. As a procedure, the reliability of coding by a single rater was enhanced by the process of

coding each blog message and essay repeatedly with an intervening period of one week. Reliability was established when the segments were consistently coded within the same 19 codes during the repeated rating process. The repetition or replicability of the process over two sequential semesters served as a form of intra-rater reliability (Rourke et al, 2001).

Prior to the start of each term, a course blog was created through Blogger.com (<http://www.blogger.com>) to function as the instructor-designed forum for the class. At the start of each semester, students were instructed on the process for creating individual blogs that were subsequently linked through the course site. Data extracted from the student writings were coded by an author designed rubric (Appendix C) to identify instances and levels of higher-order thinking. The basis for the rubric was the established theories of Bloom (1956), as expanded and enhanced by Petress (2004), Henri (1991), and Garrison (2001). Evidence of these instances were codified by computer software and subsequently electronically analyzed. MacKinnon (2003) similarly established a coding system for his work on rating critical thinking over an electronic discussion forum. Although he used multiple raters, his strategy likewise included a grading system based solely on participation, not content, and used a rubric to evaluate evidence of higher order thinking.

Coding data is a process of disassembling instances to create a conceptual theory. Data must be microanalyzed and interpreted in qualitative research (Strauss & Corbin, 1998). The use of software facilitated the consistency of coding and the reliability of coding retrieval. Morris (1994) compared computerized content analysis with that of

multiple rater human coded content analysis and concluded that computerized content analysis provides superior stability and reliability of results.

The Quantitative Research Model

Although the investigation was a qualitative exploration of a unique population, there were quantifiable elements to be considered. The large volume of data culled from the blogs and essays was categorized by the researcher into classes of blogger types. This was accomplished through the quantitative device of a simplified form of *cluster analysis* to minimize the differences of individuals by grouping bloggers into categories that exhibit similar characteristics of activity and content.

Cluster analysis is a method for understanding the complex nature of data relationships. It is characteristically used as an exploratory method of data interpretation in the form of pattern recognition as a reduction method for large data sets to classify individuals or objects into similar groups without prior knowledge of groups. There are many clustering techniques.

Hierarchical clustering is a divisive technique that starts from one group, which in this case was the entire population of blogging students (N=67), and then divides iteratively into two groups, then to three groups and so forth. In hierarchical cluster analysis, the clustering process can be expressed in a tree form, known as a dendrogram (Kim, Kwon, & Cook, 2000). Data mining software facilitates cluster analysis. The investigation used QDA Miner ® for the cluster analysis that created dendrograms as visual displays of the results.

Although the investigation focused on words as a qualitative element, within each blog posting and essay, words and phrases were extracted for quantitative content analysis through the process of counting and codifying numbers of instances.

Krippendorff (2004) describes *content analysis* as an unobtrusive view of data that must be interpreted through classification and evaluation. Much scholarly discussion centers on content analysis as a quantitative or qualitative paradigm. However, the investigation used a qualitative approach to content analysis, based on the interpretive reading of a relatively small number (500) of blogs and essays (67) (Krippendorff, 2004) and the intense involvement of the researcher in the process (Creswell, 1994). In this aspect content analysis was used as a data reduction tool in a qualitative study. Neuendorf (2002), who views content analysis as a quantitative paradigm, acknowledges a qualitative approach to content analysis and identifies the type of content analysis as “interpretative analysis” (p. 6), with an emphasis on forming theory from the observation of coding of messages. She further classifies this type of content analysis as qualitative in nature and deems it a valid source of “deep” information (p. 14) about text. The concept of qualitative content analysis is described by Mayring (2000) as an extension of the rigorous methodologies of quantitative analysis to include qualitative and inductive interpretation.

Development of Research Design

Prior to the start of each of the two semesters, course blogs were established on a publicly accessible Internet site for use by each class (Appendix D). Within the first week of each semester, students were instructed on the procedures for creating individual peer blogs. Once created the peer blogs were hyperlinked within each course blog.

After the blogs had been established and populated with data, the first data collection step was a quantitative investigation into the actual activities of student bloggers, including number of blogging posts and duration of blogging period. This step was followed by a qualitative analysis of the content of the blog postings and the perceptions of students concerning blogging as reported in their reflective essays. Here the goal was explorative, with the predictions of the prior quantitative analysis used as a validation tool. Through the qualitative method preliminary blogger classifications were derived, based on student activity (Appendix E), student interaction, and student evaluation of blogging. The two-semester case study provided reliability in the form of replication of results. Finally another quantitative analysis in the form a cluster analysis was performed to separate blogger types, making each type distinct and determining the unique characteristic of each. The final analysis served as the basis for proposing future computer science curricula changes.

Although a triangulated mixed methodology was employed for validation purposes, the investigation primarily used a qualitative approach. The qualitative paradigm was appropriate considering that the researcher served as the course instructor who directly interacted with the student bloggers in creating and maintaining the course blogs. Additionally, multiple simultaneous factors of blogs and essays were used (Creswell, 1994). Through the use of computerized content analysis software, patterns and categories of student bloggers that were identified through blog usage became apparent. The objective of the research was to identify emerging aspects of learning by examining the student blogs and blogathon essays. Categories discovered during the

inductive process were used to develop theories for understanding the efficacy of blogging technology in student reflection.

Verifying qualitative data can be problematic, however computerized analyses coded and retrieved instructor-identified instances used in accepted pedagogical theories of Bloom (1956), Vygotsky (1986), and Schon (1987) that relate to critical thinking (Bloom, 1956), social learning (Henri, 1991; Garrison, 1992), and the value of reflection respectively (Wong, Kember, Chung, & Yan, 1995).

Blogging took place on both a course (social) level and on an individual student (personal) level. Students were provided with online instructions on creating and maintaining a student peer blog (Figure 1).



Figure 1: Online Instructions for Creating a Blog. Available online <http://blogger.com>

A hardcopy describing the technology and the reflective purpose of web journaling was provided to the students at the start of the semester and remained available

as a webpage on the course's intranet for the duration of the term. For each course, a course blog was established to serve as a model of the process, to provide suggested course-related topics for blogging reflections, and to serve as a portal of hyperlinks to all student blogs.

During the first ten weeks of the semester, each student was required to read both the course blog and the blogs of peers, and to provide entries to an individual student blog. Although only active participation, and not the content of the blogs, was a graded element of the course, toward the end of the semester, a required in-class exercise, termed a "blogathon," was the venue for each student to write a paper evaluating his/her use and perceptions of both the course and peer blogs (Appendix F). Blogging was a required element of course and grades were assigned to the participation in the process. Students who did not blog at least once during the semester were cautioned that they would lose participation points for the course. In each course blogging was presented as a laboratory exercise to be accomplished during the weekly assigned three hours in the computer laboratory. Students with personal Internet access were able to blog at any time, and some participated by blogging and reading blogs outside of the prescribed laboratory hours. The amount of time students were expected to spend in reading and contributing to blogs was not specified. This was a deliberate decision by the researcher to permit flexibility, spontaneity, and freedom in blogging.

The reflective essay was the final question in a short questionnaire distributed at the end of the experiment. It was preceded by five multiple choice selections regarding (a) the student's prior experience with blogging; (b) the student's active contribution to his or her blog during the semester; (c) the student's passive reading of the course blog,

and (d) the student's passive reading of peer blogs; and (e) lastly, the student's intention to continue with blogging. These data were compiled for statistical analysis. Survey questions included in the blogathon were designed to identify personal qualities and activities of students that might affect blogging. The first question categorized those students who had prior experience with blogging. Previous use of blogging was explored as a factor in student active participation. Questions surfaced concerning students who previously blogged as being more active in the current semester's blogging activities, and if previous blogging experience indicated a persistence in using the technology beyond the current term.

Data on student's active and passive participation in the blogging process were captured in survey question two (*When did you add to your student blog*), question three (*When did you read the instructor's course blog*), and question four (*describe your activity with other student blogs*). Data gathered from these answers related to student activity and interaction with their instructor as well as their peers. Multiple theorists define learning activity in terms of interaction with the subject matter, the content deliverer, and the others participating in the learning environment (Moore, 1993; Fulford & Zhang, 1993; Gunawardena, 1995).

The fifth survey question sought to identify students who signaled an intention to continue the blogging process. The students who intended to persist in blogging were identified for subsequent analysis of the reasons they found blogging to be valuable in their learning process.

In addition to the multiple choice survey questions, the blogathon exercise required students to write for a minimum of 30 minutes. The paper topic, “My Journey of Discovery in [course name]” reflected the purpose of the paper. The student work was a self-reflective essay on the constructivist process of learning in the course, as facilitated by the use of Internet blogging. Paralleling the academic freedom of blogging, grading of the essay as well as the blogging activity was based solely on participation, allowing the students freedom of expression in their respective blogs. The ungraded content of the paper was used to provide data on student perceptions. Additional data were inferred from the statements made in the blogs. These data were analyzed by content analysis software.

Specific procedures

Prior to the start of each semester, a course blog was established for each course. Within the first week of the semester, students were trained in creating individual student blogs. The link to these peer blogs was subsequently included in the course blogsite. Throughout the term, students were expected to read the course blog, including the blogs of their peers and to post individually in the personal blogs.

At the conclusion of the 10th week, an in-class exercise was administered to each class. The exercise, termed a *blogathon*, consisted of a short survey of student experience in blogging, and a reflective essay on student perception of the technology.

In order to analyze the data into emerging pattern, each blog posting and blogathon essay was transcribed into a Microsoft® Excel spreadsheet (Appendix G). Separate worksheets recorded demographic data from the blogathon’s survey

questionnaire. Multiple worksheets tracked blogging activity, blogging frequency, and student identification. A separate worksheet recorded the student identification code linked to gender, specific class, and resultant blog type with course grade. Additionally, frequency counts of blogging activity were tracked. These components constituted the data for quantitative analysis. Content from both the blog postings and the essay on blogging were transferred initially into an Excel spreadsheet. The content data were exported to QDA Miner text analysis software for further analysis.

Bloom's taxonomy of higher order cognitive skills (1956) is the basis of defining critical thinking. Critical thinking for the purposes of the undertaken investigation included student deconstruction of previous knowledge, the combination of concepts, and the evaluation of situations and opinions. A coding scheme was created by the author to identify instances of these higher-order thinking skills (Table 2).

Table 2: Coding for Bloom's Taxonomy

	Bloom's analysis	Bloom's synthesis	Bloom's evaluation
Coding format	BA	BS	BE

Additionally, the extension of Bloom's cognitive higher-order skills was provided by Petress (2004). His characteristics of the critical thinker were coded to provide additional data points for the two-semester case study. The code for Petress is in Table 3 below.

Table 3: Coding for Petress' Six Characteristics of Critical Thinking

	Sufficiency	Reliability	Relevance	Consistency	Recency	Objectivity
Coding format	PS	PR1	PR2	PC	PR3	PO

Beyond locating instances of individual critical thinking, the case study sought to locate the additional aspect of collaborative learning. The bases for these codes were located in Henri's Five Domains of Computer Mediated Communication (1991), and Garrison's Five Stages of Critical Thinking (1992). The data points for these elements are found in Table 4 below.

Table 4: Coding for Collaborative and Social Learning

Garrison's Five Stages of Critical Thinking Coding format	Garrison Problem Identification GID	Garrison Problem Definition GD	Garrison Problem Exploration GE	Garrison Problem Applicability GA	Garrison Problem Integration GI
Henri's Five Dimension of CMC Coding format	Henri – Participative HP	Henri – Social HS	Henri – Interactive HI	Henri – Cognitive HC	Henri – Metacognitive HM

To answer the four research questions the following steps were applied:

For the first research question, *“What are the observable outcomes in student learning success uniquely attributable to the technology of blogging?”* a qualitative analysis of student statements in both their blogs and their essays resulted in codifying phrases into categories of critical thinking. Learning success was defined for the purposes of the investigation to be the instances of manifest and latent expressions of the critical thinking skills of analysis, synthesis, and evaluation. These a priori categories were drawn from theories by Bloom (1956), Henri (1991), Petress (2004), and Garrison (1992).

The use of a priori coding of these instances rather than emergent coding in examining the data was necessitated by the existence of a single reviewer. With multiple reviewers independently examining the data an agreement on coding can be reached to ensure a level of reliability. The use of a priori coding substituted the scholarship of pre-determined categories, in this case those of Bloom (1956), Petress (2004), Henri (1991), and Garrison (1992, 2002), as a means of reliability, rather than relying on agreement among independent coders (Stemler, 2001).

After defining the critical thinking instances as observable outcomes, blogger types were clustered into categories. Clustering was further explored through the frequency and duration of blogging throughout the semester. The Blogger software for each blog provided the frequency and duration data, while cluster analysis defined the blogger categories or type. By identifying consistent and persistent bloggers, some determination was made on the efficacy of the value of the technology in learning. The

unique aspects of blogging were classified as time, linkage, and collaboration comment features. Using these aspects qualitative data were categorized as to the use of course blogging, that is, the identifiable interactive and relevant content and the personal or self-reflective content of student posting. This was designed to address the question of the uniqueness of blogging as a learning tool.

The second research question, “*How does the use of blogging technology facilitate student collaboration to provide a viable forum for social learning?*”, was addressed directly through content analysis of the individual blog statements, interaction of blog content with course blog and peer student blog, and the categorization of student blogging as described in the methodology. The analysis draws from the work of Schrire (2002) in her triangulation of analysis by incidents of learning interaction, cognition, and discourse. She further investigated the connection between the depth of learning and the collaboration of knowledge-building through an examination of patterns. Student collaborative learning in the current case study built on that process of examining emerging patterns of interaction.

In addition to creating a collaborative environment, the personal publishing aspect provides a platform for individual expression. The facet of blogging was investigated in the third research question, “*How does the use of blogging technology facilitate the progression of student critical thinking?*” To address this question, a content analysis on both the blog postings and comments in the blogathon essays was performed according to the tenants of Bloom’s taxonomy of higher order cognitive skills (1956), specifically expressions indicating student analysis, synthesis, and evaluation. This analysis, similar to the investigation of the first research question on learning success,

focused on the blogging technology medium. Blogging, if determined to be a disruptive technology, will by definition replace the dominant technology of Internet communication, including LISTSERVs, discussion groups, and other forms of messaging (Christensen, 1997).

The final research question, “*What elements of blogging did student report provide motive to continue the reflective journaling process in future course?*” was examined in several ways. First the intention of students to continue reading or maintaining blogs was measured through statements in the blog essay and by the response to the fifth survey question of the blogathon. Then a more problematic attempt was made to hypothesize an experimental correlation between student grades on the comprehensive final course grade with the student evaluation of the blogging experience. Would the student who perceived blogging as educationally valuable score significantly higher in the course? Were blogger types linked to academic success? In what ways, if any, did the quality and quantity of blogging relate to the grade? These hypotheses were left for future research.

The qualitative methodology used in the study was interpretive content analysis, an unobtrusive technique that combines a qualitative paradigm with computerized quantitative operations (Nuendorf, 2002). Students created personal blogs to reflect on the progress of their learning in each course. In addition, each course provide a “class blog” written and maintained by the instructor that contained: (a) supplemental links to websites relevant to the course, (b), commentary by the instructor suggesting relevant topics for student reflection, and (c) links to all individual student blogs as required in the

syllabus. As announced in class and written into the course syllabus and schedule, each student was accountable for reading the class blog weekly.

Supplemental to reading the course blog, each student was required to create and maintain an individual blog as described both online and in a course handout. The handout described the requirements and prohibitions for these publicly accessible sites. Although each student was allowed modified academic freedom of expression – offensive text, images, tone, or other content resulted in a course failure – the expressed expectation required links to peer student blogs, as well as course-relevant commentary and links.

The instructor's course blog (Figure 2) served both as a topic guide and as a portal to access the blogs of fellow students. It was the student reflections and their interaction of collaborative links that were analyzed in the proposed study.

Figure 2: Course Blog for ITNW1437: Introduction to the Internet.

The reflections from student blogs and essays were analyzed using the definition of critical statements that were most significant in the learning process of a student (Naidu & Oliver, 1999; Ip & Naidu, 2001). Each identified critical statement was codified to be processed for statistical analysis through a computer program. For the investigation, the QDA Miner © program available for download from <http://simstat.com/QDAMiner.htm> was used.

Involvement of the Investigator in the Process

As the instructor of the courses, the research investigator was intimately involved in the processes of the case study. Creswell (1994) acknowledges the inclusion of bias, values, and judgment of a participating investigator in interpretative research, and advises that such individuals disclose past experiences to provide information on the investigator's personal background that might influence the interpretation of the report.

Pertinent to the relevance of the case study, the investigator had taught in the college computer science program for approximately eight years prior to the semesters of this research. Furthermore, the investigator taught the specific courses repeatedly throughout that time, and even instructed students who participated in other classes prior to enrolling in the courses studied. With the familiarity with the environment, the course content, and the student population, the investigator possessed solid understanding of the conditions inherent in the investigation.

A major limitation of the exploratory study was the use of one individual to conduct the activity as well as compile, analyze, and interpret the data. Involving the researcher in the activities and interpretation of data is a characteristic of qualitative

research (Creswell, 1994). However, inherent biases and judgments resulting from the involvement limit the research in replicability and generalizability. Additionally the experience gained in the first phase influenced the behavior of the researcher when repeating the processes in the second phase. Specifically, the verbal instructions to students were repeated and clarified in the second phase in an attempt to prevent the technical difficulties in establishing peer blogs that created frustration for the first phase students. The variation of instruction was only verbal. All written instruction and online processes remained the same for both semesters. Although the experience gained by the researcher in the first phase altered the verbal instruction to students in the second phase, Strauss and Corbin (1998) view personal and professional experience as a beneficial motivator in research.

More significantly, the researcher who administered the activities was the sole rater in analyzing the data. Several steps were employed to overcome the limitation of a single-rater system. Using a system of rating and rerating, all data sets were analyzed three times with an interval of one week between ratings to avoid memorizing the classifications. The system created a form of intracoder assessment to create a form of stability reliability (Neuendorf, 2002). However, Krippendorf (2004) warns that this form of reliability is minimal. The use of a single, intracoder was a major limitation of the investigation that directly affected its resultant generalizability. As an innovative exploration of this new technology, the use of a single rater was a pragmatic choice with intentions to enhance the investigation more formally in future research.

Before the inception of the case study, the investigator obtained written formal approval from the Assistant Chancellor of the college to conduct research on selected

students (Appendix H). Approval from Nova Southeastern university institutional review board (IRB) was granted prior to the start of the first of the two semesters (Appendix I). Student confidentiality was ensured through a system of identification codes to replace student names.

Data Collection Strategies

Data were collected and analyzed in multiple formats. Data were collected from the blogs and the blogathon survey with reflective essay. Data from the blogs existed in electronic form and were copied and pasted into a Microsoft Excel workbook (Appendix G) for each of the four classes in the worksheet labeled “Blogs” and the field of “Blog keywords.” Data concerning the number of blogs, the duration of blogging activity, and responses to survey questions on prior experience in blogging, student blog contribution, student reading of the course and peer blogs, and student intention of persistence in blogging were manually entered into the same workbook by course, under the worksheet of “Survey by item.” Similarly student gender was included manually by the researcher in the worksheet labeled Population. The student responses from the reflective essay were also manually entered in their entirety into the course workbook under the worksheet labeled “Essay-Blogathon.”

Each class was coded by course number as identified in the college catalog, and by month of delivery. For example, the 1437, Introduction to the Internet course, was offered twice during the case study. The summer course began in June and the fall course started in August. Therefore the identification scheme for the course indicated 143706 for the summer course and 1437 for the fall semester. The final three digits of

the “Student ID” field identified individual students as randomly assigned sequential number. This was done to provide anonymity to the participants.

Following the collection of data into electronic workbooks, the same data was exported to QDQ data mining software for coding and code retrieval. This was an automated process with full integration of data from one program to the other. Specifics of the software are detailed in the *Software* section below.

Student ID	Student Blog	Read Course Blog	Read Peer blogs	Blogging Persistence	Blogger Type
1437080401		3	3	3	4
1437080402		3	2	3	1
1437080403		2	3	3	1
1437080404		3	3	3	3
1437080405		3	3	3	4
1437080406		3	3	3	4
1437080407		3	3	3	3
1437080408		3	2	3	2
1437080409		1	4	4	3
1437080410		3	2	3	1
1437080411		3	1	2	4
1437080412		3	2	3	2
1437080413		3	2	3	4
1437080414		3	2	3	4
1437080415		3	3	3	4
1437080416		2	2	1	2
1437080417		3	2	1	2
1437080418		3	2	1	1
1437080419		1	2	1	2
1437080420		3	3	3	3
1437080421		1	2	4	4
1437080422		3	2	3	1

Blogging Result
 1=will continue to read course blog
 2=will continue individual blog
 3=will create new blog
 4=will delete blog
 5=other response

Blogging Persistence
 1=only when required
 2=every week
 3=occasionally
 4=never

Course Blog: when did you read the course blog?
 1=only when required 2=every week 3=occasionally 4=never

Peer blogs: activity with peer blogs
 1=read peer blogs regularly 2=read & commented on peer blogs 3=rarely read 4=never read

created blogs previously created blogs 0%
 no familiarity no familiarity 0%

Figure 3: Sample Microsoft Excel Workbook for the Introduction to the Internet Summer course

Instruments

Data collection used three distinct sources: the online student blogs, the questionnaire, and the student reflective essay. The online blogs continued for the

duration of the investigation, i.e., eight weeks, a comparable time period for the full 16-week semester of the fall course, and the shortened ten-week semester of the summer semester with lengthened class periods. Specimens of the course blog site (Appendix D), a student blog site (Appendix J), the blogathon (Appendix F) are included in the appendices. Screen captures of the software collection and analysis tools are part of the *Data Collection Artifacts* below.

Software

The exploratory and innovative nature of the research necessitated multiple software programs for data collection and analysis. Microsoft Excel as detailed above was the primary data collection repository. Data from Excel were analyzed through its add-in data analysis tools, through third-party extensions of XLMiner® (<http://www.resample.com/xlminer/index.shtml>) and XLStat® (<http://www.xlstat.com/en/home/>). Additionally data in Excel were exported to QDA Miner® (<http://www.provalisresearch.com/QDAMiner/QDAMinerDesc.html>) and its associated program of WordSTAT® (<http://www.provalisresearch.com/wordstat/wordstat.html>). The extensive use of analysis software provided a computerized consistency in coding retrieval and analysis.

Data Collection Artifacts

The computerized analyses used in the investigation incorporated multiple software programs. Microsoft Excel housed much of the initial data. Data were kept in separate Excel workbook files for each class. These workbooks were identical, using multiple worksheets for the element analyzed. The descriptive statistics used to provide a

numeric picture of the population were isolated by in the population worksheet which included the student identification number, the gender, and the resulting

Student ID	Blogging Experience	Added content	Read Course blog	Read Peer Blogs	Blogging Persistence
1425080401	3	2	2	2	1
1425080402	1	3	2	2	1
1425080403	3	3	2	2	2
1425080404	1	1	2	3	4
1425080405	3	1	1	3	2
1425080406	3	3	3	3	4
1425080407	3	1	3	1	4
1425080408	1	2	3	3	2
1425080409	2	3	2	2	2
1425080410	1	3	2	1	1
1425080411	1	2	2	1	1
1425080412	2	2	2	2	1
1425080413	3	2	2	2	1
1425080422	3	2	2	2	2
1425080430	1	2	2	3	4
1425080431	3	3	3	3	1
1425080432	1	3	3	4	5

Blogging Experience	Student Blog: Added content	Course Blog: when did you read the course blog?	Peer blogs: activity with peer blogs	Blogging Result
1=previously familiar with blogs 2=previously created blog 3=no familiarity	1=only when required 2=every week 3=occasionally 4=never	1=only when required 2=every week 3=occasionally 4=never	1=read peer blogs regularly 2=read & commented on peer blogs 3=rarely read 4=never read	1=will continue to read course blog 2=will continue individual blog 3=will create new blog 4=will delete blog 5=other response

Figure 4: Microsoft Excel Workbook Showing Data for ITNW142508

course grade. An additional worksheet for each course workbook tallied the answers to the five blogathon survey questions, i.e., previous blogging experience, level of contribution to student blog, reading of course blog, reading of peer blogs, and intention to continue blogging in the future.

Coding of the identified critical thinking categories was accomplished through the WordSTAT modules. WordStat as a text analysis software application uses automatic categorization of through either dictionary concordance or manual coding. The existing

data in Excel worksheets were imported into WordStat for further analysis of the numeric variables captured in the descriptive statistics of gender, and survey responses along with the content of transcribed text from the student blogs and essays.

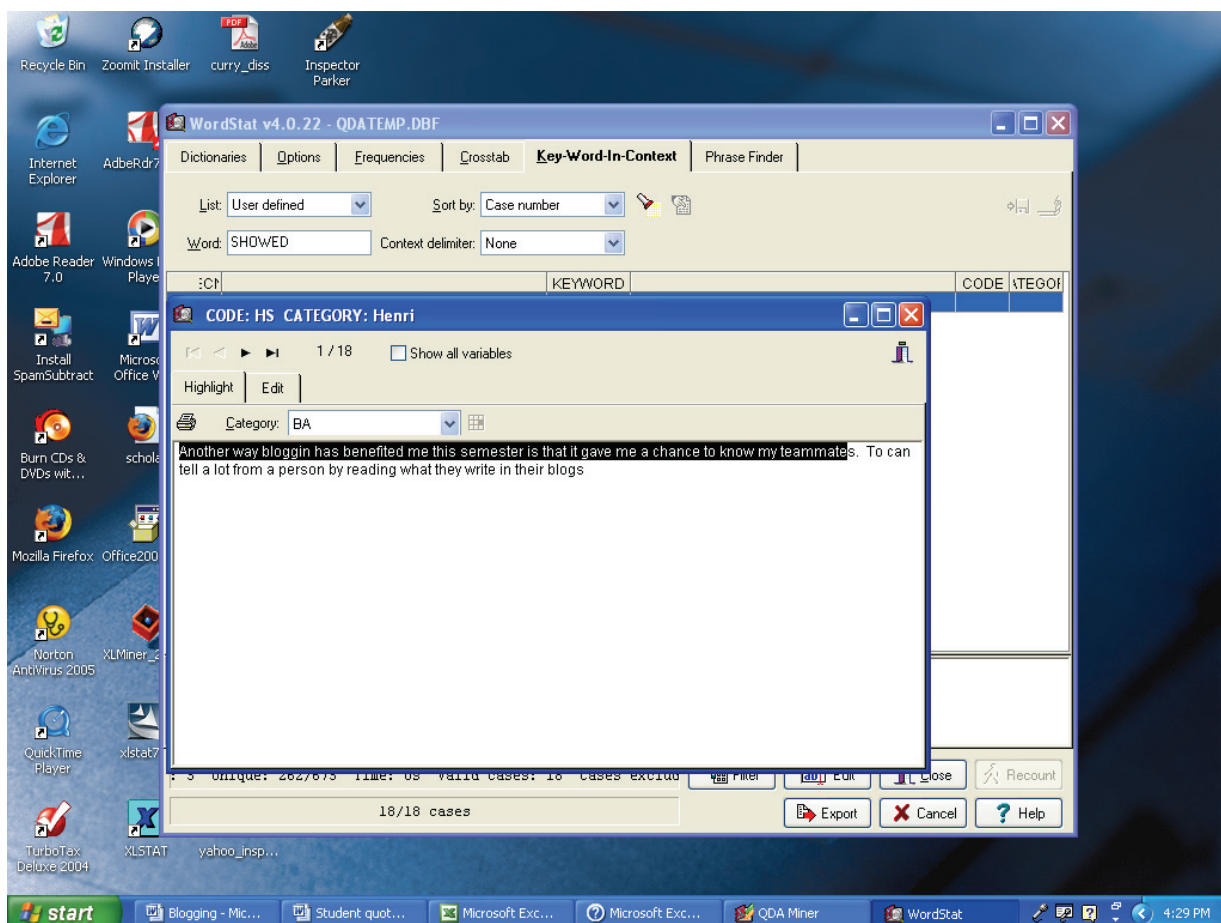


Figure 5: Screen Capture of WordStat module processing Bloom's Analysis (BA code) for KWIC

WordStat is a text analysis module that must be executed from within the QDA Miner text analysis software. QDA Miner creates views of code frequencies and relationships of user defined codes. Coding retrieval was a function of QDA Miner.

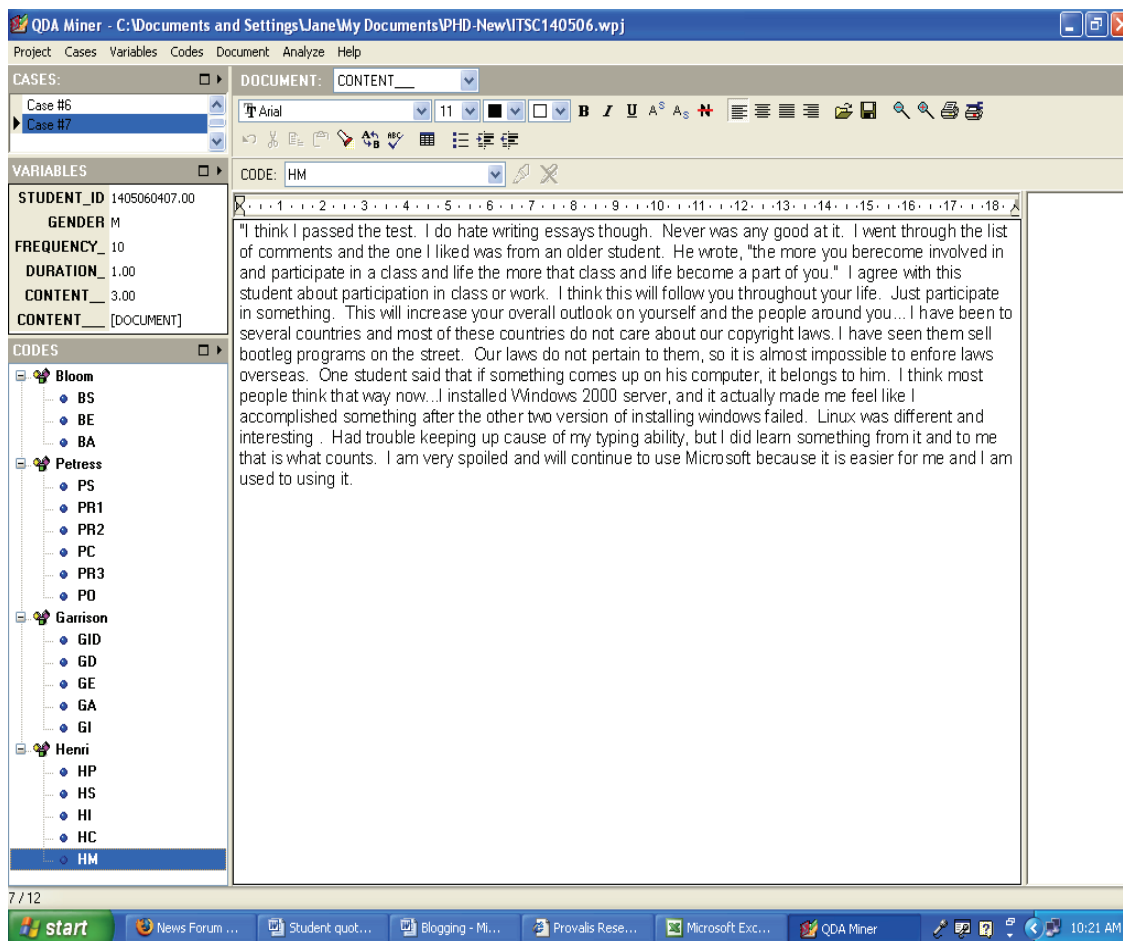


Figure 6: A screen capture of the QDA program showing the codes of the 19 categories from Bloom, Petress, Garrison, and Henri

Data Collection Procedure

Following the Neuendorf (2003) flowchart model, a nine-step process analyzed the blog data. First, the decision on experiment scope was made to include two courses over two semesters. The summer semester served as a pilot for the following fall semester. Each semester included two classes, although only one, the Introduction to the Internet course, was repeated. The investigation examined both the content of the student blogs and the student essay on evaluation of blogging technology. By defining student statements in both the blogs and the blogathon essay as critical incidents, a

conceptualization of the variables used in the investigation was made, completing the second step of the model. Creswell (1998) refers to the process as data management. It is the initial step in the iterative, cyclical, and often non-linear process of data management, data examination, data description, classification and continuous re-classification, and interpretation of the data.

The next two processes involved the internal validity of data collection. Internal validity is an integral part of the rigor of data analysis. It has been defined as function of the variables that are measured or controlled. In the research internal validity is addressed by asking if blogging made a difference in student learning behavior. Two units, the blog statements and the statements made in the blog technology evaluation essay, were studied. Using the three higher-order cognitive skills of analysis, synthesis and evaluation from Bloom's taxonomy (1956) as the basis for determining incidents of critical thinking, and extending those concepts with the six characteristics of critical thinking as designed by Petress (2004), the first nine codes were developed and imported into the software. The remaining ten codes were classified through Garrison's Five Stages of Critical Thinking (2001) and Henri's Five Dimensions of Computer Moderated Communications (1991), focusing specifically on cognitive skills. These statements were captured from the blogs and blogging essay and coded according to a coding dictionary created and used through the analysis software. Additionally, mentions of incidents recorded in the blogs of statements made by peer students in their respective blogs were also identified and recorded for processing. The use of content analysis allowed the author to identify and codify major constructs of words and phrases within the body of research (Weber, 1990). Building on the framework of the 2002 Schrire study, content

analysis concentrated on incidents of learning interaction, cognition, and discourse. The sets of data used in the investigation were collected through multiple instruments as listed in the table below.

An author-designed table of methods used on each of the instruments is indicated in Table 5.

Table 5: Specific Analysis by Data Collection Instrument (Author)

Data Collection Instrument	Content Analysis: A research methodology for relating symbolic data in the form of keywords in context KWIC to investigate content of written material	Cluster analysis: An exploratory procedure for combining similar objects into groupings or clusters, and then using those clusters as the basis for further analysis
Survey	None	Statistical multivariate cluster analysis – of relationships among three or more variables at the same time – blogging experience (question 1); reading of course and peer blogs (questions 3 and 4); AND action at the end of the course (question 5)
Blog postings	KWIC as defined by the concordance and coding scheme (Appendix B)	Counts of numbers of postings; lengths of posting data (by words), duration of posting over the semester including frequency, duration, and count of postings used in determining blogger type
Blog essay (Blogathon)	KWIC as defined by the concordance and coding scheme (Appendix B)	Combined with content analysis of blogathon to determine blogger type

Content analysis itself can be divided into two categories – conceptual and relational analysis (Erdener & Dunn, 1990; Newman, Webb, & Cochran, 1995). Through

the use of content analysis software, data on the concepts of computer science and the relation of the identified concepts within and among student blog entries were processed. Initially, both concept and relational analysis required the identification of and tracking of concepts or themes. Of these identified entities, distinctions were made between relevant and irrelevant concepts, which in the scope of the study, were determined by Bloom's taxonomic distinctions of higher-order thinking skills (1956). Henri (1991) identified five dimensions for collaborative learning: participative, social, interactive, cognitive, and metacognitive. Content analysis software was configured to classify and code the incidents of relevant text, and to calculate the resulting statistics. Finally, in pursuit of determining the value of web journaling as discourse among the students (Fiedler, 2003b; Paquet, 2002), relational statistical analysis explored, coded, and mapped the relationships among journal entries.

Using content analysis of the blog entries and blogathon essays along with the frequency, content, and interactivity of actual blogs, the results of student activity and the content of student blogs emerged as the basis for classifying student blogger types. The third method of analysis resulted from clustering. Cluster analysis is a statistical technique used to categorize cases into similar groups as a precursor to other analyses that use the information derived from the cluster analysis. Essentially it is a statistical exploratory procedure used when the expected results from the data are unknown. It was anticipated that students would be classified into groups, initially defined as by the author as Enthusiast (those who approached the blogging exercise with enthusiasm and frequent participation), Disenchanted (those whose enthusiasm and/or participation diminished during the ten-week period), Convert (those who began slowly or negatively, but showed

more positive attitudes and/or participation during the blogging period), or Anti-blogger (those whose comments were consistently negative and/or failed to participate). The data suggested the possibility of other group types; however, the limited number of students did not demonstrate all of these types. The blogger types that emerged from the classified data are discussed later in the report.

Within each category, the author isolated the concepts of Attitude, Action, Result, and Blogging Evaluation to determine the classifications. A subset of reactions that constitute student perception was analyzed through statements in the reflective essay to determine individual student perception of worth of blogging as a reflective tool. Potentially, grades of students could be correlated with student blogger categories to determine if perception of blogging worth was related to course content mastery. However, that analysis was beyond the scope of the current research.

As a method of research, all students were identified confidentially through a numbering system that identifies the course by course numbering system (1437 for Introduction to the Internet, 1405 for Operating Systems, and 1425 for Fundamentals of Networking); a series of numbers indicating the semester (0604 for June, 2004) and a randomly generated number for the individual. The author's initial concept scheme for identifying student blogger types was defined by attitude as analyzed by content analysis; by action as identified by quantity and frequency of blogs, by resultant action as identified in the student essay as an interest persisting in blogging after the conclusion of the semester, and by evaluation of blogging technology as a content analysis of the student essay on personal perception of the technology's value in the course.

The outcome of the investigation determined the validity of Internet-enabled blogging as an effective tool for student learning that was evaluated through student expressions of blogged thoughts, analyzed content, blogging activity, and essay. The investigation was intended to answer the primary research question to determine if blogging as a technology was an effective self-reflective and socially collaborative learning tool, or if, by its public nature, it was a disruptive and possibly negative technology in the learning process.

Software and Investigation Process

Data were compiled in a Microsoft Excel ® spreadsheet (Appendix G). Once the frequency and duration data were recorded, QDA ® Content Analysis software was used for the initial content analysis of comments included in the peer blogs and the student essays. The software is available for download through the SimStat website located at <http://www.provalisresearch.com/>.

In addition to the qualitative coding of blogs and blogathon essays in Microsoft Excel (Figure 3), content analysis software (WordStat) was employed to search for words or phrases, known as “keywords in context” (KWIC) that indicated the selected qualities, activities, and commonalities expressed in the blogs and essays (Figure 5). Coding schemes including the creation of a codebook or dictionary of measures and a coding form comprise the heart of content analysis. Precise design of the scheme was critical to the study’s validity.

Bloom’s taxonomy (1956) was the foundation instrument for critical thinking classifications. The top three classifications of synthesis, analysis, and evaluation

constitute the elements codified as evidence of critical thinking, while Petress' (2004) expansion of the concept included the six characteristics of critical thinking, namely sufficiency, reliability, relevance, consistency, recency, and objectivity. in the content of the message.

Theories from Vygotsky (1978) and Schon (1987) formed the pedagogical foundation for social learning and reflection respectively. Vygotsky's contribution to learning stated that mental development consisted of higher mental functions, cultural development, and the mastery of personal behavioral processes. These concepts were echoed in the proposed study with an investigation into student critical thinking, social learning, and behavioral changes brought about through the use of online reflective journaling. Furthermore, Schon argues that the contemporary application of technical knowledge, a concept relevant to vocational computer science students, requires the continuous use of rigorous problem solving skills, in an epistemological model termed "reflection in action" (p. 49). The model evolved from the need for practical competence in divergent situations that require unique solutions.

Schon's reflection in action theory is derived from the application of instinctive knowledge, which he defines as "knowing-in-action" (p. 54). He posits that knowing-in-action becomes "knowledge-in-action" (p. 59) when intuitive responses become deliberate applications of learned behavior. In the progression, Schon argues that learned behaviors from intuitive and deliberate experiences can be used as a patterned construct of knowledge through reflection. The reflective practitioner paradigm is an alternative, practical model of technical learning that parallels the traditionally rigid model of

scientific application of academic learning. This is particularly applicable to the hybrid academic-vocational training of the studied student population.

Data were collected electronically through the logs of the blogging software. Students were aware of the use of their blogs as input for course grading and as a method of peer collaboration.

The summer semester began on June 7, 2004 and concluded on August 13, 2004. The fall 2004 semester extended from August 30 to December 17, 2004. Although most computer science department web pages are hosted on internal, intranet servers, the blogs for the study was hosted through Blogger™ (<http://www.blogger.com>), at its Blogspot server, a free Internet site. By hosting the blogs outside the college intranet, students had access to the blogs from outside the departmental labs for the expressed purpose of being able to blog from school, home, or any location. The expressed purpose of the Internet host was to facilitate spontaneous blog entries.

Student participants were introduced to the concept through lecture, hardcopy handouts, and electronic online instructions. Participation in the web log reflection program was written into the syllabus of each of the following classes: ITNW1437: Introduction to the Internet: ITSC1405: Operating Systems, and ITNW1425 Fundamentals of Networking. Over the investigation period, the author taught sections each of these classes resulting in a participating population of 67 completing students.

As a supplement to the electronically captured blogging data, a survey section incorporated in the “blogathon” instructions (Appendix F) identified student blogging behaviors. At the end of ten weeks during each of the two semesters, the student in-class

blogging evaluation essay demonstrated any behavior and/or attitudinal changes stemming from the blog experience. The data were analyzed at the conclusion of each semester.

Data Collection

An investigation of student blogging activity combined with interpretation of student perceptions required multiple presentations of results. The compiled data of student blogging frequency and persistence were entered initially into an Excel spreadsheet (Appendix G) for analysis. These electronic data were further explored through Excel pivot tables and dendrograms (Appendix K) created through the plug-in programs of XLMiner and XLStat modules, and through exportation from Microsoft Excel ® to QDA Miner ®, for clustering .

Using a simplified form of cluster analysis as described later in the report, the following patterns of student blogging activity emerged from these data.

An additional consideration was the actual content of comments taken from student blogs and essays. Using key words culled from Bloom's taxonomy (1956), a coding schema as described below was generated to codify the text that evidenced the higher order thinking skills of synthesis, analysis, and evaluation. It was the combination of these skills that constituted the investigation's definition of critical thinking (Astleitner, 2002).

Table 6: Preliminary Coding Schema Using Bloom's Taxonomy

Skill (from Bloom's Taxonomy)	Key Words for Coding Schema
Analysis	Patterns, organizations, meanings, components, analysis, order, classifications, comparisons
Synthesis	Combinations, integrations, arrangements, designs, formulations, generalizations
Evaluation	Assessments, decisions, rankings, measurements, recommendations, discriminations, supports

Bloom's taxonomy of the cognitive domain (1956) was extended by Petress (2004) to include specific characteristics of the critical thinker. The updated interpretation provided further detail for identifying incidents expressing critical thinking on the part of students in their blogs and in their reflective essays at the culmination of the investigation.

Table 7: Preliminary Coding using Petress' Characteristics of Critical Thinking

Characteristics of Critical Thinking (Petress' Extension of Bloom)	Key Words for Coding Schema
Sufficiency	Demonstrated in context an adequate amount of background support for claims
Relevance	Demonstrated in context that the statements are pertinent to the overall discussion and that embedded terminology is defined
Reliability	Demonstrated in context that the information presented originated from qualified sources
Consistency	Demonstrated in context that internal and external observations and statements do not conflict
Recency	Demonstrated in context that the information expressed is current
Objectivity	Demonstrated in context that statements are unbiased

The investigation focused on the efficacy of blogging technology to the individual blogger type, rather than on an aggregate of the value of blogging in instruction. Building on Schrire's work (2002), data were compiled from the blogathon questionnaire section and the blogging comments in regard to interaction with course content, with the instructor, and with other learners (Moore, 1993). These data were analyzed by both quantitative (by frequency) and qualitative (by content analysis of terms) measures. To determine the efficacy of blogging technology, a cluster analysis was performed to identify blogging types.

Table 8: Interaction of Student Blogger Types

Student Blogger Type	Number of Interactions with:		
	Course Content	Instructor	Peer Bloggers
Enthusiast/Satisficer	High	High	High
Disenchanted	High to low	High to low	High to low
Convert	Low to high	Low to high	Low to high
Anti-blogger	Low	Low	Low

Ultimately, the research question concerning the efficacy of blogging technology was addressed. Frick (2002) categorizes the inquiry of effectiveness as either unique (blogging is a successful learning technology) or generalizable (blogging is effective when it achieves specific goals). These observable goals, culled from Merrill's determination of effective instruction (2001) are: (a) learning is problem-based, that is, it requires the higher order thinking skills of analysis, synthesis, and evaluation; (b) learning demonstrates prior learner knowledge; (c) learning is focused on instructional demonstration; (d) learning provides a forum for guided practice, which in the instance of the investigation is independent online research; and (e) learning encourages integration of knowledge gained with the learner's life. These data were compiled as averages through quantity by count and quality of relevance through content analysis.

Table 9: Learning Efficacy by Blogger Type

Blogger Type	Thinking Skills	Demonstration of prior knowledge	Focused learning	Practice through online research	Integration of learning with blogger's life
<i>Determination</i>	<i>Shows evidence of higher-order skills</i>	<i>Shows evidence of prior knowledge</i>	<i>Indicates relevance in blogs & links</i>	<i>Provides accurate and relevant links in research</i>	<i>Demonstrates relevance of topics to self use</i>
Enthusiast	Yes	Yes	Yes	Yes	Yes
Satisficer	Yes	Yes	Yes	Yes	No
Disenchanted	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No
Convert	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes
Anti-blogger	No	No	No	No	No

To determine the efficacy of blogging in the computer science curricula, Kirkpatrick's Levels of Evaluation (1959) was used (in Frick, 2002). These criteria measure student satisfaction, achievement, transfer to real life context, and results on organization, which was the departmental curriculum.

Table 10: Blogging Evaluation based on Kirkpatrick

Blogger Type	Satisfaction with blogging (from essay)	Achievement in learning (averaged by type from course grades)	Transfer to real-life context (averaged from content analysis of blog comments)	Results on departmental curriculum.
Enthusiast	Yes	Yes	Yes	n/a
Disenchanted	No	No	No	n/a
Convert	Yes	Yes	Yes	n/a
Anti-blogger	No	No	No	n/a

Environment for the Research

The resources necessary to develop, administer, and complete the study included the hardware, software, college administration, and student population. The hardware and software were Pentium 4 multiprocessor clients using Windows XP and Internet Explorer 6.0 browser and servers running Red Hat 9.0 Linux operating system to connect to the Internet and Internet-hosted web log server program, Blogger at <http://blogger.com>, with individual blogs hosted at individually named sites at the Blogspot server. Course connection to the server was from the departmental advanced computer laboratories, a series of three facilities with a total of 150 personal client computers running Microsoft Windows XP for student use, and five dedicated servers running Microsoft 2003 Server operating systems. Access to the laboratory was restricted to participating students who have accounts on the client computers, but are precluded from accounts on the dedicated servers. Students who had access to the Internet beyond the college laboratories were able to blog from any Internet-connected computer, from any Internet-connected cell phone, or from a Personal Digital Assistant (PDA), such as a Palm Pilot or Blackberry.

The participants were Central Texas College computer science majors, who have completed a minimum of eight semester hours of prerequisite computer science courses.

The project necessitated release forms and Institutional Review Board permissions from Nova Southeastern University (Appendix I) and Central Texas College (Appendix H). In addition, the computer science department chairperson granted permission to substitute student participation in the blog for one existing research paper requirement for the Fundamentals of Networking classes and the addition of participation in the other classes. The Dean of Instructional Services verified and approved the syllabus changes. The Institutional Review Boards of both institutions approved the research project prior to the beginning semester. The Dean and Department chairman approved the inclusion of blogging in each of the identified courses.

Qualitative analysis culminates in interpreted categorization of data. The elements used to develop categorized groups of student bloggers were instances of expressed relevance, and intentions to persist in future blogging, blogging activity both active posting of blogs and passive reading of course and peer blogs, and expressed perception of blogging in the learning process. The student blogger types that emerged from this two-semester study are defined in the table below and further explained in the next chapter on the report findings.

Table 11: Author Defined Blogger Types

	Attitude and Relevance (content analysis of blog postings)	Actions (count of blogs; and content analysis)	Persistence in future blogging (content analysis of essay; count of survey response)	Evaluation (content analysis of essay)
<i>Enthusiast Satisficer</i>	Posts enthusiastic content relevant to course material and interactive with content of other student blogs.	<i>Quantity:</i> > =8. <i>Quality:</i> Content relates to both course and peer blogs.	<i>Essay:</i> will continue to blog . <i>Survey:</i> “Enthusiasts” responded positively to question 5. “Satisficers” responded negatively.	Views blogging as effective NOTE: “Satisficer” fulfilled the requirements, but rejected blogging in essay
<i>Disenchanted</i>	Initially posts enthusiastic, relevant, and interactive content. Over the semester shows a decline in enthusiasm and/or relevance.	<i>Quantity</i> >5<8: Frequency of blogs decrease over time <i>Quality:</i> increasingly negative	<i>Essay:</i> Indicates no interest in continuing to blog after the conclusion of the course <i>Survey:</i> Responds negatively to question 5.	Views blogging as effective but indicates that there were negative conditions to offset any value in blogging
<i>Converts</i>	Initially negative statements, but become increasingly positive	<i>Quantity:</i> >5<8 <i>Quality:</i> minimally and/or irrelevant	<i>Essay</i> will continue to blog after the conclusion of the course. <i>Survey:</i> Responds positively to question 5	Views blogging as effective
<i>Anti-blogger</i>	Initially and consistently expresses negative statements	<i>Quantity:</i> <5 <i>Quality:</i> Little or no references to course or peer blogs	<i>Essay:</i> Categorically state that he/she will not continue to blog after the conclusion of the course <i>Survey:</i> Responds negatively to question 5	Does not value blogging

Environment for the Research

The research relied on software generated analyses at every stage. Data from the online student blogs, word-processed reflective essays, and online survey instruments were captured electronically and entered into Microsoft Excel spreadsheets, exported from the spreadsheet format to QDA Miner for further data mining, and ultimately explored by WordStat for consistent content analysis. The software employed for analysis provided a repository for the data, a set of instruments for the analyses, and a mechanism for graphically representing the findings.

Software generated data analysis has fundamentally changed content analysis by providing reliable and consistent searches for codes within electronic text coupled capabilities for analyzing the results. Paradoxically, computer assisted text analysis is limited by its reliable consistency in that the computer only recognizes character strings, not inferences that may be present in the text (Krippendorff, 2004; Neuendorf, 2002).

The qualitative method must interpret data. For this reason, the rigor of quantitative validity tests, not available in qualitative research, is replaced by triangulation of data collection methods and sets of data for internal validity standards, and the concept of limited generalizability of the findings as a corollary to the external validity measures of quantitative research. Internal validity assures that the investigation accurately addresses the research questions.

Validity

Content validity is defined as measuring that which it intends to measure (Gay & Airasian, 2000; Cozby, 1992). Attention was made to the specificity of the research as an

investigation of the efficacy of blogging technology. Seligman (1996) differentiated efficacy studies from effectiveness studies by the rigor with which the efficacy studies are controlled (in Meltzoff, 1997). The limited scope of the experiment necessitated that it be a study of blogging efficacy.

In this regard, the blogging experiment focused on three elements of student blogging: (a) the passive reading of the instructor's course blog; (b) the interactive discourse manifest in comments relating to peer blogs; and (c) the comments included in the individual student blog and related course essay on blogging. In these three aspects, data were collected to examine the four research questions. Data regarding relevance to the course topics were gathered from student blog postings relating to the instructor's blog. This was a method of examining the first research question (*What was the observable outcome, specifically related to evidence of reflective critical thinking in student learning, that was uniquely attributable to the technology of blogging?*) on observable outcomes in student learning success. Social learning, addressed in the second research question (*How did the use of blogging technology facilitate student collaboration to provide a viable forum for social learning?*), was measured through the content analysis of blogging comments relating to peer blogs. The second element used the data culled from blogs that reference other student blogs. The investigation of demonstrations of critical thinking, the third research inquiry (*On an individual level, how did the use of blogging technology encourage and document the progression of student critical thinking?*), was performed through the keywords included within student blog postings that are associated with Bloom's cognitive skill levels of analysis, synthesis, and evaluation (1956). Finally, the required student essay evaluating the

blogging experience (*What elements of blogging did students report provided motive to continue the reflective journaling process in future courses? As a subset of this research question, patterns were sought to see if student perceptions and behaviors could be codified into types of bloggers.*) was parsed to examine individual perceptions of the blogging effort, and determine if those perceptions changed the student's learning behaviors. The multiple analyses of the tri-part elements in blogging, specifically time, links, and comments, gave validity to the investigation by examining each element in relation to the four research questions.

An additional validity issue arose from the use of research that requires, as the investigation did, the use of both qualitative and quantitative approaches. Gay and Airasian (2000) identify action research as teacher determined, conducted, and interpreted. Invalid results would arise if care was not taken to collect tangible data, to set forth clear criteria for the practice of blogging that was investigated, and to delineate data from evidence.

Statistical reliability requires that test measurements are consistently accurate (Meltzoff, 1997). By repeating the blogging experiment over two consecutive semesters and using four sections of classes, the reliability of the research was increased. The use of content analysis software inserted the issue of rater bias in coding definitions, specifically in subjective determinations of positive or negative comments. Coding of blog postings and blogathon essays was accomplished through QDA software. Efforts were taken to design an objective list of data dictionary keywords for use in the content analysis application program, however, the researcher who also served as the course instructor, was the sole rater.

Once the raw data were collected, the use of blogger type categories required special care to avoid distortions of scale in distinctions among types. This required separate calculations per each of the five classifications of blogger type. Both quantitative counts and qualitative content analysis were used to classify student bloggers. The analysis was generated through computer software, a process which established construct validity.

External validity to establish the extent to which the investigation's findings can be generalized was problematic. By replicating the process in the succeeding semester, the findings of the first semester were somewhat generalized.

Reliability was demonstrated in that the operations of the case study, specifically data collection and coding procedures were repeated in each of the four courses with the similar results. Defined as the degree to which an operational definition is stable and consistent under similar circumstances, reliability involves consistency in measurement, repeatability of findings. Specifically, reliability applies to measure of item consistency (are blog posting responses consistent across constructs?), test stability (do responses vary when blogging data is coded repeatedly?), and consistency in administration of the process (were errors caused by differences in blogging instructions or surveys?). All these factors were consistent throughout the four courses.

Finally, validity of the research was enforced through replication by repeating exactly the blogging and essay/survey elements in a second semester case study. The findings showed consistent results throughout all courses.

Validity of Computerized Analyses

The four questions of the investigation were designed to explore the efficacy of the new technology of blogging, particularly in its dual nature of public and private reflective writing. The convergence of data sets gathered from multiple sources, namely, the online blog entries, the electronic essays, and the quantified answers to the blogathon survey, provided the qualitative triangulation of internal validity. Additionally, the blending of qualitative interpretation of keywords with the quantitative counting of survey responses supplemented the internal validity of the experiment.

External validity was achieved through the replication of blogging over two consecutive semesters. Although the process was repeated precisely in each semester, the uniqueness of the student population limited the generalizability of the findings beyond the studied population of learners.

Reliance on criteria from educational theorists, e.g., Bloom (1956), Petress (2004), Henri (1991), and Garrison (1992, 2002) compensated for the single rater of codes. Interpretation of keywords and phrases by a single, involved investigator also limited the generalizability of the investigation. Detailed procedures serve as a means of providing similar replication of the investigation to other researchers for further investigation.

The Research Design

The research design included iteration of the process; multiple instruments of surveys, written essays, and blog postings; and multiple analyses. It culminated in a

classification of blogger types that were applied to a hypothesis of expectation of success by bloggers in future iterations.

Creation of the blogsites preceded the data collection. The course site was established, consisting of a continuous blog from earlier semesters of the same course. The existence of a continuous blog provided an example of blogging as well as a resource for current semester students. Each student created a personal, or peer, blog that was linked to the course blog. At the start of each semester, peer blog links from previous semesters were deleted and current student blog sites were posted.

Throughout each semester the instructor provided weekly course-relevant links in each course blog. This served as a topic catalyst for student blogs, and a majority (93%) of the student blogs referenced these sites. In both the intranet and hardcopy instructions, students were informed of the boundaries for blog postings as well as the freedom of expression. Aside from the standard Internet usage policy of the college that prohibited objectionable and illegal use of Internet access, students were encouraged to express independent thoughts that related to the coursework and beyond.

During the ten-week period, each student was required to read the course blog and the linked peer blogs. Again, a majority of 99% indicated that they did. The students were also directed to post to their individual peer blogs weekly. For the total investigation a majority (87%) complied.

Summary

At the conclusion of the ten-week exercise, an in-class essay, termed the blogathon, was distributed to each student. The essay was combined with a multi-

question survey on previous and current blogging experience. Data from the survey question were analyzed through Excel. Data from the blogathon were coded into qualitative analysis software.

The final step in the multi-faceted exercise was the creation of an inductive research hypothesis based on the observed development of blogger types. The non-directional hypothesis can be stated as:

There is a significant difference in the mastery level of computer science course content between positive student bloggers and those students who are classified as negative bloggers.

Positive bloggers were defined as those classified as Enthusiasts or Converts, while negative blogger types were categorized as Anti-bloggers or Disenchanted bloggers. Qualitative research such as the investigation uses the exploratory identification of patterns, which in this case meant the creation of blogger types, to generate hypotheses (Gay & Airasian, 2000). The testing of the inductive hypothesis was beyond the scope of this work.

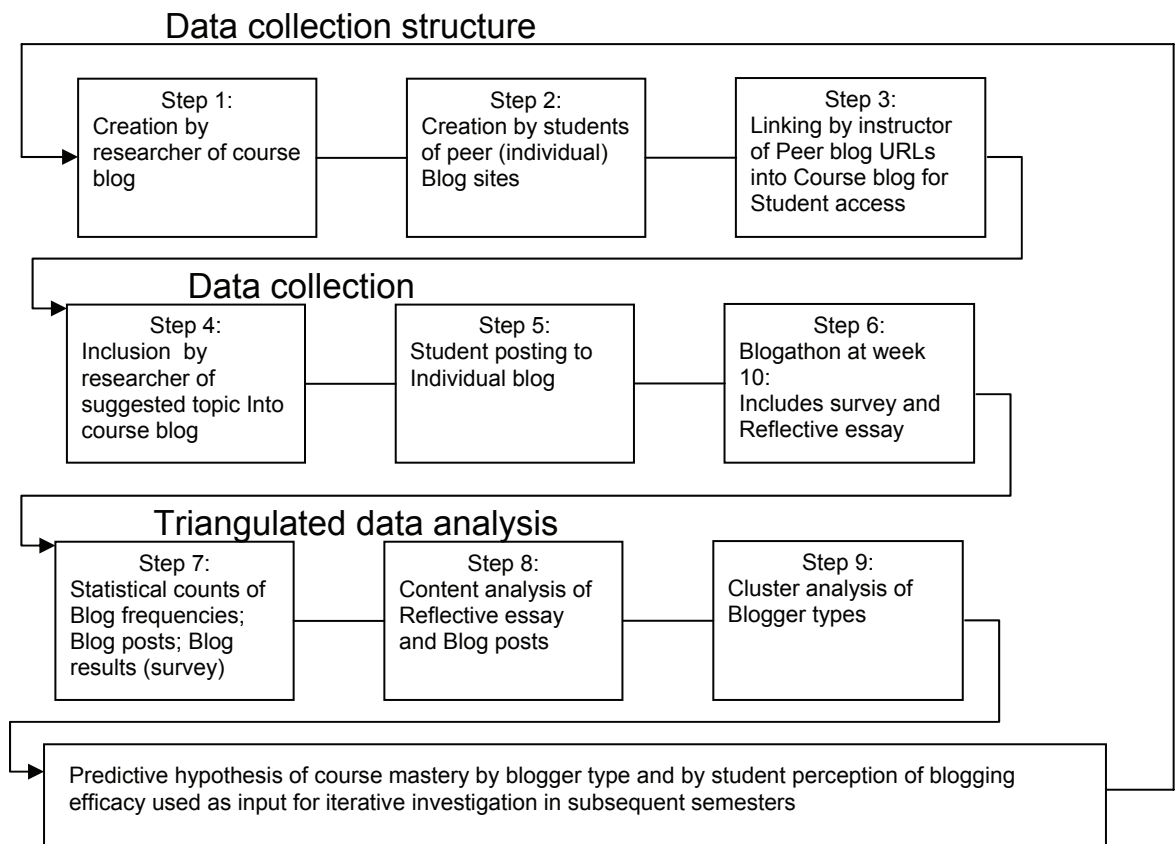


Figure 7: Iterative Research Design by Author

Chapter 4

Results

Data Analysis

At the conclusion of the summer 2004 semester data collection ended and the data from the student blogs, the student essays, and the survey were collected electronically for analysis. Using computerized software, the 19 codes were applied to the text of the blogs and the blogathon essay. Once the codes were assigned to text, the data were analyzed to identify (a) evidence of critical thinking as a behavioral outcome directly attributable to blogging as defined in Research Question One (RQ1), *What was the observable outcome, specifically related to evidence of reflective critical thinking in student learning, that was uniquely attributable to the technology of blogging?*, (b) evidence of social learning through blogging as defined in RQ2, *How did the use of blogging technology facilitate student collaboration to provide a viable forum for social learning?*, (c) evidence of the progression of student critical thinking as defined in RQ3, *On an individual level, how did the use of blogging technology encourage and document the progression of student critical thinking?*, and (d) evidence of student intention to continue of blogging as defined in RQ4, *What elements of blogging did students report provided motive to continue the reflective journaling process in future courses? As a subset of this research question, patterns were sought to see if student perceptions and behaviors could be codified into types of bloggers.*

The successive semester provided a means of replication of the process and the findings.

To identify instances of critical thinking in the blogs and essays, the definitions of analysis, synthesis, and evaluation were coded as BA, BS, and BE respectively. Table 12 below shows a representative sample of such instances from the all four classes:

Table 12: Excerpts of student writing addressing Bloom's higher level cognitive skills

	Bloom's Analysis	Bloom's Synthesis	Bloom's Evaluation
Coded as	BA	BS	BE
Example	<i>... it is helpful to see how others have approached targeting webpages to age groups [of Internet users]</i>	<i>As I study to become an IT specialist, I notice the growing trend toward networking....I see the idea of the Internet as being taken and used to construct global news and communication.</i>	<i>I have always been somewhat of a skeptic about new and different things. The blogging thing was not different. The simple class I signed up for turned into an adventure. It encouraged us to think, read, explore, listen, and write. The writing part pushed me because I am not a great writer.</i>
KWIC/phrase	<i>To see how –implies examination</i>	<i>Notice the growing trend – implies forecasting</i>	<i>Turned into an adventure – implies judgment.</i>

The extension of Bloom's taxonomy (1956) addressed by Petress (2004) provided a current description of the critical thinker. The elements of sufficiency, relevance, reliability, consistency, recency, and objectivity were labeled PS, PR1, PR2, PC, PR3, and PO respectively. Unlike the keywords in context that identify the three attributes of higher-order cognitive skills from Bloom's taxonomy (1956), the six characteristics of a critical thinker required reading and interpreting extensive sections of student writing to be determined. The first characteristic of sufficiency (PS) presupposed that the student blogger provided valid support for his claims. To ascertain the sufficiency of a statement, the data had to be interpreted by the actively involved investigator in the context of the course material presented in the class. The limited experience of students with the technology and their participation in an introductory class severely restricted the number of sufficiency instances. Beginning students were hesitant to make statements of substance, but those who did were intrepid. One student stressed her expertise at every opportunity, including this statement in her culminating essay:

I have been on the internet since 1996, designing and maintaining websites including a blog. I have to remember that I'm not the only one going on this [course] journey [of discovery]. There are my classmates, 24 other people of various ages and backgrounds taking the same course I am. How of them I wondered were like me? More importantly, how many of them were not like me?... [the age and experience discrepancies] weren't detrimental; in fact, it was pretty helpful. I was able to help out with some

parts of the course, refreshing and strengthening the existing knowledge I had.

Petress' next characteristic was less problematic. Relevance (PR2) to the topic under discussion could be identified by all involved, including peer bloggers. The lack of relevance in a networking student's blog incurred the indignation of a peer who commented as follows:

When people are blogging about El Torito as a restaurant [rather than the hardware/software concept], get a clue. Come on now, we are in a computer class. This is not Home Economics. I think they just typed in El Torito and the first thing that appeared on the search engine; they made into a link on their blog. That told me immediately who [in the class] was going to contribute and who was going to do only what is necessary to get by

The characteristics of reliability (PR2) and consistency (PC), like that of sufficiency (PS), required repeated reading and interpretation by the investigator to discern individual student contributions in the blogs. Reliability occasionally overlapped with the characteristic of objectivity (PO) as student bloggers referenced and linked to non-objective resources such as hardware and software vendors, and questionable non-expert sites such as personal, rather than academic, websites. Students who linked to sites of dubious value often made misleading, inconsistent, and erroneous statements. Students who demonstrated consistency included statements in their blogs and essay such as this:

DOS as an operating system is no longer viable because the newer applications cannot run in real mode or under 640K of base memory... but for specialized or custom written applications, this is a very easy and simple OS that has almost become freeware if you search the Internet.

The cited blog entry exhibits recency in the current status of the DOS operating system, sufficiency in the accuracy and basis for the claim, relevance to the course (PC Operating Systems), reliability in the body of blogs submitted by the students, consistency in the logic expressed throughout the blogs by the student concerning DOS as an operating system, and objectivity in the links to academic references. The allusion to DOS as freeware, however, was interpreted by the investigator as inaccurate.

Beyond identifying instances of personal critical thinking, the investigation sought to locate examples of collaborative learning. As a publicly accessible entity a

blog serves both as a personal platform for individual thought and as a repository of information for others to examine. Theories for collaborative computer-assisted learning were gathered from Henri and Garrison's bodies of work.

Henri (1991) focused on computer mediated learning by identifying five dimensions of computer mediated communication (CMC) as participative, social, interactive, cognitive, and metacognitive. To be consistent in coding these five were coded as HP, HS, HI, HC, and HM respectively. Henri's five dimensions served as the basis of much subsequent research including Garrison's (2000) cognitive presence model which assessed critical thinking skills used in problem solving. Garrison categorized critical thinking concerning problems into problem identification, problem definition, problem exploration, problem applicability, and problem integration which were coded as GID, GD, GE, GA, and GI respectively.

Examples of Henri's five dimensions were marked by iterative readings of each blog and essay. Henri used the message unit in her work. This was replicated in the current investigation as the preferred way to isolate the characteristics of both Henri's and Garrison's units.

Participation as a defining element of CMC was identified quantitatively as well as qualitatively. The participative blogger posted information and links relevant to the course material and the class discussions. He or she routinely took an active part in extending the class topic beyond the lecture hall to the blog site as a blog or a comment to the course or peer blogs. When the discussion online became a conversation with several students participating, the blog entries were coded as interactive with peers and/or with

the course blog. Many students used the blogs as a social forum that contained messages both relevant to and extraneous to the coursework. These incidents were coded as social without regard to the focus of the topic. Social in the investigation was a term only referring to interpersonal information. Although some students used the medium of the blog as a social site, most of the blog postings had a minimal course focus.

These 19 codes were marked using computer data mining software and analyzed for frequency. All coding retrieval was computer generated and retrieved by codes. The code retrieval was segmented by participating class and by individual theorist. Frequencies of each code are shown in the table below.

Table 13: Frequencies of Codes by Class

	ITNW143706	ITSC140506	ITNW143708	ITNW142508
BA	4	7	14	6
BS	2	3	4	3
BE	14	8	34	18
PS	1	0	5	4
PR1	0	1	0	2
PR2	3	2	3	6
PC	0	1	0	2
PR3	0	1	0	5
PO	0	2	0	3
HP	0	5	1	8
HS	3	1	3	4
HI	0	45	10	8
HC	8	4	13	7
HM	9	6	9	5
GID	1	3	5	2
GD	2	7	6	3
GE	2	4	3	2
GA	1	1	3	3
GI	0	0	1	3

Classifying Student Bloggers through Cluster Analysis

With the data available in electronic form, a coding process used frequency of blogging activity to identify types of bloggers through the number of individual blog posting. The resultant two categories of bloggers emerged: those who posted the minimum of eight or more times over the 10-week period (37 students or 55%) and those who posted less than the suggested minimum (30 students or 45%). All 67 students in both semesters posted at least one blog, and all wrote the reflective blogathon essay. The average number of blog postings for the entire population was 7.66 posts per student, or slightly less than the required eight postings of one per week, excluding the first and last weeks of the 10-week investigation.

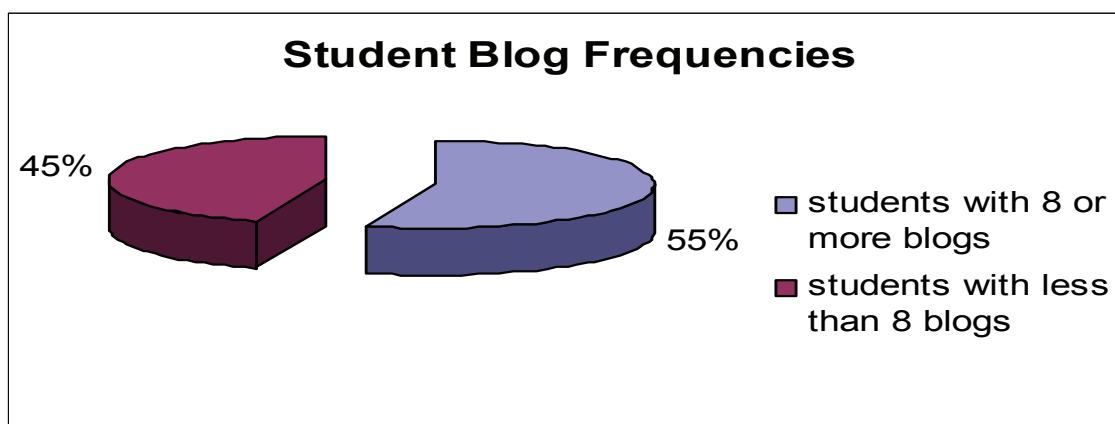


Table 14: Student Blog Frequencies

Additionally, data on the prior experience of the student bloggers indicated that 40.3 % of the students had had some prior experience with reading or creating blogs, while blogging was totally new for 59.7% of the students as shown in Table 15: Blogging

Experience (Survey Question1). Further breakdown of blogging experience by type is discussion later in the report.

Table 15: Blogging Experience (Survey Question1)

Total Students	67	percentage
No experience	40	59.7%
Some experience	27	40.3%

Findings for Phase One: The Summer Semester

Background to Summer Semester

Research during the summer semester involved two classes, an Operating Systems class (ITSC1405) and an Introduction to the Internet and HTML (ITNW1437). A course blog was established for each at <http://newitsc1405.blogspot.com/> and <http://newitnw1437.blogspot.com> respectively. Each of the participating students (P=28) created an individual or peer blog, and all peer blogs were linked to the course blog. Data were collected on quantity of blog posts, quality of relevance of blog posts, intention of persistence in the blogging process beyond the duration of the semester, and the perceived student value of blogging as culled from a content analysis of the blogathon essay, the blog posts, and the culminating student survey. All students in both semesters were aware of the research effort involving blogging.

Evidence in Response to Research Question One

Research Question One sought evidence of critical thinking as a behavioral outcome directly attributable to blogging. Answering the question required a presumptive analysis of the unique attributes of blogging. These were determined to be

time, linking, and collaboration as stated in the previous chapter reviewing the available literature.

Time was a major factor in the summer classes. Some students complained of the time constraints, even using the mechanics of blogging as a detrimental factor, such as the student in the summer Operating Systems class who wrote:

Every time I blog I have trouble getting in [to the student's blog site], simply because I don't remember my username or password. I sure I have created at least 8 [blogs] and have only located 2. I don't remember how to get to the screen where it shows the topic of the day. Consequently, I can't truthfully write on a specific topic. When I am walked through [the process], it seems simple enough to remember. By the next class time, it's a different story. I think I maybe burned out on rushing to work, rushing to class; just everyday life rushing, rushing.

Others were more equivocal on the value of blogging as the respondent from the summer Introduction to the Internet course who indicated:

I will need to decide if the time I devote to blogging is worth the expense in time. There was a time when I didn't know if learn to use a computer was worth the time. I now think it was. I may find similar rewards in blogging.

The value of linking, as an intrinsic part of blogging, found proponents such as the reflective essay comments as did the student who blogged:

To put a face to what we have done in class, I would call our blogs as dynamic as the complexity of the Internet itself. We covered a broad range, from trends in technology to practical applications of what we were currently working with. One of my peers wrote "technology and information can go well together, but there is always the potential for someone to misuse or abuse it." I would have to agree completely because everything out there on the web, in life, is not always what it seems and can be purposefully false.

This "journey" that we have been on, through the blogs, over the net and down the wires hasn't so much been an eye opening experience as it has been a mind broadening one. I've known that the net is a vast place and have often used it resourcefully as a tool, but there is always something new, something interesting in a way of conceptual to actual.

Fabrics that emit light, who would have thought. I wouldn't have lest it was a blog topic. .. As I study to

become an IT specialist in the area of maintenance and repair, I notice the very-growing trend toward networking, more so than I think most others do. I see the idea of the Internet as being taken and used to construct global news and communication.

Perhaps the communication and news organizations will merge and become a mega-corporation to accomplish this. It seems a little sci-fi and predictionish [sic] but with the way the economy is moving toward a global setting it would only make logical sense for everything to be interconnected with the ability to be accessed from just about any point on the globe.

I've always tried to expand my horizons, keep an open mind about possibilities and keep myself informed and up to date on technology. It's becoming such a vastly important aspect of our lives and this course has strengthened this concept for me.

Many previous researchers (Henri, 1991, Garrison et al., 2001; Schrire, 2002) focused on the presence of collaboration in learning. Although collaboration was evident in the blogs of many, it was more apparent in the responses to question four of the blogathon survey which asked, “How often did you read the blogs of your peers”? The summer semester indicated that all students in both summer courses read the blogs of their peers. This was not the case in the fall semester, however. In that semester, three of the 39 students or 8% of the registered students admitted to never reading their peer blogs.

Evidence in Response to Research Question Two

Research Question Two sought content evidence of social learning through blogging. Using the codes of Henri’s Five Dimensions (coded as HP, HS, HI, HC, and HM) and Garrison’s Five Stages (coded as GID, GD, GE, GA, and GI) the quantitative software revealed the following:

Table 16: Collaborative Critical Thinking - Summer Semester

Course	Instances of Henri’s Five Dimensions	Instances of Garrison’s Five Stages
ITSC1405 – Operating Systems	15	8
ITNW1437 – Introduction to the Internet	19	6
Combined Summer Classes	34	14

One student stressed the importance of collaboration in the comments, *“In the world today, there is [sic] knowledge learning and interactive learning. We as human beings have a lot to discover. I think if we apply our selves and are open minded, we will see that communication is a plus. So blogging is a way to understand and see new ideas.”*

The concept of collaboration in learning was echoed by a peer who said:

I got to read and think about other people’s opinions on different situations on life issues which is very educating due to the fact that all of us haven't seen things that others may have. I also have learned how different people deal with the same type of situation; just different ways of solving it so your mind is always running with information and new thoughts on how you may better yourself or how to better the outcome.

In the Operating Systems class, the concept of collaboration was expressed by a respondent who stated, *“In reading the blogs, I learned quite a lot about other people and the things that they write or perhaps the way that they think, the way they feel.”* His peer found his own uniqueness through blogging by commenting,

Through the course of this semester I have created blogs and read blogs of their students from across the internet, and I have come to find out that I have some very unique perceptions on life and the world around me. It has made

me put my future into perspective...I was really confused about how I wanted my future to deal with computers and the world of technology. I have discovered that I am a semi-computer geek.

Evidence in Response to Research Question Three

Evidence of the progression of student critical thinking as defined in RQ3 (“On an individual level, how did the use of blogging technology encourage and document the progression of student critical thinking?”) used the codes of Bloom (codes as BA, BS, and BE) and the modern extension of Bloom in Petress (coded as PS, PR1, PR2, PC, PR3, and PO).

Table 17: Individual Critical Thinking - Summer Semester

	Instances of Bloom’s Higher Order Cognitive Skills	Instances of Petress’ Extension of Bloom’s Higher Order Cognitive Skills
ITSC1405 – Operating Systems	6 in 13 (46%)blogs 13 in 13 (100%) essays	2 in 13 (15%) blogs 5 in 13 (42%) in essays
ITNW1437 – Introduction to the Internet	2 in 19 blogs (10.5%) 19 in 19 essays (100%)	1 in 19 (5%) 3 in 19 (16%) in essays
Combined Summer Classes	8 in 32 (25%) blogs 32 in 32 (100%) essays	3 in 32 (9.3%) blogs 8 in 32 (25%) essays

These coded incidents include a student evaluation on color choice for her webpage project in the Introduction to the Internet class. She stated, “*This is one of the best websites I’ve seen... in my opinion the colors and the animation does [sic] improve*

the website. I enjoyed all the colors but the one I like the most was the color purple which I chose for my student webpage. The color purple represents ambition, art, anxiety, and aristocracy.” Here the student expressed an opinion on color choice (a lesson requirement), enhanced her opinion with research on the psychology behind color that reflected her self image.

Evidence in Response to Research Question Four

However, the final research question necessitated an analysis of the evidence of student perception of the value of blogging. For the analysis, both the responses to survey question five on intended continuance of blogging and the comments in the reflective blogathon essay were examined. Table 20 displayed the survey response to blog persistence for summer. Comments culled from the student reflective essay at the culmination of the blogathon were also revealing.

The Emergence of Blogger Types

An outcome of qualitative research is the classification of data into categories. At the onset of the investigation, the research posited that four distinct types of student bloggers would emerge as a result of observable blogging activity. Unexpectedly a fifth type, the data revealed a fifth distinct type of the pragmatic *Satisficer*.

Table 18: Proposed Student Blogging Type by Frequency

Student Blogging Type	Observable Blogging Activity (measured in frequency and persistence)
Enthusiast	Posts more than required number of blogs throughout the semester
Disenchanted	Quantity of blogs decrease over course of semester
Converts	Quantity of posts increase over course of semester. (This type was also distinguished from Disenchanted through content analysis of satisfaction component through the evaluative essay.)
Anti-blogger	Quantity of posts number minimal to none

From the Operating Systems class one student gave his evaluation on blogging in this way:

I have always been somewhat of a skeptic about new and different things. This blogging thing was no different. The simple class I signed up for turned into an adventure. It encouraged us to think, read, explore, listen and write. The writing part pushed me because I am not a great writer. This was personal writing, not business writing and that made it a little harder... I felt obligated to read, think, and blog. I did not think I could write so much until I read over what I had done. I know what I have written will not fill volumes but it is mine. It is from me. That is what everyone out there blogging is doing. They are sharing something from themselves. I have lost the skepticism about blogging that I had when I started this course.

*Having to look at the wide variety of subject in the course
blog helped. It made me think outside my little box.*

According to the research design, the next logical step required the determination of student types. The creation of classifications is a common practice in qualitative research. Furthermore, it was a requirement for the ultimate goal of determining the efficacy of blogging in course mastery. A rubric (Appendix C) was designed to classify blogger types, although these preliminary categories were modified through the data as analyzed by cluster analysis.

The elements of the rubric are both quantitatively and qualitatively derived. The survey instrument distributed at the Blogathon, included responses that will determine the frequency of blogging. Enthusiasts have the highest requirement of blogs at a minimum of one per week, excluding the first and last weeks of the investigation, for a total of eight. The Disenchanted and Converts, according to the design, have posted less than the minimum, but more than one-half the requirement at five. The Disenchanted started with eager blog postings, only to slack off in the later weeks. Likewise the Converts have a five to ten range of posts, with frequency increasing over the research period.

Qualitatively, the more subjective aspect of positive or negative expressions in the blogs and the blogathon essay were determined. This is highly problematic, but the research attempted objectivity by setting a majority rule, that is, if the number of statements are more than 50% positive, a positive is recorded, or if 50% of the statements

are judged negative, then a negative is recorded. Virtually all of the statements were unambiguous, which created a simplified method for the procedure.

The number of posting differentiated the Enthusiast and Anti-blogger types, but the Disenchanted and Converts were rated with the same number of postings. These two types were distinguished by persistence and comments in the reflective essay. The Disenchanted indicated that they would not continue to blog beyond the semester and furthermore submitted a blogathon essay with more than 50% negative comments on the blogging process. The Converts indicated on the survey that they intended to blog voluntarily and had a positive report of blogging on their essays. Further research might undertake an activity over time to investigate the point at which student bloggers declined in blog postings and in blogging content to identify more precisely the reasons for blogging success or failure.

Table 19: Rubric to Determine Blogger Types

Blogger Type	Quantitative Analysis			Qualitative analysis	
	# of blog postings	Duration	Persistence Survey Q5	From blogs	From essay
Enthusiast	≥ 8	Full period	Beyond semester Any response not 4 (delete blog)	Positive	Positive
Disenchanted	$>5 < 8$	Partial	Not beyond Response 4	Either	Negative
Convert	$>5 < 8$	Partial	Beyond semester Any response not 4 (delete blog)	Either	Positive
Anti-Blogger	< 5	Partial	Not beyond Response 4	Negative	Negative

Cluster Analysis

Strauss and Corbin (1998) suggest that research analysis is a dynamic exchange between researcher and the data as examined both quantitatively and qualitatively. As the initial summer phase of the investigation proceeded, it became apparent to the author that quantitative keyword counts supplemented by qualitative interpretations of content resulted in patterns of blogging activities that could be classified by types of student bloggers. The types that emerged were unknown prior to the research and became obvious only through the use of cluster analysis. The grouping of bloggers into types is a typical procedure in qualitative research. The resultant groupings or cluster are subsequently used for as input for further study (Afifi, Clard, & May, 2004).

Cluster analysis is a multivariate statistical classification technique used to determine groups by making quantitative comparisons of multiple variables. Traditionally data mining is the exploration of large sets of data that uses cluster analysis of either the cases (the students) or the variables. The study focused on the clustering of students into

previously unknown groups for the purpose of determining, which, if any, types of students benefit from blogging.

The groups or classification of types that emerge from cluster analysis can be used subsequently as exemplars for further study, in the case as a predictor of the efficacy of blogging for student reflective learning. To ascertain true distinction among groups, cluster analysis statistically determines that the differences within any group should be less than the differences between groups. QDA Miner ® was the software employed to perform these statistical functions. The variables used to discriminate among these types were: (a) responses to the student survey administered at the end of the experiment, (b) evidence of interaction among student blogs, (c) evidence of interaction between student comments and the course content, (d) content analysis of blog postings, and (e) content analysis of student essays. As a result, (Appendix L: Cluster Analysis) five distinct student blogger types emerged: (a) the Enthusiast, (b) the Satisficer, (c) the Disenchanted, (d) the Convert, and (e) the Anti-blogger.

Formative Evaluation: Prototype Bloggers for Summer 2004 Courses

The Enthusiast

Actions by the defined type of blogger address the student's attitude as well the relevance of his or her blog posts. Initially the blogger type posted with enthusiastic content that was relevant to course material, and interactive with content of other student blogs. The blogger type continued positive comments for the duration of the blogging period. An example of positive comments is the initial blog concerning the process of creating a blog in the Operating Systems class:

Not a hard operation to get started. This may not be as bad as I thought.

He followed that beginning observation with a series of other positive comments including the observation that directly addressed the vocational focus of a community college student:

I think most college students take sites like Salary.com for granted. The vast amount of job description, salary, and other demographic information available did not freely exist a few years ago. The information here is free to anyone with internet access. Only a few years ago information like this could cost a job hunter hundreds of dollars. I think it is great to have this much information available so easily now. It gives potential employees information they can use to their advantage.

On August 4, 2004, the same student concluded his collection of blog posting with the final entry concerning the impact of blogging technology on society. He wrote:

Oh my gosh. I thought, what the heck, I'll look for blogs on the "2004 Election" and see if I get anything. I sure did. 48,700 results and it only took 0.19 seconds.

The passion that comes out in some of these blogs can be

surprising. Republican or Democrat. Conservative or Liberal. Politics can really make people get involved. Even the candidates have blog sites. You can get news blogging, personal opinion blogging, sarcastic blogging, ethnic blogging, humor blogging, and many others. Most of the blogs are in good taste but a few are downright rude and crude. If you go looking, be careful.

In regarding to the quantity of activity, the type of blogger posted more than the required minimum of one blog per week. The student in the summer semester who posted the most number of blogs was a female in the Operating Systems course. She posted every week, with multiple postings in two of the weeks. Unfailingly her posts were course related, as in this example:

Today I learned how to install Linux. It was a little boring, but after I did a couple of commands, I thought it was kind of cool. Because I have learned a couple of things that I never knew.

However, by definition, in evaluating quality, blog posts relate to both course and peer blogs. Although the student was a frequent blogger, she often mixed her personal life with her comments on the course. The title of the blog, *Toothday and Confused*, was a pun on Tuesday, the day the class met.

I went to the dentist today and [sic] gotten my tooth pulled. It is not hurting yet. But I know as soon as this numbing medicine wears off, I am going to be in trouble. But I have some medicine for that. But on the other hand, I can't get my letters in my [operating system] program to go small. I will keep working on it until I figure something out.

Persistence in blogging as evidenced from the survey indicates that the student of the Enthusiast blogger type will persist in blogging beyond the end of the semester. Of the ten Operating Systems students, one-half indicated that they will continue to read the continuous course blog beyond the duration of the semester, while 12 of the 18 Introduction to the Internet students (67%) indicated a positive persistence in blogging by indicating an intention to read the course and/or continue with their peer blog or create a new blog. Additionally, they will continue to read that course blog. On the negative side, only 4% of the combined courses indicated a negative intension regarding their future blogging. The survey choices were:

1 – will continue to read the course blog after the conclusion of the semester

2 – will continue to actively add to the individual blog

3 – will create a new blog

4 – will delete the individual blog

5 – other response. The category included those students who selected a combination of other choices or who did not give a response to this item.

A positive persistence in blogging was indicated in both courses during the summer semester. The first three choices of continuing to read the ongoing course blog, continuing to contribute to the existing student blog, or creating a new blog were construed as positive responses. The selection of deleting the course blog was determined to be a negative choice, although further revision of the survey instrument could remove the ambiguity from the choice and the final selection. It is possible that the choice “4” is not definitively negative and that choice “5” could be an accidental omission or an indication of several choices. The survey instrument failed to make clear these determinations. The table below illustrates the results of the persistence factor as determined by the survey instrument.

Table 20: Intended Persistence in Blogging during Summer Semester

Persistence in Blogging							
Summer	ITSC1405 # of blogs	ITSC1405 - %	ITNW1437 # of blogs	ITNW1437 - %	Combined # of blogs	Combined - %	
	1	5	50%	3	17%	8	29%
	2	0	0%	2	11%	2	7%
	3	1	10%	7	39%	8	29%
	4	4	40%	5	28%	9	32%
	5	0	0%	1	6%	1	4%
TOTAL	10		18		28		

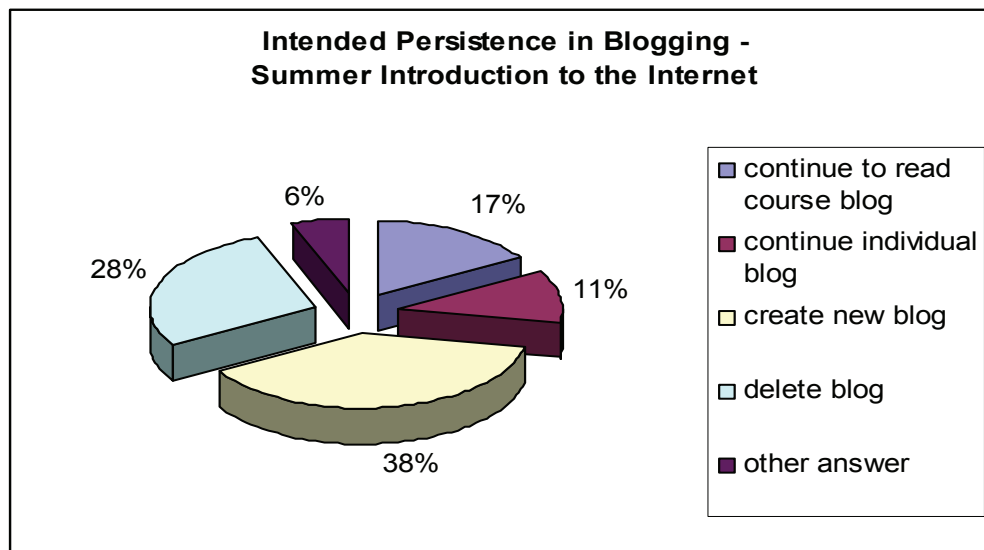


Figure 8: Percentages of Intended Persistence in Blogging in ITNW1437

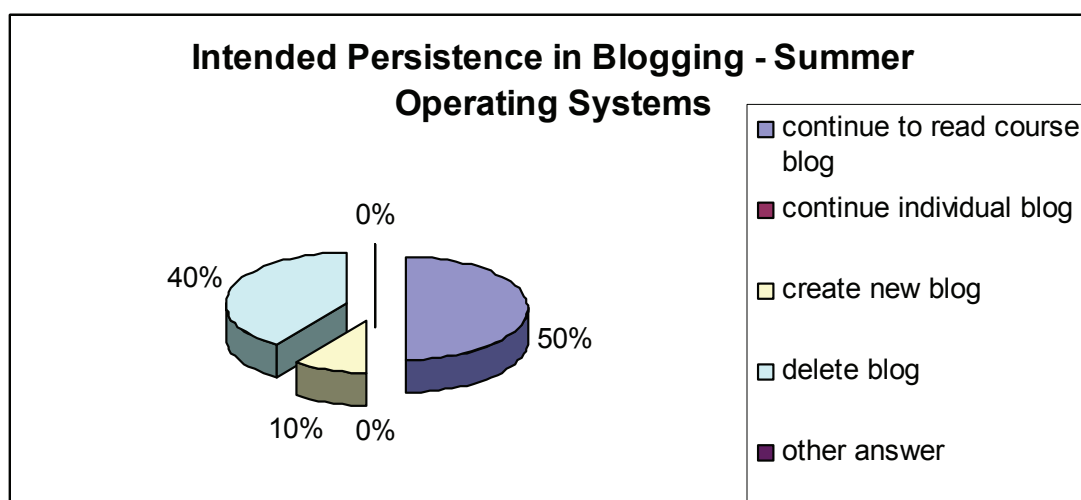


Figure 9: Percentages of Intended Persistence in Blogging in ITSC1405

Evaluation of the blogathon essay was accomplished through content analysis. The “Enthusiast” student blogger viewed the blogging process as an effective learning tool in his or her course education. An example of reflection on the value of blogging is

evidenced in the essay from a student from the summer operating systems course who wrote:

I have always been somewhat of a skeptic about new and different things. This blogging thing was no different. The simple class I signed up for turned into an adventure. [blogging] encouraged us to think, read, explore, listen and write. The writing part pushed me because I am not a great writer. This was personal writing, not business writing. That made it a little harder... I felt obligated to read, think, and blog. I did not think I could write so much until I read over what I had done.

Of the 28 student bloggers in the summer semester, 19 or 67.8% initially qualified as “Enthusiast.” by posting eight or more blogs. Of the group, only one indicated that he would delete his course blog at the end of the term. This disqualified him from the Enthusiast group, even though he posted more than the requisite number of blog messages. All 19 of the group posting in the required number of entries persisted for the duration of the investigation. However, the Enthusiast group also required a positive outlook on blogging. Of the 18 potential Enthusiasts, 13 or 72.2% recorded positive perceptions on blogging. This number constituted the Enthusiast group. The table below shows the clustering according to the frequency, duration, intended persistence, and perception of blogging. The disqualified bloggers, although initially qualified through the number of blogs posted, formed a new group, termed the “Satisficers” for those who pursue a course of action that satisfies the minimum requirements to achieve a goal

(<http://dictionary.reference.com/search?r=66&q=satisfice>) An example of the type can be found in the comments of the student, who stated in his culminating essay:

I didn't blog like I should have because I think that I spent more time on understanding the html codes. After reading some of the other student blogs I know that the majority of them feel the same way as I do....I 'm trying my best [in the mandatory essay] to show that I have read my blogs and my peers blogs...Some students were able to blog everyday, I'm not sure if they really blogged on anything of importance."

The group as defined, posted the required blogs as a means to a superior grade, yet failed to qualify as true "Enthusiasts" by including negative comments in their reflective essays, and/or indicating an intention not to continue blogging beyond the semester. Gay and Airasian (2000) point out that it is typical in qualitative design to see the emergence of new classifications. The characteristics of all blogger types, including that of newly discovered "Satisficers" will be addressed in the conclusions section of the report.

Table 21: Breakdown of Summer Enthusiast and Satisficer Groups

Population	Posted 8 or more blogs	Of the qualified those who blogged over entire period	In response to survey question 5, will persist in blogging	Positive comments on blogging in essay
28	19 (67.8%)	19 (100%)	18 of 19 (94.7%)	13 of 18 (72.2%)
Enthusiasts	13 of 28 (46.4%)			
Satisficers (Disqualified members of "Enthusiast" group)	6 of 19 (31.6% of group) 6 of 28 (21.4% of total summer population)			

The Disenchanted

Through the captured data, a third blogger type emerged whose actions or expressions displayed a diminished regard for the technology. Using the same rubric for categorization of all types, the "Disenchanted" blogger type began with frequent and relevant blog postings, only to exhibit a decrease in the number and quality of contributions.

The Disenchanted bloggers were a highly disparate group whose impediments to blogging ranged from personal time to philosophical reluctance. In attitude and relevance, the blogger type initially posted with enthusiastic content that was relevant to course material, and interactive with content of other student blogs. Subsequently, content analysis indicated that the blogger type demonstrated a decline in enthusiasm, and/or relevance, and/or interactivity over the blogging period.

In relation to blogging activity, the quantity and frequency of blog posts declined during the semester. Similarly, the quality of the posts declined as the blogger failed to relate to course and/or peer blogs. Another qualifying factor in the type was persistence. Persistence in blogging was gleaned from the blogathon essay as well as the response to survey question five. The Disenchanted blogger indicated that he or she did not intend to continue to blog beyond the semester.

The final factor determining the type was the student's evaluation of blogging itself. Through content analysis, the student blogger Disenchanted type indicated that for identified reasons there were negative conditions to offset any value in the blogging effort. Over the course of the two semester, these reasons were technical (could not access the blog, did not have access to the Internet), personal (no time, other non-course conditions), and/or evaluative (why blog when no one else is adding to his/her blog; reluctance to place personal thoughts on a public forum).

There was only one "Disenchanted" blogger type in the summer semester. Although his reflective essay contained some positive references to blogging, he indicated that outside factors influenced his decision to discontinue blogging. He stated,

I put very little effort into my blogs, just did enough to meet the requirement to write something. As I came to this conclusion [to cease blogging] some personal problems on the home front and a change in work schedules had an effect on my continuation and possibly a better use of the

blog to express my opinion on the course and the course blogs

The sole member of the “Disenchanted” blogger group posted six blog entries that demonstrated incidents of Bloom’s evaluation (BE) in the comment, “*But for specialized or custom written applications, this is a very easy and simple OS, that has almost become freeware.*” He also expressed the concepts of Garrison’s Problem definition (GD) and Petress’ Relevance (PR2) and Recency (PR3) when he stated, “*DOS as an operating system is no longer viable because the newer applications cannot run in real mode or under 640k of base memory.*” The individual indicated that he would delete his course blog, the deciding factor in classifying him as “disenchanted.”

Table 22: Breakdown of Disenchanted Type for Summer Semester

Population	Posted less than 8 but more than 5 blogs	Of the qualified those who blogged over entire period	In response to survey question 5, will persist in blogging	Of Group - Positive comments on blogging in essay
28	1 (3.5%)	1 (100%)	0 (0%)	1 (100%)
Disenchanted	1 of 28 (3.5%)			

The Convert

At this point another blogger type emerged. The new type of student blogger valued blogging, although his or her activities may not have qualified for an “Enthusiast” classification. This type of study blogger is listed under “Converts.” The Convert group was the activity opposite of the Disenchanted. While the Disenchanted activity

diminished over the duration of the investigation, the Convert blogged more frequently during the length of the blogging period.

In attitude and relevance of posting, this type was initially reluctant to post and/or posted negative statements. The “Converts” actions showed an increase in quantity as the semester progressed, in conjunction with content and links that demonstrated quality of reflections as defined by the 19 data points of Bloom (1956), Petress (2004), Garrison (1992, 2002), and Henri (1991). In attitude, the blog posts and links progressively indicate interaction with the course and peer blog discussed topics. In the area of persistence in blogging as determined from the blogathon essay and survey question five, this type of student signaled an intention to continue blogging. In the reflective essay the student type reported an initial negative attitude toward blogging as a technique for learning and further indicates that he/she will consider blogging beyond the semester. Finally, the Convert type indicated a positive perception of the blogging technology in his or her educational process.

Of the 28 student bloggers during the summer semester, only one qualified as a “Convert.” The student complained of initial difficulties in creating a blog but once she had overcome these technical problems, she posted on a regular basis.

The sole Convert in the summer classes had mixed messages in her essay. She observed that a blog is *“kind of like a journal in a way, and I’m not too big on journals, so I guess it’s just not my thing. But it’s still cool in ways if the topic is something that really interests you and you really want to voice your opinion.”*

Within her blog postings the Convert carefully commented on each of the course posted sites. She exhibited instances of analysis (BA) and evaluation (BE), as well as interactivity with peer blogs (HP and HI). Her insights on blogs lacked some relevance to the course topic (“*I especially like the ones who blog about newly release movies. It gives me an idea of whether I should actually see them at the theater or just wait to rent it.*”). The lack of relevance (Petress PR3) was partially attributable to her non-computer science major, a fact that caused her some difficulty through the semester.

Table 23: Breakdown of Convert Type during Summer Semester

Population	Posted less than 8 but more than 5 blogs	Of the qualified those who blogged over entire period	In response to survey question 5, will persist in blogging	Of Group - Positive comments on blogging in essay
28	1 (3.5%)	1 (100%)	1 (100%)	1 (100%)
Convert	1 of 28 (3.5%)			

The Anti-blogger

In attitude and activity the final type is classified as an “Anti-blogger.” The individual initially and consistently expressed negative statements against the concept of reflection, collaborative knowledge sharing, and/or the public nature of blogging. In quantity, the blogger type posted the least number of blogs, less than five over the entire term period. The blogs that were posted did not relate to either the course or peer blogs.

Consistently, the Anti-blogger's attitude toward persisting in blogger was also negative. He or she indicated in the blogathon essay and/or the survey question on persistence, that there was no intention of continuing to blog beyond the semester. Furthermore in the evaluation from the blogathon essay, students of this type indicated that they did not value blogging as a technology for reflection and/or did not value the concept of reflective learning.

Of the 28 summer student bloggers, seven (25%) qualified as "anti-bloggers." The section on conclusions examines the factors that contributed to each identified type, focusing on both the positive aspects of blogging as mentioned by Enthusiasts, Satisficers, and Converts, and the negative elements identified by the Disenchanted and Anti-Bloggers.

In the pilot summer semester, blogging was a new experience to the majority (67.8%) of the students. The anti-bloggers of the term cited technical problems as the primary obstacle to a successful blogging experience. A typical anti-blogger essay included the statement, *"I had so many frustrating days that I cannot count them. The hardest and most agitating part of the semester was not being able to have my blog working correctly. That was one thing that had me upset the most. I really didn't want to read any of the student blogs because I could not get mine to work."*

A characteristic of the "anti-blogger" type was the paucity of blog postings. Although some students categorized as this type by posting fewer than five times, there were both positive and negative comments in the recorded messages. Again, technical difficulties were cited. One member of the group created a blog title of "Third Blog

becoming a pain!” and included the contents of that blog as “*maybe this time it will work.*” Notably, only 28.6 % of the defined group (N=7) exhibited instances of critical thinking as defined by the nineteen criteria in content analysis.

Table 24: Breakdown of Anti-blogger Type during Summer Semester

Population	Posted less 5	Of the qualified those who blogged over entire period	In response to survey question 5, will persist in blogging	Negative comments on blogging in essay
28	7 (25%)	0 (0%)	0 (0%)	7 (25%)
Anti-blogger	7 of 28 (25%)			

Findings for Stage One – the Summer Semester

At the conclusion of the summer semester, data compiled over the ten-week investigation were analyzed in regard to the four research questions. Research question one (“What was the observable outcome, specifically related to evidence of reflective critical thinking in student learning, that was uniquely attributable to the technology of blogging?”) sought to identify observable student outcomes in the form of reflective critical thinking. Content analysis of the blog postings and blogathon essays for the two classes during the semester indicated that critical thinking as codified by the 19 criteria did take place. The second part of research question one referring to the unique technology of blogging was more difficult to classify. To attribute learning progress to the unique aspects of blogging, those aspects must be isolated. Through a review of the literature, blogging was determined to be unique in the elements of time, linkages, and

comments. Again, the summer semester participants showed evidence of these attributes in their blogs and essays.

Research question two (“How did the use of blogging technology facilitate student collaboration to provide a viable forum for social learning?”) examined the social context of blogging by analyzing student collaboration as a direct effect of the technology. Again, the concepts unique to blogging, namely time, linkages, and comment, were evidenced in the blog entries as well as referenced in the reflective essays. Blogging showed student awareness of the new technology’s potential to extend the classroom discussion beyond the lecture and laboratory.

By coding student instances of critical thinking, research question three (“On an individual level, how did the use of blogging technology encourage and document the progression of student critical thinking?”) was answered positively. Students indicated that they were aware of their learning progress as it was documented in their blogs. Content analysis confirmed learning as defined by instances of the nineteen critical thinking criteria.

The final research question (“What elements of blogging did students report provided motive to continue the reflective journaling process in future courses? As a subset of this research question, patterns were sought to see if student perceptions and behaviors could be codified into types of bloggers.”) was answered through content analysis of the statements made in the blogs and essays, and in the indication of persistence of blogging. The logic that those who value blogging would continue to participate actively by maintaining a blog and/or creating a new blog or passively

continue to read the ongoing course blog, put emphasis on the fifth survey question.. Persistence in blogging was construed as valuing the technology. Both positive and negative reasons for continuing to blog were noted for analysis.

Classification of students into types was an attempt to explore the commonalities of perception by the positive bloggers (the Enthusiasts and Converts) and the negative bloggers (the Disenchanted and Anti-bloggers). By comparing data on each of these groups, blogging efficacy was demonstrated in fact (instances of critical thinking criteria) and perception (statements in blogs and essays).

Inherent in qualitative research is the opportunity for bias. To mitigate this weakness, the experiment was repeated in the fall semester. Data culled from that semester was contrasted with the original pilot of the summer classes in an attempt at validity through iteration.

Findings for Stage Two: The Fall Semester

Background to Fall Semester

As a measure of validity, the blogging exercise was repeated in the subsequent semester. The fall semester involved two classes, a Networking Essentials class (ITNW1425) and another section of Introduction to the Internet and HTML (ITNW1437) that had been delivered in the previous semester. Again, a course blog was prepared for each at <http://newitnw1425.blogspot.com/> and <http://newitnw1437.blogspot.com> respectively, with the ITNW1437 course containing the blog postings from the previous term. Repeating the process from the summer semester, each of the participating students for the fall term (N=39) created an individual or peer blog that was linked to the course

blog. Data collection was identical to the previous semester concerning quantity of blog posts, quality of relevance of blog posts, intention of persistence in the blogging process beyond the duration of the semester, and the perceived student value of blogging as culled from a content analysis of the blogathon essay, the blog posts, and the culminating student survey.

Evidence in Response to Research Question One

Using the same set of research questions from the previous term, the data from the fall semester indicated observable evidence of critical thinking as a behavioral outcome directly attributable to blogging. Blogging as a technology is distinguished by its use of time, links, and comments. These elements were reflected in the student postings and essays through coded criteria.

Time was a major factor in the in the fall classes as it was in the summer term. The convenience of blogging was expressed in his blog post by a student in the Networking class as:

Blogging can be useful if I miss class and have no idea what is going on or what I'm supposed to do. I can always go to the blog to check what my instructor has blogged or what my team has blogged to catch up on what I missed.

In reference to the second unique aspect of blogging, the use of hyperlinks also was mentioned in student responses. One student found an online tutorial on the OSI model to be helpful by indicating, *“The presentation on the OSI reference model was a lot of help to me. I had read the [textbook] chapter and I was a little confused. The presentation helped me to understand how it worked and why it is used.... I am really trying to get an understanding of networking.”*

By including comments in blogs, students directly interacted with the course material highlighted in the course blog and with each other in both the course blog and peer blogs. Collaboration was seen by students in the semester to be a factor. Similarly to the earlier term, many students indicated that blogging facilitated collaboration. Some students indicated surprise that the Internet hosted blogs were viewed by individuals not in the course. Comments from “outsiders” dismayed some (*“To my surprise I received comments [in her blog] on my research from people around the world.”*) and validated the opinions of others (*“I try to see what others have written [in comments] so I am able to read the thought and opinions of someone else.”*)

The use of comments and hyperlinks within blogs was also function of collaborative learning. The social aspect was explored as the focus of research question two.

Evidence in Response to Research Question Two

Research question two (*How did the use of blogging technology facilitate student collaboration to provide a viable forum for social learning?*) sought evidence of social learning through blogging. Using the codes of Henri’s and Garrison’s criteria the

quantitative software revealed 31 instances of social learning in the student blogs of the fall semester or 22% of the total blog entries for that term. By comparison, the previous semester showed 17 instances in the student blogs of social learning or 49% of blogs during that semester.

Research Question Two additionally looked for content evidence of social learning as identified by students in their culminating essays. In their reflective essays, there were 69 cited instances in the total of 39 fall student essays. Employing the codes of Henri's Five Dimensions (coded as HP, HS, HI, HC, and HM) and Garrison's Five Stages (coded as GID, GD, GE, GA, and GI) the quantitative software revealed that some Fall semester students found that collaboration was facilitated by blogging (*"The course blog is a tool I've enjoyed this semester because I'm allowed to express myself and inform my teammates on networking topics."*), while others identified the lack of collaboration as a dysfunctional factor in the course (*"However, many times I feel people began to rely on blogging. If you go back and look through our blogs on the "Tuesday Presentations" you'll see that only 3 or 4 people were blogging."*).

Table 25: Instances of Henri & Garrison Codes in Fall Courses

Courses (Including student essays and blogs)	Instances of Henri's Five Dimensions	Instances of Garrison's Five Stages
ITSC1405 – Operating Systems	32	13
ITNW1437 – Introduction to the Internet	37	18
Combined Fall Classes	69	31

Evidence in Response to Research Question Three

Once again the repeated blogging exercise in the fall semester demonstrated evidence of the progression of student critical thinking as defined in RQ3 (*On an individual level, how did the use of blogging technology encourage and document the progression of student critical thinking?*) by using the codes of Bloom (1956) and Petress (2004) to measure instances of synthesis, analysis and evaluation from the cognitive domain, and to identify characteristics of the critical thinker respectively

These coded incidents included an analysis (BA) in the blog of an Introduction to Internet student who felt, *“Pictures can be a two-sided sword... too many pictures are distracting; too few pictures make the site boring. I have not found a website that is absolutely flawless yet.”* However, not all analysis was positive, as indicated by the student in the same class who said, *“Blogging wasn't at all very helpful, because I didn't know of too many people who would read other people's blogs”*. Petress' characteristic of relevance (PR2) dominated all blog postings as students routinely included hyperlinks within their messages to validate their findings by linking to pages with similar opinions and/or data. In one case, a student demonstrated the characteristic described by Petress as “sufficiency” when she wrote, *“I have been on the Internet since 1996, designing and maintaining websites including a blog. I have to remember that I'm not the only one going on this journey.”*

Table 26: Bloom and Petress Codes in Fall Courses

Course	Instances of Bloom's Higher Order Cognitive Skills	Instances of Petress' Characteristics of Critical Thinkers
ITSC1405 – Operating Systems	27	24
ITNW1437 – Introduction to the Internet	52	8
Combined Fall Classes	79	32

Student acceptance of blogging as a technology for the purposes of the investigation was defined as their signaled intention to continue with blogging after the end of the course. The concept of student perception was addressed in research question four.

Evidence in Response to Research Question Four

The final research question (What elements of blogging did students report provided motive to continue the reflective journaling process in future courses? As a subset of this research question, patterns were sought to see if student perceptions and behaviors could be codified into types of bloggers.) looked at student perception of blogging, using the responses to survey question five on intended continuance of blogging and content analysis of the comments in the reflective blogathon. In comparison with the previous semester, 62% of fall students (N=38) indicated that would continue to use blogging. This was a 4% decrease from the 66% (N=28) summer population who indicated that they would continue to blog. Student blogathon essays reflected a similar balance between students who had a majority of positive comments on the concept of blogging; students whose perception was negative; and those whose

opinion was difficult to discern (“*Well, it's obvious that I really don't like blogging but it kinda [sic] gets interesting as the time goes by in the semester. You [the instructor] said to read some of the other blogs, but there is one slight problem, some of my class mates didn't even bother writing in their blogs. I like this class. It is majorly [sic] different*”)

As in the previous semester, the author transferred the results of content and count analysis to the same rubric to discover emergent student blogger types. The identified types were then compared to data from the earlier semester as a form of validation, and ultimately used in the conclusion of the report on the efficacy of the blogging technology.

Prototype Bloggers for Fall 2004 Courses

The Enthusiast

Actions by this defined type of blogger address the student’s attitude as well the relevance of his or her blog posts. Initially the blogger type posts with enthusiastic content that is relevant to course material, and interactive with content of other student blogs. The blogger type continues positive comments for the duration of the blogging period. In the fall Networking class, one Enthusiast blogger type routinely contributed relevant links to course topics in her peer blog. She found value in the links posted by her class peers as evidenced in the comment, “*I think that I've learned a lot about the OSI model. Through [peer links in the blogs] I actually have more of an understanding on the subject.*” Other students commented on the observation by agreeing that the links located by others were substantially valuable. However, collaboration was not perceived as a

universal virtue in the class. The same student who saw such value in peer blog links also was critical of his non-contributing peers. He commented in his essay:

Blogging itself is not the easiest task in the world... and hardly anyone on our team has posted things on their individual blogs. I have even only made a few posts, and they are hardly worth reading.

However, an Enthusiast type student concluded his evaluative essay by expressing appreciation for the collaborative aspect of blogging:

I really like the fact that you can view blogs of other people, as well as have others view yours. This helped the whole blogging community link together to share information and some have even interjected information and links into our [course] blogs. This class has been a great learning experience and I will continue to blog if I can find a good blogging community to share and \exchange information with...

Expectations of the Enthusiast blogger type based on previous semester.

According to the rubric designed for the investigation, the Enthusiast type of blogger posted the required minimum of one blog per week, excluding the first and last weeks for a total of eight blogs. The two courses in the fall semester included 15 or 38.4% of the total population (N=39) who were classified as Enthusiasts. This was contrasted to the results of the summer semester in which 13 or 46.4% of the students were categorized as Enthusiasts.

Table 27: Comparison of Student Blogger Types by Course and Semester

Type	ITNW 143706	ITSC 140506	Total Summer	ITNW 143708	ITNW 142508	Total Fall	Combined
Enthusiast	9 (50%)	4 (40%)	13 (46%)	7 (32%)	8 (47%)	15 (38%)	28 (42%)
Satisficers	4 (22%)	2 (20%)	6 (21%)	1 (5%)	2 (12%)	3 (8%)	9 (13%)
Disenchanted	0 (0%)	1 (10%)	1 (4%)	3 (14%)	1 (6%)	4 (10%)	5 (7%)
Converts	1 (6%)	0 (0%)	1 (4%)	6 (27%)	3 (18%)	9 (23%)	10 (15%)
Anti-bloggers	4 (22%)	3 (30%)	7 (25%)	5 (23%)	3 (18%)	8 (21%)	15 (22%)
Total	18 (100%)	10 (100%)	28 (100%)	22 (100%)	17 (100%)	39 (100%)	67 (100%)

As indicated in the first phase of the investigation, persistence in blogging was determined by a non-negative answer to question five of the blogathon survey. The Enthusiast blogger type, by definition, will persist in blogging beyond the end of the semester. This was specified by any answer other than the fourth selection, which states that the blogger intends to delete the student blog. In the fall term, a total of 24 students (61.5%) from the two courses indicated that they would continue blogging in some capacity. Of these 15 (38.5%) were categorized as Enthusiasts and nine (23.1%) were typed as Converts. In the earlier term, Enthusiasts who indicated persistence in blogging comprised 46.4% of that population, while Converts included only 3.6% of the group. For the two semesters, persistence was 57% overall, divided between 42% Enthusiasts and 15% Converts. Although this was only an exploratory, rather than a quantitative investigation, it appears that in both terms, students consistently indicated an intention to pursue blogging. Appendix M (Indicators of Persistence in Blogging) illustrates the results of the persistence factor by blogger type as determined by the survey question 5. Fifty seven percent of bloggers over both semesters indicated that they would continue to blog beyond the semester. Of those, 42% were classified as “Enthusiasts” and 15% were

“Converts”. This intention to persist in blogging showed an increase over time as 50% indicated positively in the summer term and 61.5% so indicated in the fall semester.

Through content analysis, the student blogger viewed the blogging process as an effective learning tool in his or her course education. In the fall term one networking student commented, *“I have learned a lot about my own life through my blogging experience. I have noticed that a lot of people in the world have some of the same issues that I have and share some of my same opinions. Blogging has been a very interesting experience for me, and I would not change it.”* Validation of student ideas and opinions emerged as a beneficial element identified by bloggers in the investigation.

Remarkably, one Enthusiast in the same networking course first disparaged blogging (*“If you look back our personal blogs didn’t really accomplish much. Only a few of us actually participated in this activity.”*). He then paradoxically promoted blogging by stating,

I really like the fact that you can view blogs of other people, as well as have others view yours. This helps the whole blogging community link together to share information and some have even interjected information and links into our blogs... I will continue to blog if I can find a good blogging community to share and exchange information with.

Data on the Fall Semester Enthusiast Type

Within the Enthusiast group, the student interactivity was apparent. Blog messages routinely linked to team project topics, with evidence of student cooperation in sharing the research necessary for the team projects. In these instances Petress' characteristics of relevance (PC), recency (PR), and objectivity (PO) were paramount as was Henri's concepts of participative (HP), social (HS), and Interactive (HI). This blog excerpt typified a network student's activity, *"Our team has high expectations to meet in our presentation on RFID... Here is a link for everyone to review."*

As a group, the Enthusiasts found value in blogging. They perceived it as a reinforcement of the class issues (*"The blog helped to reinforce the class. It gave the students a chance to research the information given and to find out new things about networking. It also has taught me to ask questions and to research deeply on things. [Blogging] has taught me that everything is not what it seems and to examine and plan for anything that may come up in life."*). Additionally, the group mentioned the aspect of required blogging. Typically, blogging as an assignment was viewed as a necessary component of the course, but not beneficial overall. A student in the fall semester of the Introduction to the Internet class stated:

The class blogs were – to say the least – interesting. As could be expected, most people only posted when the teacher requested it. I figure that’s pretty natural. I’ve had a Live Journal for a few years now, and I can speculate that people feel more comfortable blogging freely when they’re not doing it as a set assignment. When a person owns a blog as something they want to do, it’s because they really want their thoughts to reach the people. Although most of us only posted when asked, it did ensure that we saw the material that the teacher wanted us to see... and that’s the important thing after all.

The Disenchanted

The fall semester include four “disenchanted” types. As defined by the rubric, a disenchanted blogger initially posts with enthusiasm, including content that is relevant to course material, and interactive with content of other student blogs. As the term progressed, he or she showed a decline in enthusiasm, and/or relevance, and or interactivity over the blogging period.

In quantity, the “Disenchanted” type posted less than eight blogs, but more than five. The limitation was combined with a generally negative perception of blogging as expressed in the student essay.

Typical of the “disenchanted type” was the blogger whose first blog showed some enthusiasm (“*I really really need to get used to blogging*”) but his fifth and concluding

post stated that he *“just want to get it done and over with mainly. Now just to get the paragraph tag working right on my webpage. That is the problem.”*

In the essays, these four Disenchanted all addressed the same elements of blogging as negative. They each objected to posting private thoughts with one stating *“I feel that my peers in this class judge me for not knowing what I am doing. It is tuff [sic] to be an older person and go to school.”* Another had a predetermined prejudice against the concept:

When our teacher first explained the concept of a blog, I assumed it would be a waste of time, and something that would have no bearing on me or how I would participate within this class, but participation was vital to receive a good grade in the class. Well, as far as it being involved with the class, I was right. It is only used for a grade, but other than that I have found it a useless tool, one more username/password that I have to keep up with. I am not one to sit and type my feelings or whatever every day for the whole world to see.

Paradoxically, each of the student’s six blog postings, despite his essay statement to the contrary, included personal statements on his (lack of) social life! Only his comments on the course and peer blogs had any reference to the course content.

Each of this type during the fall semester failed to value blogging in the learning experience. Consequently, each of the four indicated a determination to delete the student blog.

The overall percentage of “Disenchanted” types for the two semesters was 7%. In the summer courses, only one student (4%) fit the profile, while four students or 10% were classified as “Disenchanted” in the later term. Although there were commonalities in the reasons for rejecting blogging, this was a highly disparate group whose impediments to blogging ranged from personal time to philosophical reluctance to participate.

The Convert

The Convert was the antithesis of the Disenchanted. Similar to the Disenchanted, this type posted more than five, but fewer than eight blog entries. Unlike the Disenchanted, the Convert’s attitude and relevance of posts increased over the duration of the investigation. Furthermore, by indicating a value in the blogging experience, the Convert, unlike the Disenchanted, signaled an intention to continue to participate in blogging. The only element separating the Convert type from the Enthusiast type was the frequency of blog postings.

Converts, like Enthusiasts, showed evidence of individual and collaborative learning. In the fall semester all nine student grouped as Converts, posted blogs containing relevant links, comments, and information on course topics. Without exception, each member of the group interacted through comments and links with other students as well as the course blog. Each one demonstrated all six characteristics of the

critical thinker. Specifically their posts showed sufficiency of information, reliability of data through authoritative links, relevance to the course material, consistency of concepts, currency of information, and objectivity achieved through links to qualified sites. In addition, members of the group sought to analyze the course material through research to additional online data.

In addition to an increased number of blogs, the Convert demonstrated a distinct change in attitude toward blogging as the semester progressed. This was most evident in the reflective essays. Demonstrable incidents that served as the catalyst to view blogging in a positive way included (a) mastery of the technology (*“Blogging became a habit along with checking my e-mail”*); (b) an awareness of the power of personal expression through the blog (*“The course blog is a tool I’ve enjoyed this semester because I’m allowed to express myself and inform my teammates on networking topics.”*); and (c) an awareness of personal learning (*“I have learned a lot about my own life through my blogging experience*).

In the reflective essays, student Converts mentioned the value of blogging as a tool to maintain a connection with the course and classmates. One student had family health issues that kept him from attending several classes. In his reflective essay he wrote, *“My semester started out a bit rough as you know. The course blog allowed me to keep up with what my team was doing. The blogs kept me involved. I would get lost from time to time but the blogs and my classmates helped me out.”* Furthermore, it provided a validation of individual opinions and concepts as described by the Introduction to the Internet student who wrote, *“Blogging was not even part of my vocabulary before I began this class. Even after I started blogging I wasn’t very interested in it until I started*

actually posting my own comments and realized how everyone in the class had almost the same opinion about each topic. Some opinions were a little more opinionated than other but still the same opinions.”

Of the total student bloggers (N=67), ten (15%) qualified as “Converts.” This type showed a disparity of percentages in the summer and fall semesters, with nine (23%) classified as Converts in the fall, but only one (4%) in the summer courses. The section on conclusions poses some possible further research to examine the disparity.

The Anti-blogger

The group of student bloggers who failed to participate and indicated in their essays that they did not view blogging in a positive way were labeled “Anti-bloggers.” This type of blogger posted less than five blogs, although all students were required to post an initial blog entry. Survey question five relating to persistence in blogging was universally selected as negative. The Anti-bloggers had no intention of continuing in a technology that they did not value.

The paucity of blog entries shed little light on the reasons for not blogging. The eight (21%) of the type in the fall semester, posted a total of 22 blog entries for an average of 2.75 blogs per Anti-blogger. By contrast the average for all fall students (N=39) was 7 blogs from a total of 274 blogs. With one exception, the Anti-bloggers posted no relevant data on their blogs. The one exception did link to three reference sites in his four postings. However, the remaining seven either posted a “test” message and/or personal, irrelevant information.

The essays of the Anti-bloggers revealed some data on the group's reluctance to blog. One Anti-blogger expressed his impression of blogging as "*nothing more than a discussion board but with a different name.*" Another felt blogging was invasive. She stated, "*I didn't like the idea of everyone in the world having access to read my blogs.*"

These negative students comprised 21% of the fall classes; 25% of the summer classes, and 22% overall. Blogging as a technology did not impress them favorably, and as a group they chose not to participate in the initiative.

The Satisficer

The pragmatic group who posted in only in sufficient quantity and quality to satisfy the course requirements appeared in both semesters. The Satisficer type expressed little or negative value concerning blogging in the concluding essay, and selected the survey option to delete the student blogsite as an indication of a disinterest in the technology.

Although the Satisficers posted the minimum number of postings, their essays and survey response to question five on continuing to blog eliminated them from the Enthusiast group. Unlike Enthusiasts, the Satisficers were quite articulate in stating their negative impression of blogging. An experienced Internet user stated:

When I signed up for Introduction to the Internet I was doing it as a requirement. On the subject of blogging I've been there and done that. I believe it is beneficial and that relieves stress from school if it is used properly but I've done that.

Another was more ambivalent in his essay. He wrote:

Blogging was an experience all in itself. At first, it sounded goofy and I had no idea what it really was, even though it was explained every day... it actually took time to understand what it really was intended for. To me, emailing other student in my group was the way to go.

The third Satisficer did not address the topic of blogging in her reflective essay.

As a whole the group dismissed blogging as a technology, although they each demonstrated considerable critical thinking skills in their respective blogs. All three of the group were active in linking relevant sites and commenting on peers' blogs. All three exhibited instances of analysis and evaluation. Therefore, the negative perception of the group was contradicted by their actual instances of learning.

Outcomes

For purposes of correlating both blogging activity and student perception with content mastery, the author classified student blogger types according to blogging frequency and duration as well as by content as found in the blogs and the reflective essay. The classification scheme was based on the frequency of blog posts and duration of blogging as well as a content analysis of blogs and essay comments indicating quality (i.e., relevance and interaction with peers), intention of blogging persistence in the learner's future, and perceived value of blogging technology in the computer science

curriculum. It was an experimental research design to explore the value of a new technology on the actual learning progress and students' perception of learning.

Constraints and Limitations

The most obvious limitation of the study was the limited duration of investigation over two college semesters. As blogging become more commonplace, a greater number of students and faculty will be exposed to its existence and usability in education.

Additionally, the composition of student learners varies widely per semester and by course. A longer, broader use of blogging in the offered courses might expose new uses and or drawbacks to reflective learning though online journaling.

Chapter 5

Conclusions

Conclusions

Blogging as practiced during the research investigation demonstrated the characteristics of immediacy, universality, informality, spontaneity, collaboration, and chronology that are unique to the technology in its element of time, linkage, and comment. Student blog postings showed evidence of critical thinking, both independently derived and fostered through social learning. Factors that inhibited successful blogging included technical obstacles, time limitations, and personal philosophy opposing private thought displayed over a public forum.

In general, students expressed empowerment, a personal voice in contributing to the course as well as to their own learning, a sense of inclusion in the learning process, and an awareness of their own learning. Blogging provided convenience of time and place for class work, research, and collaboration in team efforts. It gave authority to information through relevant and appropriate links. It broadened the collaborative environment from within the class to the blogosphere by including resources and individuals outside the classroom in the greater Internet-connected world.

As a technology, the uniqueness of blogging was identified as being related to time, to links and to collaborative comment. In regard to time, blogging provided an immediacy of publication through the ease of posting provided by most blogging software. Paradoxically, the immediacy of blogging is balanced by the persistence of

ideas that is facilitated by permalink features. The Internet suffers from a randomness of volatile links that disappear often without warning.. Permalinks, and to a lesser extent, trackbacks, provide a continuity of thought online.

An additional aspect of time in blogging is the concept of currency. The immediacy of posting can be enhanced by the use of syndicated feeds that automatically provide a current link to the site. The most current research is available over the Internet without publishing delays, a factor that can be both liberating and misleading to the novice researcher. Additionally, blog links insulate the blogger from dissenting opinions. Blog links serve as directional indicators of other opinions, not necessarily those of the blogger.

Linking is the essence of the blog. As designed by the originators of Internet technology, the Internet itself is a mechanism for linking from one document to another. Using links in a blog provides a provenance of ideas, which the investigation indicated was a positive factor in student perception of the technology. Validation of student ideas was cited repeatedly as a positive aspect of blogging. The linking factor was a way to assert a unique or unconventional concept in a non-confrontational way.

Social or collaborative learning resulted from the final aspect of blogging i.e., collaborative comments. As previously stated, supporting comments by peers and outside blog readers affirmed student opinions and statements. This provided a sense of both empowerment in the student's personal learning growth as well as a sense of ownership of the learning taking place both individually and as part of the group. Stating

ideas within a blog identified the learner with the concept. It was mentioned as a positive alternative to the relative anonymity of verbally contributing in the class.

The methodology used for data collection was both unobtrusive and quantifiable. Content analysis is a quantitative system, although it was used to analyze qualitative concepts. The rigor of the study was limited by the involvement of the researcher in the process, the need for interpretive knowledge of the topic, and the exploratory nature of the investigation. However, these are all recognized elements of qualitative methodology. In an attempt to validate and interpret the findings, a rudimentary cluster analysis was used to distinguish groups of bloggers. The classification system exposed unknown types of student bloggers.

On the negative side the Disenchanted and Anti-bloggers perceived no value in the technology, although content analysis showed that members of this group, as all groups, exhibited characteristics of individual and collaborative learning as defined by the theorists Bloom (1956), Petress (2004), Henri (1991), and Garrison (1992, 2002). A pragmatic group, the Satisficers, completed the investigation requirements in blogging, but failed to perceive the technology as valuable. Only the Enthusiasts and Converts were aware of the positive consequences in learning that blogging facilitated. Appendix N lists the instances of positive and negative student perceptions by blogger types. To distinguish blogging from similar educational technologies, Appendix N further delineates each of the unique elements of blogging; namely time, linkage, and comments, through excerpts of student blog postings and reflective essays.

Implications

The technology of blogging has been in existence for less than a decade, with educational use of the concept studied only recently. As the growing body of research investigates the use of blogging for teaching and learning, the number of bloggers is increasing rapidly, with the research group Technorati (<http://www.technorati.com/>) estimating that globally there is one blog created every second. There is a great likelihood that students and faculty will become more familiar with the technology. Some educators (Fiedler 2003b; Wrede, 2003) predict that blogging is a disruptive technology which will revolutionize electronic learning to the extent of making similar technologies such as LISTSERVs and discussion forums obsolete.

The incorporation of enforced reflection in vocational computer science courses has the potential to refocus the current community college curriculum toward more constructivists, learner-centered instruction. The dual public and private nature of blogging poses questions concerning its applicability to education. The identified elements of time, links, and comments may be compromised by the volatile nature of the Internet in general. However, blogs can be viewed as durable to the extent that they remain on a publicly accessible website through additional technologies such as trackbacks, permalinks, and archives. Questions may be asked to see if the visible learning journey is encouraging or inhibiting to the student blogger.

The public nature and the archiving of the blogs have the potential to concern some students. Further investigation might reveal student attitudes toward a persistent documentation of their work on a publicly accessible website. Questions regarding learner attributes might be investigated including observable changes in (a) interaction

with content material, other peers, and the instructor; (b) an increase in significant learning, (c) student recognition of course material relevance to current research; (d) a change in student engagement and accountability for learning and (e) student sense of empowerment in hearing their own voices in the educational process.

In addition, the student blogger types identified as negatively perceiving the use of reflective blog journaling might be further examined for conditions that produce negative impressions while resulting in either positive or negative grade assessment. Finally, the positive aspects of blogging as identified through content analysis of the blog postings and essays from all the identified groups, might serve as a starting point for future research into the beneficial aspects of reflective writing on a public forum that exhibit elements of higher-order learning as well as inform, validate, and personalize the journey of discovery for the student bloggers.

Recommendations

The viability of the community college as a provider of vocational and lower-level academic post-secondary education includes a responsibility to provide opportunities for its students in life-long learning skills that will endure to serve the learner long after the current skills of information technology are obsolete. Blogging as a technology is growing exponentially in popularity, and its role in providing a forum for critical thinking skills through reflection may be a valuable source for future educational research.

Computer science departments, particularly on the vocationally-oriented community college level, can provide deeper learning for students by requiring student

reflection on learning. Blogging and more complex technologies such as wikis and podcasts, open the door to global learning beyond the confines of the lecture hall and laboratory. Longitudinal statistical investigation into the consequences of blogging as a mechanism for student learning could discover aspects of learning as yet unknown. The simplicity of creating and maintaining course and student blogs for extended learning in both traditional and online post-secondary learning makes blogging a seamless addition to any course by providing a venue for reflection that is unobtrusive and virtually transparent to the student. The format for blended learning has been recommended for by the researcher for all computer science courses at her institution.

Summary

Problem Background

The need for critical thinking skills in post-secondary education is crucial to all disciplines, but it particularly relevant in the rapidly changing field of information technology. Students at the community college level who seek employment immediately after graduation must be able to use the long-term skills of reasoning throughout their professional lives as well as onto any further academic experience. For that reason, the higher level cognitive skills of analysis, synthesis, and evaluation as applied to problem solving must be stressed in addition to skills involving the current technology. A proven way of exposing students to such training in critical thinking is through the use of reflection.

As the use of the Internet becomes commonplace, the web-enabled technology of online journaling, known as blogging, continues to gain in popularity. Blogging over the

Internet provides a forum for personal thought. Here, student reflective learning can be studied to identify incidents of analysis, synthesis, and evaluation that comprise the essence of critical thinking. Blogging is an evolutionary technology, combining the collaborative discourse of earlier mechanisms such as a bulletin board or discussion forum, but enhancing such earlier formats with chronological threading, linkages to other blogs, and comments on postings. By serving as a personal voice, blogs empower students to document their own journey of discover as well as to contribute in a significant and identifiable way to the collective learning of the group.

Research Goal

Over the course of two semesters, four separate vocational computer sciences courses required student participation in a blogging experiment. The goal of the investigation was to identify evidence of critical thinking in the student blogs and in the reflective essays that completed the study. Both social and individual aspects of critical thinking were analyzed for content and subsequently coded according to theories of cognition and characteristics of critical thinkers. Also considered was student perception. Students were required to reflect on the value of blogging, its applicability to the progress of the course material, and the effect on their personal learning.

Combining the data, aggregate groups of blogger types emerged. Types of bloggers exhibited specific behaviors in frequency of blog postings, in duration of continuous blogging, and in quality of blog statements. By clustering types of bloggers, the efficacy of blogging technology moved from individual cases to a more generalized concept, although as a qualitative exercise, generalizability of the concept was not

presumed beyond the population of the four classes participating in the exercise.

Qualities of time, linkage, and comments identified as unique to the technology became the framework for understanding the power of blogging in a learning experience.

The Research Plan

The investigation took place over two college semesters and involved four separate computer science courses. In these courses, data were gathered from student contributions to a personal blog and from a culminating reflective essay. The blogs entries were coded for specific instances of critical thinking and for interaction among student peer blogs. The essays provided insight into student perception of the blogging technology.

A triangulation of data instruments was used to verify the exploratory findings. The coded data were analyzed through data mining processes including content analysis for counts and frequencies of keywords in context (KWIC) and cluster analysis to classify types of student bloggers. Student blogger types were then analyzed to isolate qualities in blogging that encouraged critical thinking and obstacles inherent in the technology that made public journaling dysfunctional in student learning.

Technology and Theory in Literature

Journaling has been investigated extensively as an effective method of encouraging students to reflect on their personal learning experiences. Blogging, as an electronic form of journaling, was the focus of the report which further looked for incidents of critical thinking found in student contributions to blogs and in their

evaluative essays. Bloom's higher level cognitive skills of analysis, synthesis, and evaluation (1956) were used as benchmarks of critical thinking. To further expose personal critical thinking on the part of the participating students, the five elements of critical thinkers as defined by Petress broadened the coding base. However, Internet blogging is intrinsically both personal and public. To address the public aspect of blogging, the theories of Henri and Garrison provided the basis for social learning incidents.

Bloom's Higher Order Cognitive Skills.

Bloom (1956) devised a widely used taxonomy that categorizes the cognitive, affective, and psychomotor areas of learning. The domain of cognition contains six subdivisions that increase in complexity. The three top categories of analysis, synthesis, and evaluation are used in higher education as the basis for critical thinking.

For student learning to be assessed, the investigation used instances exhibiting one or more of these three categories. Data were culled from student blog postings and culminating reflective essays. Data mining software, QDA Miner © facilitated the coding process by marking instances of Bloom's higher order cognitive skills as Bloom's Analysis (BA), Bloom's Synthesis (BS), and Bloom's evaluation (BE). These coded instances were used in further analysis to determine the existence of critical thinking by all students, and to determine how emergent categories of student bloggers express critical thought

Petress' Extension of Bloom in Critical Thinking Characteristics.

Although Bloom's taxonomy is a standard in educational theory, more recent interpretations of critical thought have been examined. Petress (2004), in particular, provided an extension of Bloom's theories (1956) to describe the characteristics of a critical thinker by deconstructing statements. This was germane to the investigation, since the discourse being examined took place as written blog and essay statements. According to Petress (2004), a true critical thinker demonstrates one or more of these six characteristics: (a) sufficiency of position (PS), (b). reliability of statements (PR1), (c) relevance to the discourse (PR2), (d) consistency with past positions (Pc), (e) recency or currency of supporting statements (PR3), and (f) objectivity of expressions (PO).

The six characteristics were similarly coded using QDA data mining software. The extension of Bloom's taxonomy as described by Petress sharpened the categorizations. Student contributions often degraded into shallow "me too" statements showing lack of position; statements of dubious provenance indicating a failure in reliability; personal expressions not relevant to the class content; inconsistent expressions demonstrating inattention to detail or lack of comprehension of the concept; "aged" data valueless in the rapidly changing field of information technology; and/or personal opinions of substantive bias. Although students were encouraged in free expression, the course goal of content mastery remained the paramount objective.

Henri's Five Dimensions of Computer Mediated Communication.

By using an Internet-accessible blog, student writing was not confined to a private communication between student and instructor or even among class participants. Indeed,

student writing was a public contribution to the course. In the investigation, the lack of privacy mechanisms such as passwords exposed the student work to an audience beyond the classroom. Additionally, the inherent blog characteristic of included comments created a community of learners participating in a form of social learning.

Henri (1991) examined such computer mediated communication, and devised five dimensions: participative (HP); social (HS); interactive (HI); cognitive (HC); and metacognitive (HM). The public nature of blogging necessitated use of all five dimensions, although the focus of the investigation remained on the learning progress, cognitive and metacognitive, experienced by students.

Schrire's (2003) body of work on discourse analysis cites Henri extensively. She uses Henri's model of cognition and metacognition to determine the depth of student learning. The concept was incorporated into the current investigation in its efforts to identify higher level thinking and specify those instances as evidence of critical thought, which constituted the focus of the blogging research.

Garrison's Five Stages of Critical Thinking.

The aspect of social learning was central to other learning theorists. Garrison's work (1992) included his definition of the five stages of critical thinking. For research purposes, he bracketed critical thought inside the realm of problem solving. His five stage definition focused on problem definition, exploration, applicability, and integration of the learning situation. Although these stages can be isolated in the individual learning, Garrison's subsequent efforts on cognitive presence (2001) spotlighted the learner within a greater learning environment.

Methodology.

The selection of methodology for the project included both qualitative and quantitative paradigms. Use of a multi-method research design created a complex investigation of an emergent technology and attempted to reveal concepts and categories unexplored in electronic learning.

The quantitative descriptive statistics were derived from the data included on an author-designed student survey and from frequency counts of keywords in context (KWIC) from the blogs and essays. Qualitative data took the form of interpretative analysis of extended phrases and messages, which are units of measure larger than KWICs. A third quantitative method of cluster analysis was generated from prior analyses and formed the basis for an untested research hypothesis, a normal outcome of exploratory qualitative investigations.

Triangulation.

The investigation used triangulation as a form of data validation. Among the various types of triangulation, the concepts of data triangulation and methodological triangulation were employed, although the method of multiple investigators was not used. The limitation of an investigation using only a single investigator, who was integrally involved in the design and process of the study, required additional methods to eliminate bias in the results. Data triangulation was accomplished through comparisons of time and population. The investigation used two consecutive semesters and four computer science classes as its population.

The methodological triangulation was an author-created design of descriptive statistics, qualitative content analysis, and quantitative cluster analysis. The multi-method design was facilitated through computer software, specifically QDA Miner, v1.1 for data mining; WordStat for content analysis, and Microsoft Excel for descriptive statistical identifications. Fundamentally, the determination of identifying codes was derived from the available literature of Bloom (1956), Petress (2004), Henri (1991), and Garrison (1992, 2002).

Qualitative Content Analysis.

Beyond the rigors of traditional quantitative content analysis, the investigation sought an interpretative analysis of the free-form blog entries and essays from the participating students. Neuendorf (2002) describes this type of interpretation as ongoing and iterative as it discloses new concepts that would not be evident using traditional quantitative methods. This type of analysis relies on the researcher as a competent observer of familiar situations, which in the investigation included the design and delivery of the instructional tool of blogging.

Content analysis examines the messages of the participants. Traditional quantitative forms of the methodology use statistical counts of words to determine central themes. Text in this format is quantitatively analyzed and summarized according to a hypothesis. In the investigation, a different, qualitative, approach to content analysis used inductive reasoning to deconstruct the message units, interpret them according to the learning environment in which they were written, and finally to classify the elements into types of bloggers. This was descriptive analysis using analytic induction to develop a

theory of types of users of the technology. The process involved repetitive readings of the texts resulting in iterative refinements of the categories for coding.

Cluster Analysis.

In contrast to the traditional quantitative content analysis that develops a discriminant function to predict classification, qualitative analysis organizes emergent types into structures that were unknown prior to the research. The condition necessitated the use of cluster analysis, an alternative technique to discriminant factor analysis. Clustering can be accomplished by joining individual cases, which in this investigation were blogging students, to create larger types or by dividing the totality of participants from one large student group into similar groups. The first method, known as agglomerative, was the method used. Computerize data mining software generated a dendrogram or tree graph (Appendix K) to summarize and display the clustering of groups. Accordingly, five meaningful structures or distinctive types of bloggers emerged, using the variables of duration of blogging, number of blog postings, interactivity with course and peer blogs, and intention of persistence in the technology.

Limitations and Delimitations.

The investigation on student blogging was specifically confined to the four courses delivered over two consecutive semesters. Furthermore, the researcher served as an active participant in the process by designing and maintaining the course blog for each of the four classes. The researcher's function in the investigation was that of an informed observer to make judgments on relevancy, currency, and interactivity within student blogs.

Tracking of blog postings to identifying instances of critical thinking through reflection was isolated to the coding of statements within the individual student blogs and essays. As a further delimitation, statements of interaction among students were solely confined to text included in the blogs and essays.

The investigation itself was limited to the students in the four participating classes. As an exploratory examination, no attempt was made at quantitative sampling. The unique cases of individual students and variables concerning messages and conditions made the a descriptive qualitative investigation that may not be generalizable to greater populations and could be interpreted differently by other researchers.

Research Findings

Reflection promotes a deep form of learning in multiple ways: (a) it alerts the student to his or her progress in acquiring knowledge through research and experience; (b) it provides a forum for problem solving for the individual and the associated community of learners; and (c) it serves as documentation of instances of the essential critical thinking skill that will continue to server the student beyond formal education to become life-long learners (Andrusyszyn & Davie, 1997; Bond, 1993; Chase, Germundsen, Brownstein, & Distad, 2001; Garrison, 1992; Garrison, Anderson, & Archer, 2001; George, 2002; Greenlaw, & DeLoach, 2003; Fairholme, Dougiamas, & Dreher, 2000; Fiedler, 2003b; Imel, 1998; Kuiper, 2002; Parsons, 2000; Phelps, Ellis, & Hase, 2001; Ramasamy, 2002; Schon, 1982). The investigation explored the new technology of Internet blogging to explore its role in facilitating student reflection.

The purpose of the research was twofold: (a) to identify instances of critical thinking by vocational computer science students as demonstrated in their frequent and persistent use of the journaling mechanism of Internet blogging as a reflective tool, and (b) to determine the effectiveness of the unique technology in their learning process as it was perceived by the students. There were four related research questions.

Finding Concerning Research Question 1 – Unique Attributes of Blogging

Research question one was predicated on the unique attributes of blogging that do not appear in other analogous technologies. By definition, blogging is chronological, it has an identified author, it invites comments by others, and it uses hyperlinking to move the reader from one Internet document to another. These facets were distilled to the components of time, linkages, and comments. Questions were then posed to align the unique elements of blogging with reflective learning.

Reflective learning for the purposes of the investigation was limited to manifest and latent instances of the higher order cognitive skills of analysis, analysis, and evaluation. These critical thinking components were further expanded to include the cognitive activities involved in problem solving which is a vital skill in the rapidly changing field of information technology that is the career goal of the participating computer science students.

The time elements of blogging included the immediacy of publication. Unlike traditional webpages that have a need for a supplemental file transfer protocol program (FTP), blogs integrate the capability into a user-friendly format for transparent publication of messages. The format of a blog also reflects the element of time. By

design blogs contain chronological listing of posts, with the most recent at the top of the screen, and earlier posts automatically archived. The pathway of text contributes to the logical stream of messages, providing a traceable journey of discovery.

Links are integral to the Internet, and blogs use a variety of linking technologies. The format of hypertext transport protocol (HTTP) automatically connects the readership to relevant pages. Other features such as trackback and permalinks provide an element of persistence of the data contained in a blog.

The inclusion of comments as a part of the blog structure invites public response to the blogger's postings. The commenting aspect of blogging facilitated written discourse among bloggers and was the element measured for the second research question on social learning through blogging technology.

Findings Concerning Research Question 2 – Blogging and Social Learning

Student bloggers of every type alluded to the concept of including a personal voice in the blog. Through informality and spontaneity inherent in blogging, the individualized investment in learning extended to both personal and collaborative learning. The second research question focused on blogging as a forum for social learning. In this context, blog provided a non-confrontational format for expressing ideas and opinions as well as for referencing other sources. The use of links validated concepts and provided new avenues for information exploration. Comments also echoed the duality of validation and innovation.

Henri (1992) and Garrison (2001) both allude to online communities. The investigation used a common course blog for each class as well as individualized peer blogs that were linked through the course blog. Data indicated that student overwhelmingly interacted with the course (Appendix O) and peer blogs (Appendix P).

Findings Concerning Research Question 3 – Blogging and Progression of Individual Critical Thinking.

By defining critical thinking statements as coded instances, it was possible to isolate elements of critical thinking by students. Data mining software marked text for coding retrieval, occurrences, and sequences. The computerized capability of coding provided a standardized mechanism for coding analysis. Each student was a case with associated codes per every message. Through the method critical thinking as defined by the nineteen codes was identified and tracked for each individual. Figure 10: Screen Capture with Coded Incidents of Critical Thinking below is an example of a student blog with the 19 codes used in the data mining for the investigation.

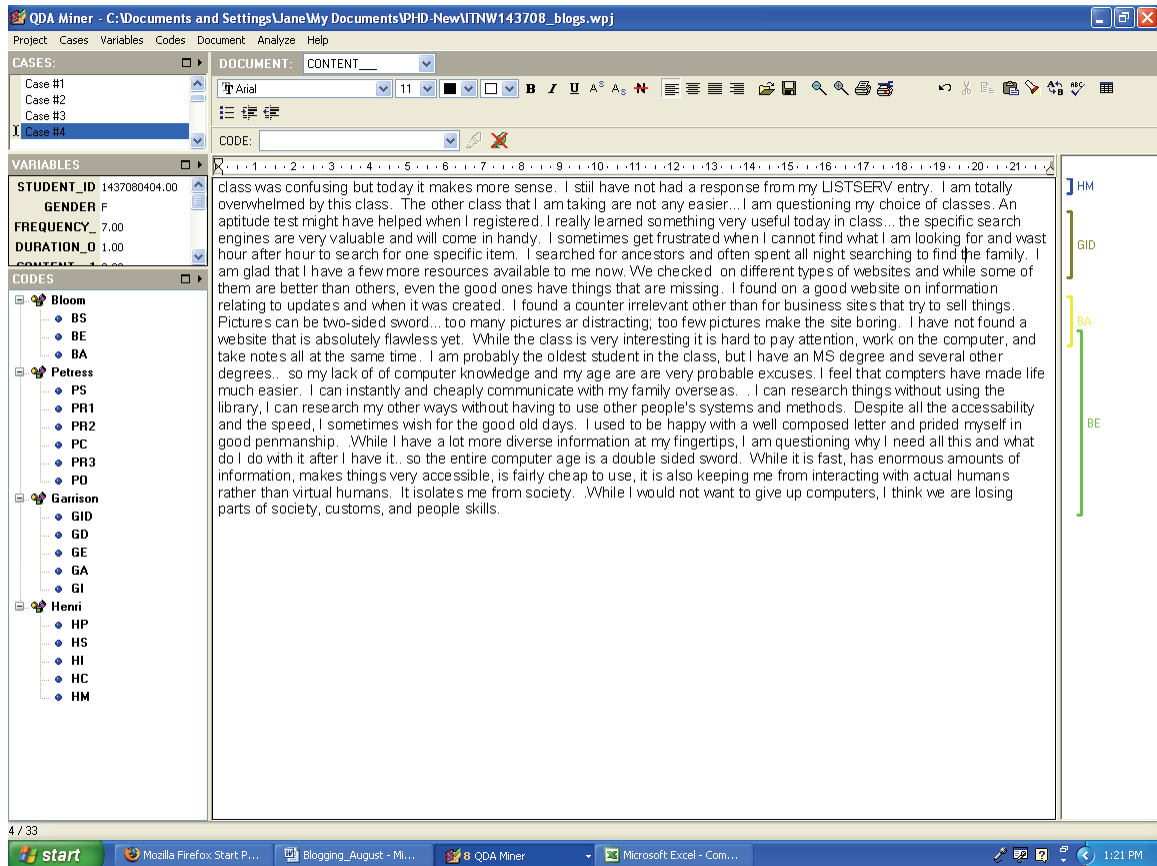


Figure 10: Screen Capture with Coded Incidents of Critical Thinking

Findings Concerning Research Question 4 – Student Perception of Blogging Technology.

The final research question examined student perceptions of the blogging technology. All students, even those with negative perceptions of blogging, showed evidence of critical thinking incidents. For clarity, individual students were categorized into blogger types for aggregate perceptions of blogging. (Appendix L Cluster Analysis of Blogger Types.)

Five distinct blogger types emerged from the population studied. Two types were entirely positive in their perceptions of blogging. Two types were either initially or eventually negative, and one type was pragmatically neutral.

On the positive side, the Enthusiast type found blogging to be a viable contribution to their learning and to the value of the course. This type was identified through activity in posting to the student blogs, interactivity in reading and commenting on course and peer blogs, and stated intention to continue blogging beyond the semester. Furthermore, content analysis of the student culminating essays showed more than 50% of the comments on blogging from this type were positive.

The second positive type initially resisted blogging. As the semester progressed, the category of learner showed an improvement in frequency and quality of blog postings and peers interactivity. These Converts to blogging paralleled the Enthusiasts with their positive essays and stated intention to continue blogging. After an initial reluctance to participate in blogging, this type demonstrated both an increased interest and a conversion of opinion on the contribution blogging makes in a course.

Negative blogger types were classified as either Disenchanted or Anti-bloggers. Again, the duration of blogging determined the category. Anti-bloggers failed to participate in the blogging component of the course and included more than 50% negative statements concerning blogging in their reflective essays. The Disenchanted initially saw promise in blogging, but for a variety of disparate conditions failed comply with the blogging minimum, indicated that blogging would end with the semester, and did not value blogging in their culminating evaluation. Although the number of critical thinking incidents was fewer in these negative types, all types of bloggers showed evidence of higher level cognitive skills. In some cases of the Anti-bloggers, this took the form of a negative evaluation of the technology. The Anti-blogger for multiple reasons started and remained unconvinced of blogging's power in learning. Both in lack

of participation and in stated opinions, the anti-blogger both would not blog during the semester and will not blog in the future.

The final blogger type pragmatically performed to satisfy the requirements without commitment to the value of the technology. Consequently they were classified as Satisficers whose goal was grade oriented rather than knowledge oriented. The type performed as well as the Enthusiasts, but for a variety of reasons did not value blogging as a learning tool.

Gender Factor in Blogging

Prior research seemed to indicate that more women than men participate in journaling. (Peterson, 2001). In the four courses studied, this was not confirmed. Of the overall Enthusiast group 18% were women and 24% were men. Negative bloggers, however, were overwhelmingly men. Table 27 shows the division of gender by blogger types.

Table 28: Bloggers by Gender

% Gender						
Type	Total Summer - males	Total Summer - females	Total Fall- males	Total Fall- females	Combined semesters- males	Combined semesters- females
Enthusiast	32%	14%	18%	21%	24%	18%
Satisficers	18%	4%	3%	5%	9%	4%
Disenchanted	4%	0%	8%	3%	6%	1%
Converts	0%	4%	8%	15%	4%	10%
Anti-bloggers	14%	11%	13%	8%	13%	9%
Total %	68%	32%	49%	51%	57%	43%
Experience -familiarity with blogging _ Survey Question 1						
Type	ITNW142508	Total Fall				
Enthusiast	3	5				
Satisficers	1	2				
Disenchanted	1	1				
Converts	3	6				
Anti-bloggers	1	2				
Total	9	16				
Percentages						

Conclusion and Recommendations for Further Study

Without exception, all student types exhibited instances of critical thinking through blogs and essays. Not all were aware of their progress. In fact the negative types of Anti-bloggers, Satisficers, and Disenchanted who disparaged the technology in reflective essays, were coded as having 106 or 24.8% of all blog instances of critical thinking. The positive types of Enchanteds and Converts indicated the larger percentage of instances of critical thought, possibly attributable to the greater activity of blogging..

This was an exploratory investigation of a new technology. No attempt was made to generalize the findings to a greater student population. As blogging becomes more commonplace, a longitudinal study to examine a research hypothesis correlating superior

reflective blogging with superior content mastery may provide further insight into the technology.

Blogging as a technology is currently debated as (Christensen, 1997; Wrede, 2003) disruptive, in that it will replace existing technologies of discussions. Conversely, blogging can be viewed as an evolution of the direct participation of Internet users, unencumbered by intermediaries of existent learning management systems. Most agree that blogging as it exists in the current environment, will, like all technologies, evolve into a new format. Recently wikis, a form of collaborative websites, and podcasts, which have been defined as verbal blogs, are becoming commonplace on the general Internet. The educational use of these and their emergent descendent technologies has yet to be examined.

At the conclusion of the investigation, the researcher presented her college administration with an evaluation of the results. As a consequence, the institutional Quality Enhancement Plan (QEP), a requisite component of the conditions established by the Southern Association of Colleges and Schools (SACS) that reaffirmed Central Texas College (2005), will include content mining for critical thinking as one of its assessment techniques for evaluating the enhancement of student learning. The use of such electronic technologies as e-portfolios and blogging will be an integral part of that initiative.

Blogging is a relatively new concept that is gaining popular exposure through the general press. Aside from its apparent function as a forum for personal expression, a

blog's aspects of chronology, linkage, and public comments make it a technology with potentially revolutionary educational implications.

Appendix A

Bloom's Taxonomy of Competencies and Skills

<i>Competence</i>	<i>Skills Demonstrated</i>
Knowledge	Observation and recall of information Knowledge of dates, events, places Knowledge of major ideas Mastery of subject matter
Comprehension	Understanding information Grasp meaning Translate knowledge into new context Interpret fact, compare, contrast Order, group, infer causes Predict consequences
Application	Use information Use methods, concepts, theories in new situations Solve problems using required skills or knowledge
Analysis	Seeing patterns Organization of parts Recognition of hidden meanings Identification of components
Synthesis	Use old ideas to create new ones Generalize from given facts Relate knowledge from several areas Predict, draw conclusions
Evaluation	Compare and discriminate between ideas Assess value of theories, presentations Make choices based on reasoned argument Verify value of evidence Recognize subjectivity, conclude, compare, summarize

Adapted from Bloom, (1956). Online at <http://www.coun.uvic.ca/learn/program/hndouts/bloom.html>

Appendix B

Example Keywords for Content Analysis

Cognitive Skill	Keywords	Petress' Critical Thinking Characteristics	Keywords
Bloom's Synthesis BS	Blend; compare; produce;classify	Sufficiency Reliability	only in context
Bloom's Analysis BA	Consider; deconstruct; look at	Relevance Consistency	only in context
Bloom's Evaluation BE	Value; estimated	Recency Objectivity	only in context only in context
Henri's Five Domains		Garrison's Five Stages of Critical Thinking	
Participative HP	[only in context]	Problem identification	only in context
Social HS	[only in context]	Problem Definition.	only in context
Interactive HI	Said, indicated, stated, commented	Problem Exploration	only in context
Cognitive HC	Thought, reasoned, analyzed, synthesized, evaluated	Problem Applicability	only in context
Metacognitive HM	Thought, realized, considered	Problem Integration	only in context

Appendix C

Rubric for Coding (Author)

Bloom's higher order cognitive skills	Bloom's analysis BA	Bloom's synthesis BS	Bloom's evaluation BE			
Petress characteristics of a critical thinker	Petress Sufficiency PS	Petress Reliability PR1	Petress Relevance PR2	Petress Consistency PC	Petress Recency PR3	Petress Objectivity PO
Garrison's Five Stages of Critical Thinking	Garrison – Problem Identification GID	Garrison – Problem Definition GD	Garrison – Problem Exploration GE	Garrison – Problem Applicability GA	Garrison – Problem Integration GI	
Henri's Five Dimension of CMC	Henri – Participative HP	Henri -- Social HS	Henri – Interactive HI	Henri – Cognitive HC	Henri – Metacognitive HM	

Appendix D

Blog site

The screenshot shows a web browser window displaying a Blogger blog page. The browser's address bar is empty, and the toolbar includes standard navigation icons. The page header features a blue banner with the text "the quick spot for your blog" and the "blogspot" logo. Below the banner, there are three promotional boxes: "Free Comments" (Hosted blog and web commenting system. Free and easy to install. Related Searches: *xml.jsp), "Create Your Blog Today" (Easy, fast, powerful web publishing Sign up for your Free Trial Weblog. Ads by Google), and "Start your own!".

The main content area has a light blue background with a white sidebar on the left. The title "Course Blog for ITNW1437" is prominently displayed in a large, dark font, followed by the subtitle "A COURSE RESOURCE AND PORTAL TO PEER BLOGS." Below the title, the date "SUNDAY, MAY 23, 2004" is shown in red. The main post title "Course Blog for ITNW1437" is underlined. The post content reads: "This is a new blog for a new course. As the course progresses, this blog will be a center of course research and collaboration." Below the text, it says "POSTED BY JANE AT 2:48 PM | 1 COMMENTS".

The sidebar on the left contains three sections: "PREVIOUS POSTS" with a link to "Course Blog for ITNW1437", "PEER BLOGS" with a link to "Last Semester", and "ARCHIVES" with a link to "May 2004". At the bottom of the sidebar is the "Powered by Blogger" logo. The background of the main content area features a faint image of a building and a landscape with rocks.

Appendix E

Student Blogging Activity – Total Student Population

	Contributed to student blog (Survey question 2)	Read course blog (Survey question 3)	Read peer blogs (Survey question 4)	Intend to continue to blog (Survey question 5)
Every week	21 (31.3%)	42 (62.7%)	28 (41.8%)	Yes 46 (68.7%)
Only when required	11 (16.4%)	7 (10.4%)	--	--
Occasionally	35 (52.2%)	17 (25.4%)	36 (53.7%)	--
Never	0 (0.0%)	1 (1.5%)	3 (4.5%)	No 21 (31.3%)

Appendix F

Blogathon Instructions

Blogging is a requirement for this course. In addition to reading the course, each student is required to establish and maintain a personal blog that is linked from the course blog. This “blogathon” requirement replaces either a paper or an examination as indicated in the course syllabus.

Place your name on the essay. This is a pass (100%) or fail (0%) grade. When you complete this essay, your name is used solely for recording a 100% grade in the course grade sheet. The contents of the essay are not graded. Failure to submit an essay will result in a grade of 0 %. Please answer the questions below and return your typed essay along with this instruction sheet.

1. Before enrolling in this class have you (Select only one):

- A. Created a blog B. Read other blogs C. Neither

2. **Your blog.** When did you add to your student blog during the semester?

(Select only one)

- A. Only when specifically required. B. Every week, whether required or not
 C. Occasionally D. Never

3. **Course blog.** When did you read the instructor’s course blog? (Select only

one)

- A. Only when specifically required. B. Every week, whether required or not
 C. Occasionally D. Never

4. **Peer blogs.** What ONE choice describes your activity with other student blogs.

- A. Read peer blogs regularly. B. Read and commented on peer blogs
 C. Rarely read peer blogs D. Never read peer blogs

5. At the conclusion of the course, will you (Select as many as apply).

- A. Continue your current student blog. B. Continue to read the course blog
 C. Create a new blog D. Delete student blog

The Essay:

The philosopher Socrates said that an unexamined life is not worth living. The purpose of this exercise is to examine your course life – your “journey of discovery” – over the previous weeks of the semester. So, re-read your own blogs, re-read the course blog, read the student peer blogs linked from the course blog, and then write for a minimum of 30 minutes reflecting on your personal journey of discovery in the course.

Appendix G

Prototype Spreadsheet for Data Collection

Student ID	Gender	Frequency# of Blogs	Duration of blogging 1=weekly full term 2=weekly part term 3=occasionally 4=never	Content 1=refers to course blog 2=refers to peer blogs 3=refers to both 4=no reference	Content keywords	Semester Grade
1437080401						
1437080402						
1437080403						
1437080404						
1437080405						
1437080406						
1437080407						
1437080409						
1437080410						
1437080411						
1437080412						
1437080413						
1437080414						
1437080415						
1437080416						
1437080417						
1437080418						
1437080419						

Appendix H

Institutional Review Board Permission – Central Texas College

June 16, 2004

Jane Perschbach, Faculty
Computer Science Department
Central Texas College
P.O. Box 1800

Killeen, Texas 76542

Dear Mrs. Perschbach,

I have reviewed the abstract of your Nova Southeastern University dissertation and approve of your use of Central Texas College student data. It is my understanding that you will maintain student confidentiality in your research and that you will utilize only students 18 years of age or older. You are granted permission from the Institutional Review Board (IRB) to proceed with your research.

I wish you success in this endeavor.

Sincerely,

Ben H. Wickersham, Deputy Chancellor
Educational Support Services and Texas Campus Operations

cc: Gertrude Abramson

Appendix I

Institutional Review Board Permission – Nova Southeastern University

The screenshot shows an email client window with a Windows taskbar at the top. The email is titled "INBOX: IRB Approval (223 of 291)". The sender is James Cannady (sj.cannady@computer.org) and the recipient is Trudy Abramson (trudy@nova.edu). The subject is "IRB Approval".

Date: Fri, 16 Apr 2004 18:35:23 -0400
From: James Cannady <sj.cannady@computer.org>
To: perschba@nova.edu
Cc: Trudy Abramson <trudy@nova.edu>
Subject: IRB Approval

Jane,

After reviewing your IRB Submission Form and Research Protocol I have approved your proposed research for IRB purposes. Your research has been determined to be exempt from further IRB review based on the following conclusion:

Research using survey procedures or interview procedures where subjects' identities are thoroughly protected and their answers do not subject them to criminal and civil liability.

Please note that while your research has been approved, additional IRB reviews of your research will be required if any of the following circumstances occur:

1. If you, during the course of conducting your research, revise the research protocol (e.g., making changes to the informed consent form, survey instruments used, or number and nature of subjects).
2. If the portion of your research involving human subjects exceeds 12 months in duration.

Please feel free to contact me in the future if you have any questions regarding my evaluation of your research or the IRB process.

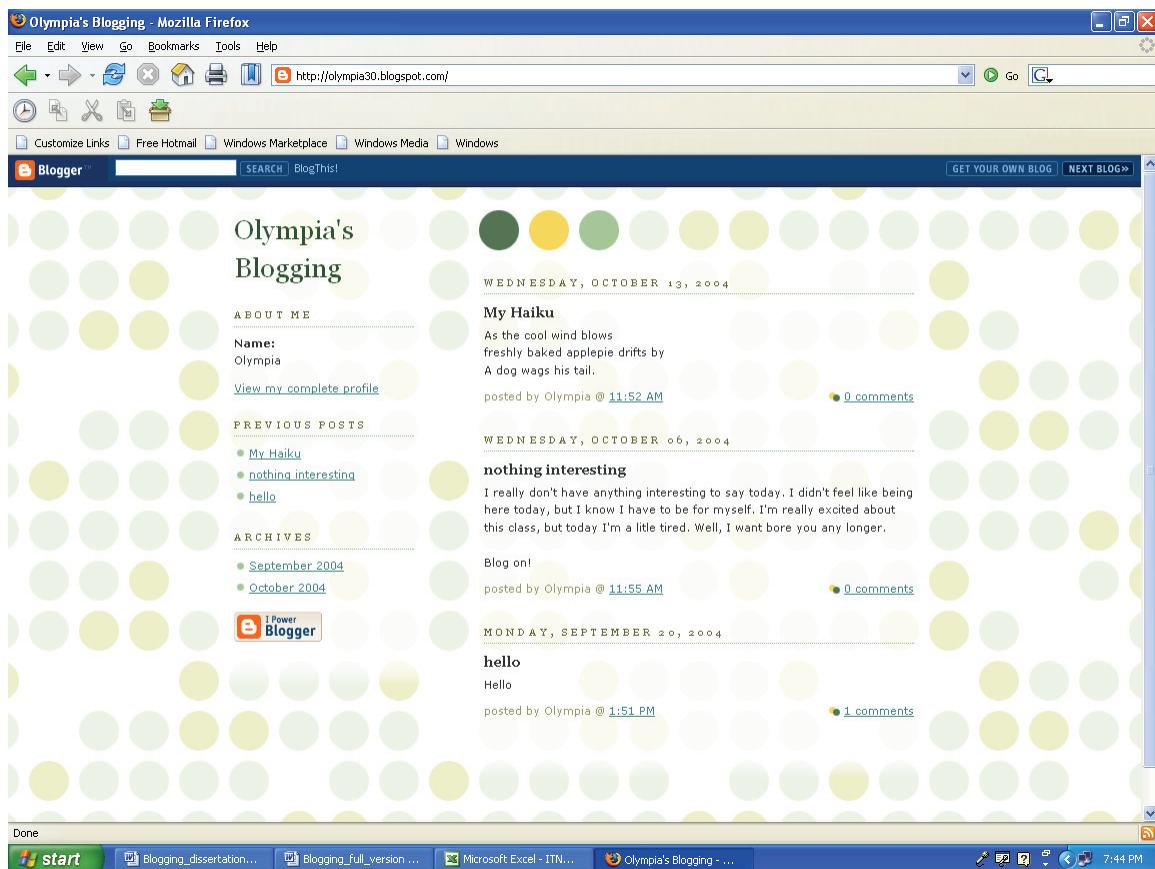
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PGP public key fingerprint:
 8169 6D03 680E EF6C 899C
 8C42 B4A3 DC9F 9F6B 4075

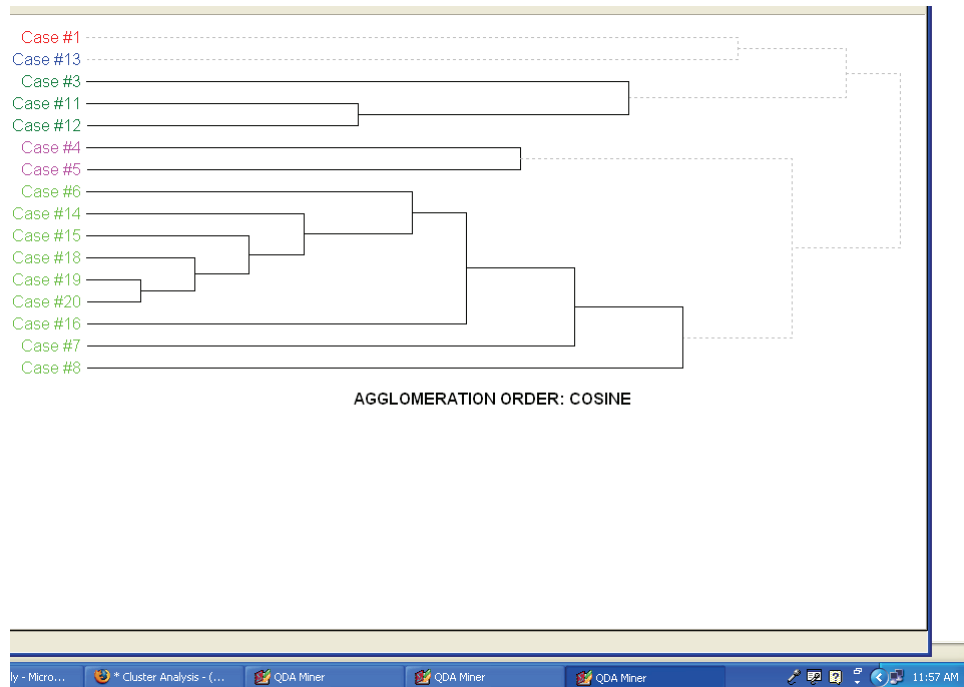
Appendix J

Example of Student Blogsite



Appendix K

Computer Generated Dendrogram



Codes co-occurrence analysis

Options | Dendrogram | 2D Map | 3D Map | Proximity | Statistics

CLUSTER ANALYSIS

Similarity matrix:

	Case #1	Case #3	Case #4	Case #5	Case #6	Case #7	Case #8	Case #11	Case #12	Case #13	Case #14	Case #15	Case #16	Case #18	Case #19	Case #20
Case #1	1.000															
Case #3	0.661	1.000														
Case #4	0.622	0.398	1.000													
Case #5	0.721	0.426	0.832	1.000												
Case #6	0.460	0.449	0.728	0.460	1.000											
Case #7	0.441	0.426	0.622	0.441	0.844	1.000										
Case #8	0.426	0.406	0.565	0.426	0.772	0.661	1.000									
Case #11	0.460	0.772	0.439	0.460	0.472	0.460	0.449	1.000								
Case #12	0.460	0.772	0.439	0.460	0.472	0.460	0.449	1.000	1.000							
Case #13	0.721	0.661	0.411	0.441	0.460	0.441	0.661	0.460	0.460	1.000						
Case #14	0.460	0.449	0.728	0.460	1.000	0.844	0.772	0.472	0.472	0.460	1.000					
Case #15	0.460	0.449	0.728	0.460	1.000	0.844	0.772	0.472	0.472	0.460	1.000	1.000				
Case #16	0.721	0.426	0.832	0.721	0.844	0.721	0.661	0.460	0.460	0.441	0.844	0.844	1.000			
Case #18	0.460	0.449	0.728	0.460	1.000	0.844	0.772	0.472	0.472	0.460	1.000	1.000	0.844	1.000		
Case #19	0.460	0.449	0.728	0.460	1.000	0.844	0.772	0.472	0.472	0.460	1.000	1.000	0.844	1.000	1.000	
Case #20	0.460	0.449	0.728	0.460	1.000	0.844	0.772	0.472	0.472	0.460	1.000	1.000	0.844	1.000	1.000	1.000

Clustering progress

Appendix L

Cluster Analysis

Blogger Type	Attitude and Relevance (based on cluster analysis of blogs)	Actions (based on frequency count & interactivity of blogs)	Persistence in future blogging (as identified in blog essay)	Evaluation (as identified in blog essay)
<i>Enthusiast</i>	Initially posts enthusiastic, relevant content interactive with other blogs. Continues positive comments for duration	Posts more than the required minimum Content relates to both course blog and peer blogs.	Indicates that he/she will persist in blogging beyond the semester.	Views blogging as an effective learning tool in his/her course education.
<i>Disenchanted</i>	Enthusiastic and course relevant content interactive with the course and peer blogs, shows a decline in enthusiasm and/or relevance, and/or interactivity over the semester period.	The quantity and frequency of blogs decrease over time as does the content quality.	Indicate no interest in continuing to blog after the conclusion of the course.	Views blogging as a potentially effective learning tool in his/her course education, but for identified reasons indicates that there were negative conditions to offset any value in the blogging effort.
<i>Convert</i>	Initially reluctant to post as reflected in negative statements	posts increasingly frequently and relevantly during the semester.	May or may not express an interest in continuing to blog	views blogging as an effective learning tool in his/her course education
<i>Anti-blogger</i>	Initially and consistently negative on reflection, collaborative knowledge sharing, and/or the public nature of blogging	Minimal posting and sharing of knowledge through hyperlinking. Little or no references to course or peer blogs	Reports a negative attitude toward blogging as a technique for learning.	Indicates that the student did not value blogging as a technology for reflection and/or did not value the concept of reflective learning.

Appendix M

Indicators of Persistence in Blogging

Persistence – Indicated will continue with blogs (Survey Question 5 not equal to response 4)

Type	ITNW 143706	ITSC 140506	Total Summer	ITNW 143708	ITNW 142508	Total Fall	Combined
Enthusiast	9	4	13	7	8	15	28
Satisficer	0	0	0	0	0	0	0
Disenchanted	0	0	0	0	0	0	0
Convert	1	0	1	6	3	9	10
Anti-blogger	0	0	0	0	0	0	0
Total	10	4	14	13	11	24	38

Percentages

Type	ITNW 143706	ITSC 140506	Total Summer	ITNW 143708	ITNW 142508	Total Fall	Combined
Enthusiast	50%	40%	46.4%	32%	47%	38.05%	42%
Satisficer	0%	0%	0%	0%	0%	0%	0%
Disenchanted	0%	0%	0%	0%	0%	0%	0%
Convert	5.6%	0%	3.6%	27%	18%	23.1%	15%
Anti-blogger	0%	0%	0%	0%	0%	0%	0%
Total	55.6%	40%	50%	59.1%	64.7%	61.5%	57%

Appendix N

Instances of Positive/Negative Statements Associated with Elements of Blogging as Reported by Blogger Type

Blogger Type	Positive Statements	Negative Statements
Enthusiast	<p>Time: <i>blogging is useful when I miss class to check on my team's progress; blogging became a habit along with checking me email every day.</i></p> <p>Links: <i>Every time I see a blog link on a website I try to see what others have written...this is interesting and important because someone else can find thing that I may not have been able to; I really like the fact that you can view the blogs of other people as well as have others view yours. It helps the whole blogging community ink together to share information and some have even interjected information and links into our blogs.; I went to {student x's} blog and found that he was correct. [Student y's] site was better or at least nicer than the site [student x] found. But now I have 4 different sties to go to to learn.</i></p> <p>Collaborative comments: <i>When a person blogs it's because they really want their thoughts to reach other people; I find myself checking to see if I have comments from people around the country; blogging is a good way both to distribute and find information</i></p>	<p>Time: <i>It's hard keeping up with the peer blogs, there;s never enough time and I'm always late posting.</i></p> <p>Links:-- Collaborative comments: <i>I don't like to convey myself to others electronically</i></p>

Satisficer	<p>Time: <i>There were times I couldn't make it to class [student is active military], but I used the blogs to catch up.</i></p> <p>Links: <i>It's amazing what you can learn if you blog</i></p> <p>Collaborative comments: --</p>	<p>Time:--</p> <p>Links: --</p> <p>Collaborative comments: The only reason I didn't like the blogging was out of all the times I blogged I only received one comment.</p>
Disenchanted	<p>Time:--</p> <p>Links: --</p> <p>Collaborative comments: <i>Blogs give everyone the opportunity to have a voice.</i></p>	<p>Time: <i>I want to write something that isn't trivial, but don't really have the time to think it out and come up with anything but filler.</i></p> <p>Links: <i>I have done the things (linking) within the past few weeks only to get the grade I desire.</i></p> <p>Collaborative comments: <i>I regard the blogs with disdain because they are not what I expected...I just don't see them as adding much to the discourse.</i></p>
Convert	<p>Time:</p> <p>Links: <i>the blog is a tool that allows me to express myself and inform my teammates on networking topics The different websites I found on people blogging about my topic was [sic] actually kinda cool...but you can't always rely on other people's opinions..</i></p> <p>Collaborative comments: <i>Through blogs I learned to value the experience or rather the abilities of other that help me to</i></p>	<p>Time:</p> <p>Links:</p> <p>Collaborative comments: <i>Blogging wasn't at all very helpful because I didn't know of too many people who would read other people's blogs; when I started posting my own comments I realized how everyone in the class had almost the same opinion about each topic; I think blogging is a journal in a way, and I'm not too big on journals ...but it's still cool in ways if the topic is something that really interests you</i></p>

fight the mundane things that I wish I already knew; blogging helps one find out about a person without really having to have a face-to-face conversation with the. A blog is a person's picture to the work..

Anti-blogger

Time:

Links:

I have learned how different people deal with the same situation, just different ways of solving it so you mid is always running with information and new thought.

Collaborative comments:

The blogs kept me involved in the class; I scanned through the comments today and there were a few that I really agree with...

and you really want to vice your opinion.

Time:

There are reasons for me not blogging as much as I should have – job, child, access to a computer, time; It never seems to be enough hours in a day to do everything including blogging..

Links:

The class was quiet but [students] shared their personal thoughts on the blogs and showed their creativity

Collaborative comments:

I didn't like the idea of everyone in the world having access to read my blogs.

Appendix O
Interactivity with Course Blog
Interactivity-read course blog Survey Question 3 (Response not 4
"Never")

Type	ITNW 143706	ITSC 140506	Total Summer	ITNW 143708	ITNW 142508	Total Fall	Combined	
Enthusiast		9	4	13	6	8	14	27
Satisficers		4	2	6	1	2	3	9
Disenchanted		0	1	1	3	1	4	5
Converts		1	0	1	6	3	9	10
Anti-bloggers		4	3	7	5	3	8	15
Total		18	10	28	21	17	38	66

Appendix P

Interactivity with Peer Blogs

***Interactivity -- read peer blogs
Survey Question 4 (response not 4
"Never")***

Type	ITNW 143706	ITSC 140506	Total Summer	ITNW 143708	ITNW 142508	Total Fall	Combined
Enthusiast	9	4	13	6	4	10	23
Satisficers	4	2	6	1	0	1	7
Disenchanted	0	1	1	3	1	4	5
Converts	1	0	1	6	2	8	9
Anti-bloggers	4	3	7	4	3	7	14
Total	18	10	28	20	10	30	58

Appendix Q

RQ1 – Evidence in Critical Thinking by Blogging Elements

Blogging Element	Example of Evidence	Explanation
Time	<i> Blogging can be useful if I miss class and have no idea what is going on or what I'm supposed to do. I can always go to the blog to check</i>	Relates to convenience of online technology
Linkages	The information in the blogs posted by my teammate included different websites that helped me.	Students were expected to research topics and post relevant URLs in their blogs
Comment	<i>I try to see what others have written [in comments] so I am able to read the thought and opinions of someone else.</i>	Comments on the Internet connected blogs were not limited to those students in the class.

Research Question One: What was the observable outcome, specifically related to evidence of reflective critical thinking in student learning, that was uniquely attributable to the technology of blogging?

Appendix R

RQ2 – Evidence of Social Learning

Social Incidents - Garrison & Henri							
Blog	ITNW143706	ITSC140506	Total Summer	ITNW143708	ITNW142508	Total Fall	Combined
Enthusiast	1	7	8	7	12	19	27
Satisficers	0	2	2	2	0	2	4
Disenchanted	0	3	3	2	1	3	6
Converts	0	0	0	2	2	4	4
Anti-bloggers	0	4	4	2	1	3	7
Total	1	16	17	15	16	31	48
Essay							
Type	ITNW143706	ITSC140506	Total Summer	ITNW143708	ITNW142508	Total Fall	Combined
Enthusiast	11	6	17	17	18	35	52
Satisficers	7	6	13	0	5	5	18
Disenchanted	0	3	3	4	0	4	7
Converts	2	6	8	13	3	16	24
Anti-bloggers	5	8	13	5	3	8	21
Total	25	29	54	39	29	68	122

Research Question Two: In a social context, how did the use of blogging technology facilitate student collaboration to provide a viable forum for social learning?

Appendix S

RQ3 – Instances of Documenting/Encouraging Individual Critical Thought

Individual Incidents - Bloom & Petress							
Blog	ITNW143706	ITSC140506	Total Summer	ITNW143708	ITNW142508	Total Fall	Combined
Enthusiast	3	6	9	6	9	15	24
Satisficers	0	1	1	0	0	0	1
Disenchanted	0	3	3	3	3	6	9
Converts	0	0	0	5	8	13	13
Anti-bloggers	0	0	0	1	7	8	8
Total	3	10	13	15	27	42	55
Essay							
Type	ITNW143706	ITSC140506	Total Summer	ITNW143708	ITNW142508	Total Fall	Combined
Enthusiast	7	6	13	19	11	24	37
Satisficers	1	4	5	1	5	2	7
Disenchanted	4	2	6	3	1	7	13
Converts	3	0	3	14	4	15	18
Anti-bloggers	7	3	10	7	1	29	39
Total	22	15	37	44	22	44	81

Research Question Three: On an individual level, how did the use of blogging technology encourage and document the progression of student critical thinking?

Appendix T

RQ4 – Student Perception of Positive/Negative Statements on Blogging by Type

Positive Essay comments (greater than 50% positive)							
Type	ITNW 143706	ITSC 140506	Total Summer	ITNW 143708	ITNW 142508	Total Fall	Combined
Enthusiast	7	3	10	7	7	14	24
Satisficers	3	2	5	1	1	2	7
Disenchanted	0	1	1	1	0	1	2
Converts	0	0	0	2	2	4	4
Anti-bloggers	3	3	6	1	1	2	8
Non-responsive essays	2	0	2	7	4	11	13
Total # - positive	13	9	22	12	11	23	45
Total # - negative	3	1	4	3	2	5	9
	18	10	28	22	17	39	67
Type	ITNW 143706	ITSC 140506	Total Summer	ITNW 143708	ITNW 142508	Total Fall	Combined
Enthusiast	39%	30%	36%	32%	41%	36%	36%
Satisficers	17%	20%	18%	5%	6%	5%	10%
Disenchanted	0%	10%	4%	5%	0%	3%	3%
Converts	0%	0%	0%	9%	12%	10%	6%
Anti-bloggers	17%	30%	21%	5%	6%	5%	12%
Non-responsive essays	11%	0%	7%	32%	24%	28%	19%
Total % - positive	72%	90%	79%	55%	65%	59%	67%
Total % - negative	17%	10%	14%	14%	12%	13%	13%

Research Question Four: What elements of blogging did students report provided motive to continue the reflective journaling process in future courses?

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