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Using Blackboard technologies as an instructional supplement for teaching high school chemistry

Steven Louis Coulombe

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USING BLACKBOARD TECHNOLOGIES AS AN INSTRUCTIONAL SUPPLEMENT FOR TEACHING HIGH SCHOOL CHEMISTRY

A Project
Presented to the
Faculty of
California State University,
San Bernardino

In Partial Fulfillment
of the Requirements for the Degree
Master of Arts
in
Education:
Educational Technology

by
Steven Louis Coulombe

June 2001
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Date: 6-11-01
ABSTRACT

The average high school student spends about an hour a day in each subject area. The typical high school chemistry student is expected to learn and master a large body of knowledge in preparation for college. Illness, vacation, state testing programs, and extra-curricular activities can distract students from performing at their highest level. This project attempts to use an on-line telecommunications supplement to extend the boundary of the classroom beyond the limits of time and space in order to improve communication and extend the reach of the classroom.

Blackboard.com and Blackboard 5 are used in this project as portals for distributing course materials over the Internet and for communicating via electronic mail by synchronous and asynchronous chat.

Evaluation consisted of reviewing student essays, surveys and course statistics. These instruments reveal a widespread acceptance of the on-line program. Students from five chemistry classes, with other teachers and guests, were voluntarily involved in the project.

Results indicated a high level of participation by students in the on-line supplement. Students have reported
that communication between peers has increased. Course
delivery and access to the chemistry curriculum has
improved and communication between students and their
teacher has resulted in a better understanding of
chemistry.
ACKNOWLEDGMENTS

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CHAPTER ONE

INTRODUCTION

Overview

Will the classroom of the 21st century be a technology-filled, four-walled warehouse with student computer users, or will education take place in a classroom at all? How do some innovate and improve the teaching process without changing the educational environment in ways that may also hasten its collapse? Postman (1979) an educational philosopher believes that the educational establishment should attempt to conserve tradition when society is innovative and to innovate when the society is too traditional. The microcomputer is changing the face of education, and its use in the classroom demands a reordering of priorities.

Teachers need to be concerned about how computing technology will change the classroom. McLuhan (1967) has alluded to the problem, "the medium, or process, of our time-electric technology-is reshaping and restructuring patterns of social interdependence and every aspect of our personal life. It is forcing us to reconsider and reevaluate practically every thought, every action, and
every institution formerly taken for granted. Everything is changing—you, your family, your neighborhood, your education” (p. 8). As a society, we need to focus on this reshaping process; we need to be conscious of the changes that will be brought about by computing technologies.

According to Postman (1985), the serious student of technology will explore both the positive and negative aspects of computer technology. The computer holds out the promise of extending our mind, stimulating our educational thirst and enabling independent and constructive learning. The tradeoff, however, is the creation of students who have their sensibilities overloaded while being subjected to experimental methods of instruction. I believe it has become important to explore both the positive and negative impacts of computer use for the 21st century student.

Marchand (1989), expressing the ideas of Marshall McLuhan, suggests that, “technology extends part of the body. The wheel is an extension of the foot and electronic technologies are extensions of the nervous system” (p. 159). The computer is an extension of the mind, the seat of thinking and reasoning. We live in an informational age; there is more news in the Sunday paper than could ever be
read in one day. How are students going to wade through the voluminous curricular materials at their disposal? The microcomputer extends the mind by allowing us to access, process, and filter through vast amounts of information in an orderly and sometimes automatic way. The Internet search engine is a powerful tool that automatically examines and filters through thousands of web sites to streamline information flow. The Internet makes available new resources and new methods of communication. Today, time or space limits no teacher. O'Malley (1999) details the experience of Joe Kitchens, superintendent of the Western Heights School District. Mr. Kitchens states, "It [the computer] can help you teach the subjects you already teach, which is important. But it can also help you teach things you would not be able to teach otherwise" (p. 106). The microcomputer, in conjunction with the Internet, can take students to places such as the Smithsonian Museum where they can take a virtual field trip. Giacquinta, Bauer, and Levin (1993) report the potential for computers to increase higher-order thinking skills and state, "many now consider it important for people to use computers as tools, as extensions of the mind, and not solely for the
transfer of knowledge" (p. 7). The computer is becoming part of our collective nervous system and consciousness.

Slide-show presentations, web lessons, and computer simulations of real-life events are all vying for the attention of the computer-age student. O'Malley (1999) quotes John Jones, superintendent of Quillalyute Valley School District in Washington. Mr. Jones remarks, "kids today have way too much stimulation for teachers to sit back and present material the way we might have years ago" (p. 108). All teachers are aware of the need to arouse the intellect, to stimulate it and to engage it. Teachers are gaining access to new tools, which can enable them to redesign their methods. According to Strauss (1999), the computer has the ability to extend our senses. If you make learning fun, compelling, and entertaining, then students will be more attentive and they will engage more of their senses.

Computers are being used to educate people at a distance. Many people know of at least one or two families who educate their children at home or in small, home-school communities. In making the transition between traditional methods of the past and the innovations of the future, many schools have lost a sense of purpose. Parents have sensed
this frustration and have begun to take charge of their children’s education. Do you want your child to have a classical education? The Internet can provide links to on-line Latin courses, tutorial chat groups, and textbooks such as Wheelock’s Latin grammar manual. The computer has extended our educational reach and our freedom; we do not have to rely on the campus institution for our classroom experiences.

Distance education allows students to learn at their own pace without worrying about the pace of other classmates. Strauss (1999) has observed that mastering the curriculum takes time. With the computer, students can learn at their own pace. No longer will it be necessary to track students into slow or fast learning groups. It may become possible in the near future for students to use personal computer tutors which can stimulate, re-mediate and refine lessons while ensuring ultimate mastery of the material to be learned. Cummings (1999) makes a number of predictions for the classroom of 2020:

artificial intelligence software continually monitors the learner’s actions and optimizes instruction, and the software’s analysis of learning patterns and assessment data shows
marked differences in the learning strategies, problem-solving techniques, and stimulus requirements of males and females. It adjusts for these differences and thus, with newly-developed, gender-specific on-line teaching materials, improves the performance of all pupils (p. 2).

With all of these automatic functions, who needs to be dependent on a human classroom teacher? Cummings endorses on-line learning because it will result in the demise of the "old-fashioned school factory" (p. 1).

What are the overindulgences that need to be considered when it comes to stimulating our students to learn? We live today in a society that is obsessed with entertainment. "I’m bored" is the typical refrain today among adults and youth. Postman (1985) has condemned an emerging philosophy, that links education with entertainment and has noted that Plato and Dewey believed that education must be rooted in "robust emotional ground" (p. 146), but they never believed that students learn or achieve more when education is entertainment.

Some educators believe that students must be bombarded by multimedia presentations and entertained constantly. But like a drug, which requires its user to constantly imbibe
more, teachers will constantly be in search of gimmicks to stimulate and cajole their audiences. The computer becomes an extension not of the rational mind, but instead becomes the purveyor of entertainment for our sensibilities. Postman (1985) laments that the classroom teacher and his curriculum are going to lose potency when teaching and learning become “vastly amusing activities” (p. 148). In order to amuse students and to retain their attention, teachers become entertainment facilitators in search of ways to keep their students amused: reality becomes mixed with myth. Postman has suggested that technological media might now be “serving as a surrogate for reality” (p. 84).

Ask a teacher or planner the following question: what exactly will you use these computers for? The answer is often “We don’t know yet, but we plan to put them to good use.” Many teachers are hesitant to use computers, and are not provided professional development time to develop lessons. In the words of Postman (1985), “a new technology usually makes war against an old technology. It competes with it for time, attention, money, prestige, and a ‘worldview’” (p. 192). We cannot afford to purchase and maintain computer technology and not provide time for teacher training. Teachers need to embrace effective
futuristic methodologies, but they must also be agents of restraint, or conservers of efficient pedagogy. The 21st century beckons teachers with new machines and fancy toys; teachers must be wise, wary and deliberate in the adoption and implementation of new methods.

Learning can take place in a variety of places and settings. Learning can take place in the classroom or in the field, during conversation and upon personal reflection. A dynamic lesson in class can often lead to a dynamic lesson outside of class. Students will stay after class to discuss the implications of a lesson and often will continue self-reflection in their conversations and experiences. An effective lesson can be a building block or connecting link to further a learning experience. The effective teacher will bring the classroom to life by extending its reach.

Many students believe that their purpose in school is to earn credits; they are not participating with the express purpose of learning. This effect can result from immaturity or from an educational system that is concerned with a factory-model approach to learning. The solution must result in the delivery of a meaning-centered
Meaning making is related to a philosophy of learning called constructivism. This educational philosophy circumscribes learning as active rather than passive and involves reflection and a social construct. Students cannot learn effectively when their teacher is seen as an authority figure that delivers information which is passively received. Students must be engaged in their learning; they must participate actively by helping direct the flow of curriculum and through being involved in its design. According to this constructivist paradigm, students learn by interacting with their environment. They articulate their beliefs by self-reflecting and by interacting with their peers. The constructivist environment is a social construct where students learn by becoming part of an educational community of learners. This environment is one that promotes interactive activities that engage the learner. The learner controls the learning environment instead of being manipulated by it. Students are able to plan while negotiating the challenges of their course according to their own needs and desires while they construct learning that is meaningful to them.
This project uses a computer software program that allows the teacher and student to build an on-line Internet learning environment. This environment will provide new resources for an extended classroom that will include participants who can meet at any time of day.

Statement of Problem

The modern student is too dependent on the classroom teacher. The traditional teacher delivers the curriculum and is responsible for communicating its meaning. The effective teacher will develop methods that place learning tools in the hands of their students, who will then take responsibility for their own learning. Students learn best when they are in control of their own education. New technologies can be used to entertain and pacify students or they can be used as tools for forging an independent and responsible learning style.

Goals

This project will use technology as a platform for improving communication and encouraging independent learning for chemistry students. In addition, an attempt will be made to extend the reach of the classroom beyond
the traditional four walls and the "hour-a-day" period of instruction.

Classrooms thrive when students perceive that they are an integral part of a community. Learning is at its zenith when communication between parents, teachers, and students is effective and substantial. Telecommunication technologies provide an opportunity for parents to access curriculum and to communicate with the teacher twenty-four hours a day. Students have access to their teacher as well as other students in the evenings.

Significance

This project will place the chemistry curriculum onto a web site hosted by Blackboard Incorporated. Students will be able to study chemistry from a distance by accessing the instructor provided course materials at home. Students will be able to communicate with their teacher and with other peers through discussion boards and through Internet chat. Learning will take place at the convenience of the student instead of the teacher.
CHAPTER TWO

LITERATURE REVIEW

Student and Teacher Collaboration

Delivering coursework to students involves communication—a two way process. The computer revolution and telecommunication technologies have opened the door for new forms of collaboration amongst students, and between students and teachers. Researchers have found that many benefits arise from effective collaboration between students and teachers when they share information and interact using communication technologies. Rich, Robinson, and Benders (2000) have reviewed a large number of publications, resources, and projects and have concluded that collaboration is the key to successful use of information and communication technologies.

New technologies promise to radically change the educational process. Some worry that these changes will supplant the teacher and have profound negative outcomes for the traditional classroom. (These fears may be unwarranted or lack research documentation.) Rich et al. (2000) have indicated some of the desired results of learning technologies: “improved learning processes and
enhanced educational outcomes; more flexible delivery of and greater access to education; improved administration of courses, and greater resource sharing" (p.264).

Effective collaboration takes many forms: interactions between students, interactions between staff, collaborative development of teaching resources, databases and information centers, and joint delivery of courses and programs. The effective use of technology demands an emphasis on communication and collaboration.

The American educational system places an emphasis on individual achievement. How does one encourage and reward individuals while incorporating a collaborative model? Using a computer is often seen as a solitary exercise but it does not have to be. The computer can facilitate communication and sharing, and these benefits are a central tenet of the student-centered model of education. Sharing can streamline information acquisition because it allows for more efficient data gathering. Various individuals and groups are able to sample a large variety of learning resources. They can then report those that are found to be the most effective. Technology should not drive the educational process; rather the educational process must drive technology. Rich et al. (2000) believe that "any
educational development, collaborative or otherwise, should include evaluation and feedback mechanisms at all stages, and increasingly is likely to be subject to performance reviews and benchmarking as a matter of routine" (p. 266).

Computer Mediated Communication

Computer-mediated communication (CMC) consists of electronic mail, video conferencing, discussion boards, and Internet relay chat. The opportunity now exists for students to communicate with the teacher and with each other without the limitations of time and space. One reason for having on-line classrooms is the flexibility that allows students and teachers to communicate with each other at their own convenience. Students can access course materials at home, on a computer, or while at school during breaks in their schedule. Poole (2000) did a case study on the participatory behavior of students taking part in an on-line course. According to Poole (2000), “the flexible participation schedule afforded by computer-mediated communication tools can lengthen the time in which students are engaged in class material, while the reflection time may encourage more widespread participation by all students” (p.175). Poole also believes that CMC encourages
the instructor to change his/her role as a teacher. Poole used WebCT as the platform for student-teacher interactions. Poole found that synchronous chat was not a format that students found useful.

Electronic office hours are virtual computer rooms where interactive conversations can occur. Unlike discussion boards, all participants are logged-on at the same time. Electronic office hours are designed to allow teachers and students to come together on-line without having to come to the class, with the hope that the instructor can make himself or herself more accessible to the students. Those who are sick or on extended trips can communicate by using this forum. Electronic office hours can also be used for guest lectures (Ragothaman & Hoadley, 1997). McKeague (2001) notes several benefits and problems that are associated with synchronous relay chat. Shy students are more likely to participate; active learning increases, and students build confidence in their relationships with their peers. McKeague comments, “When we empower students to take a creative role in shaping their encounter with class material, we contribute to active learning” (p.35).

Several problems, however, can arise with synchronous
Electronic office hours do not allow time for thoughtful encounters (Barclay & Elkins 1991). While the messages often become conversational and begin to go off track, technical problems, such as keyboarding skills can inhibit conversation. The instructor must show leadership and skill in guiding the conversations (McKeague, 2001). Students and teachers will continue to gain skills by participating in discussion boards, e-mail, and chat through experiences within these new forms of communication.

Information and communication technologies increase the chance for classroom collaboration and may be integral to its effective usage. Classrooms can use transformational distance education software to require new communication skills and to reach a new generation of students.

The student body in both college and high school is changing. Many students are working or have schedules, which limit their access to the traditional classroom and its time schedule. There is also a new interest in the way our education is delivered. Software tools can facilitate a distance education model that allows instructors to deliver instruction to nontraditional and traditional students.
alike. WebCT (WebCT 1998) is a platform used by teachers and professors to expand and transform their classrooms.

WebCT (Web Course Tools) is a software program designed by Dr. Murray Goldberg and a group of colleagues at the University of British Columbia that is used to assist the teacher in delivering a course, either partially or completely, over the Internet. WebCT is a faculty web site. It is a place where instructors can provide additional information and services to students while providing opportunities for opening up various channels of communication such as virtual chat or discussion boards. Teachers can use WebCT as a repository to attach worksheets, lecture notes, and assignments. Students can use WebCT to drop off documents electronically and communicate with their peers. WebCT can be used as an enrichment tool or as a stand-alone delivery system. Students, in effect, have access to the electronic classroom twenty-four hours a day.

Different groups of students, including the nontraditional, are not at a disadvantage when they use technology for teaching and learning (Wernet, Olliges, & Delicath, 2000). The authors define nontraditional students as students who are not full-time. Interactions between
students occurring over WebCT (WebCT 1998) result in more sharing and cooperative learning. Wernet et al. found that nontraditional students preferred this web based delivery system to traditional systems.

In the WebCT study in question, Wernet et al. (2000) compare the differences in performance between graduate students who follow a nontraditional schedule and undergraduate students who follow a traditional schedule. These two groups were asked to evaluate their WebCT course. Most of the students had no experience with web-based instruction or what to expect. Posted lecture notes were seen as a factor for improving performance but the discussion board was deemed to be useful only for nontraditional students. It seemed these students appreciated the opportunity to extend their discussions with their instructor outside of the classroom. Traditional students who attend college full time were less likely to access the course syllabus, course calendar, hyperlinks, and other tools. Nontraditional students felt that these tools had a positive impact on their grade.

In conclusion, students utilized WebCT in proportion to their perceived need for the tools. They needed to see a reason for using them. Students who are balancing jobs
and/or other interests with their scholastics are more likely to participate in active learning with these tools. It also remains to be seen whether or not exposure to these tools over a longer period of time will influence their utilization. Students and teachers will have to be convinced of the efficacy of these modern tools if they are to incorporate them into their instruction.

Students seem to be motivated to incorporate web-based learning technologies when they have access, technology skills, and performance objectives that relate to their learning. When are students more likely to use computer-mediated communication in a distance education course? It seems that students will use technology in proportion to perceived need and familiarity. Students will participate and use new methods, but instructors must be willing to provide the necessary time to familiarize students with the technology and show them how this technology will streamline their gathering and access to information.

Johnson and Huff were interested in how and why students use computer-mediated communication. They examined the electronic messages of seventy-six social work students. Johnson and Huff (2000) administered a survey to determine the usefulness of this method of communication.
The students in the study were divided into two groups: one group took a social welfare class on campus while the other group took the class as a distance education course. Both groups were required to use computer-mediated technologies, including the use of listservs and e-mail journal assignments.

The results of the surveys indicate that off-campus students were significantly more likely to use computer communication technologies in the course. Johnson and Huff (2000) have concluded that the technology was used to resolve the shortcomings of distance education rather than to supplement the education itself. Johnson and Huff (2000) have reported that educators are searching for ways of reducing the feeling of isolation that may accompany distance education by focusing on how to improve interactions among students and instructors as well as between themselves. Johnson and Huff (2000) have recognized that the lack of interaction can negatively affect learning. Obviously, student-teacher interaction cannot be sacrificed, but it is not so obvious what the effects of low student-student interactions are to learning. Student-student interactions may be the most difficult to facilitate, but it is generally agreed that the ability to
collaborate and communicate with one’s peers is an essential skill in today’s society. So it can be seen that technology can be used to make learning at a distance easier for students; but the goal of every educator should be to improve the instructional delivery of the course. There is quite a bit of resistance toward the use of technology for delivering curriculum, and this resistance is typically found among people requiring face-to-face relationships.

Learning Styles

Grasha and Yangarber-Hicks (2000) argue that educators must evaluate the potential benefits of technology due to the risk of establishing an impersonal relationship. There is present, among all educators a phenomenon known as instructional-method bias. If a teacher likes a particular teaching strategy, he or she will view it as successful. If computers and technology seem personally attractive to a teacher, then these tools will be more likely to be seen as effective in the classroom. Grasha and Yarbinger-Hicks (2000) have raised the following point, “how technology fits into a conceptual framework of principles for how people learn or into a broader philosophy of teaching and
learning are seldom raised" (p. 3). One must explore not only the technique of course delivery, but also what we believe about how people learn. When an instructor uses technology for learning, he or she must understand how it fits into the cognitive awareness of the student. Instructors must become aware of how they justify the use of technology, or any instructional method.

Students learn in proportion to their learning style. The effect technology has on various learning styles has been compared with various teaching styles employed by instructors (Grasha & Yarbinger-Hicks, 2000). Two groups of college faculty, who have shown interest in using technology, were sent questionnaires and were asked to evaluate both a traditional course and one utilizing technology. The questionnaire was extensive, took 45 minutes to complete, and evaluated the level of satisfaction, grade distributions, and general attitudes and perceptions of teaching and learning styles. On average, the college faculty members reported the use of at least four types of instructional technologies in their courses. The only statistically significant result found that teachers perceived the students in the traditional classes to be more competitive; otherwise students in both
types of courses were seen to have similar needs and grade distributions.

According to Grasha and Yarbinger-Hicks (2000), the collaborative student learns by sharing ideas and talents; they cooperate with teachers and like to work with others. One interpretation of this study concludes that a technology-based curriculum needs to be specially designed to meet the needs of this type of student, while such courses invite a more collaborative model.

Role of Instructor

The role of an instructor in a distance education course is different than in the traditional classroom. Distance educators know that teacher-student interaction is important but involves a different set of methods. Instructors do not serve-up information, instead, they monitor its transmission. Instructors play the role of socializing or rather humanizing the technology, which helps the students learn how to use the technology to serve their needs and to fulfill expectations.

Inman and Kerwin (1999) were interested in the attitudes expressed by both students and instructors in regard to their experiences with distance education. Eleven
instructors of the University of Kentucky Community College System were surveyed along with 354 students. The average age of the students was reported as 28.4 years. A regression equation was calculated for ratings on the quality of instruction, overall quality of the course, and amount learned. Instructors evaluated their courses as "equal to" or "of lesser" quality than the courses that they delivered on campus, but students did not report a diminished satisfaction level. It is interesting that instructors are a little unsure of their effectiveness with distance education, although they appear to be more optimistic if they have a greater degree of familiarity with the technology.

According to Carey (1991), the most important factors concerning course satisfaction were related to quality of course materials, quantity of work required, and amount learned. In ratings of the quality of the instructor, the most important factor was the ability of the instructor to help students interact with the distance learning technology. Students find satisfaction with the distance-learning environment when there is good teaching, well-defined roles for teachers and students, and a well-developed ability to use the technology. Carey (1991)
asserts the notion that "it is important to emphasize the service to be provided, not the technology that provides it" (p. 11). He argues that telecommunication technologies will serve a vital role during the next century.

Valley View High School has been quick and efficient in building a digital computing network, but most computers and presentation stations are not in use. Carey would argue that there is a lack of training and planning in the school system. The policymakers have lofty goals but do not provide a road to reach them. The rhetoric has to be matched with the planning.

A second issue mentioned in his article, is the need for technology-based learning applications to be service driven not technology driven. If needs are not being met, the technology will fail. As we have seen, teachers need to be trained in the use of technology and the new roles in which they will be employed. Students must have access to a quality interactive education. Teachers should be brought into the planning process and they should see technology as a tool to improve the delivery of their instruction, not a replacement. Technology should be seen as tool that can provide more time for interactive communication while, at the same time, relieving teachers from rote instructional
tasks. In order for distance education to succeed, the pedagogy must be in place to provide a quality, active, learner-centered environment; and teachers will have to make adjustments and be trained to use computer-mediated forms of instruction. Schneider and Germann (1999) discuss the changes that will have to be in place as we move to a computer-mediated classroom. They investigated the type of learning environment included in an interactive technology paradigm. The authors gathered information on how technology influences and shapes distance education courses, while paying close attention to computer-mediated communication and the Internet, in particular.

Distance Learning

Separation by space and time are characteristics of distance learning. Most distance learning is now taking place over the Internet and is web-based. Some advantages of distance education include: the ability to extend learning outside of the classroom, ability of students to contact the instructor or each other, ability to include other resource people and the ability to equalize control between instructor and students. Other advantages suggest that these courses are efficient, increase student
responsibility, and allow increased access to resources that enable quick assignment turnaround.

Schneider and Germann (1999) have looked at population samples of students taking distance education courses and have concluded that most students taking these courses are older. There is no difference in enrollment patterns between male and females. A chi-square analysis of 1997 spring-enrollment patterns of students who took Internet classes shows a significant difference in age. The conclusion from this demographic study is that since students are older, an effective learning environment for these students should reflect characteristics that are common for older learners. Schneider and Germann, in reviewing the work of David Kolb, Irwin Rubin and Joyce Osland, summarize the essential characteristics of an effective adult learning environment. Adult learners believe that learning is a "give-and-take" proposition, experiential, demands personal application, is self-directed and integrates learning and living (Schneider & Germann, 1999). As can be argued however, these are characteristics that are important for all learners. Teachers of all grade levels can begin to engage their students in a distance learning experience that, at first,
supplements the traditional classroom and later allows for a transition to a complete distance education model. In summary, participation, student maturity, and self-motivation may be requirements for an effective learning-centered approach to distance education. Perhaps an effective learning-centered environment promotes maturity and self-motivation.

King, Harner, and Brown (2000) studied student perceptions on the effects of technology and self-regulatory skills in distance education courses. Over one hundred students participated in the study at the University of Connecticut. A questionnaire for two distance education courses was developed and was administered within two weeks after the completion of the course. The data was analyzed using standard deviations, means, frequencies, and percentages. There were forty questions on the questionnaire, and the questions were designed to measure the effect of technology on students, self-regulatory behavior, and learning efficiency.

Self-regulatory behavior describes a student's ability to plan, manage, and execute a learning strategy. It is also a measure of motivation. The instructor can recognize a motivated student because such students are self-
starters, exercise much effort, and are persistent. It is thought that a distance learning environment will promote this type of behavior.

The chi-square analysis revealed that students with self-regulatory behavior were more likely to sign up for future distance education courses and were more likely to contact the instructor outside of class through e-mail, appointments, and telephone. I believe that a study should be done to find out if there is a reciprocal effect. Can a distance education course that is interactive, and managed with appropriate care increase self-regulatory behavior in students? How will telecommunication technologies find their way into secondary schools? Will it require teachers who are adept in managing their own self-regulatory behavior, or are there other impediments to the implementation of telecommunication technologies?

According to Collis (1992), "some educators are highly enthusiastic about the use of telecommunications in secondary education, but the majority of educators are as yet showing no interest in it" (p. 98). Collis argues, in her analysis, that there is a growing interest in the educational use of telecommunication technologies, but that profitable use does not come easily. There are technical
issues relating to equipment, connections, software and regular access. At Valley View High School there is a computer presentation station in every classroom, but each classroom is filled with students from 6 a.m. to 4 p.m. This time constraint makes it difficult for teachers to use the presentation systems during their preparation hour.

Teacher training and support are necessary for the implementation of new learning technologies. Some teachers are turned off by technology and are not prepared to participate in innovation; this results from a lack of time, space and opportunity.

Distance education has a bright future in education, and has been found to be effective in delivering a quality education. However, this quality education is dependant on the student’s orientation to the technology, motivation, and a participatory, learning-centered environment. Teachers must be prepared to deliver a meaningful curriculum and have some expertise in managing technology. Time, support, and training must be provided to both teachers and students if we are going see the implementation of this new delivery system in the 21st century.
Constructivism

The guiding philosophy for educational reform in education is a philosophy known as constructivism. Constructivism is a theory of cognitive growth and learning (Vygotsky, 1978). Students learn best when they construct their own knowledge through active exploration instead of assimilating knowledge through the direct instruction of the teacher. According to Strommen and Lincoln (1992), "constructivism emphasizes the careful study of the processes by which children create and develop their ideas. Its educational applications lay in the creation of curricula that match (but also challenge) children's understanding, fostering further growth and development of the mind" (p. 467).

To be effective, the on-line learning environment must be collaborative and constructive. An environment that encourages students to create and share resources will assist students in creating their own meaning and become actively engaged in the learning community. Strommen and Lincoln comment, "The advantage of this collective effort is that children are able to reflect and elaborate on their own ideas and on those of their peers as well. Children come to view their peers not as competitors but as
resources” (p. 470). Strommen and Lincoln argue that computer technologies should reside in the background and be used as tools to provide instant access to information services and resources. The student and his or her collaborative learning community should be the focus of learning, not the technology itself. According to Riehl (1990), “new tools alone do not create educational change. The power is not in the tool but in the community that can be brought together and the collective vision that they share for redefining classroom learning” (p. 35). Instructors must decide when and where the computer can be used to promote active learning.
Design

Blackboard (Blackboard Incorporated [BI], 1997) designed the course software for this project, but the design of each course feature is left up to the instructor. The design phase began in June 2000 during an after-school seminar hosted by the Digital High School Administrator at Valley View High School. The course was given the title, Chemistry 2001. Course creators can decide which features are to be made available to students; it was decided to make all course features accessible before evaluating them.

Chemistry 2001 is accessed on the world wide web at http://www.blackboard.com/courses/Chemistry2001. The course has a number of features, which can be accessed by selecting buttons that are found on the left side of the web page. These features include announcements, course information, staff information, course documents, assignments, discussion board, virtual chat, group pages, communication, external links, student tools, resources, control panel, my blackboard, and logout (see appendix A).

The introductory page corresponds to the first button.
and is reserved for teacher announcements. Students that log on will immediately see the main course announcement window, which is usually used to post course reminders and important information. Some sample posts can be found in Appendix A.

The course information page is used to display course description information and meeting times. The syllabus information for chemistry class is also found here.

The staff information page contains specific information about the instructor. This page includes the e-mail address, office phone number, office hours, and photograph of the instructor.

The course documents area is a content-specific area. This area is used to post slides for all class lectures. Students may download the slides and view them from any remote computer.

The assignments page contains worksheets and other documents that can be downloaded by students. The purpose is to give students the flexibility to obtain course materials from home. The assignments are often posted in advance, thereby allowing students to work ahead. Students have found it useful to be able to download documents that are sometimes left at school or are simply not available.
because of illness.

The discussion board is a forum in which asynchronous threaded conversations can take place. Teachers or students can post questions and receive answers over an extended time period. Participants can also attach files here or send e-mail to each other.

The virtual chat page can be used to carry out synchronous conversations. All participants must be logged-on at the same time in order for conversations to occur. The chat page also contains a virtual whiteboard on which drawings can be composed. The whiteboard can also be used to display web pages.

The group pages area divides students into study groups and is useful for student collaboration and group assignments. Students can communicate within their group by using a private discussion board, virtual chat, file-share, and e-mail areas; the instructor must set up groups from the control panel.

The external links page allows the instructor to post links to useful web pages that can help students download software or view information that is related to the course. Students simply click on the link with their mouse, and their browser automatically connects them with the posted
site.

The student tools page can be used for students to access the course calendar, to post homepage data and to edit personal profile information.

The resources button links blackboard on-line resources with all course development issues and the course creator uses the control panel to manage the course. "My blackboard" is a logon area for participants to access all registered courses and the logout button allows the user to exit the software program.

Internet search engines were used to find web sites that provided tutorial and resource information for the study of chemistry. These links were added to the external links page. Several blackboard (BI, 1997) course sites were visited in order to gain ideas for the creation of the chemistry course in question. A chemistry course was discovered which had a link to a resource that contained a large variety of chemistry Internet tools. At another course site a link was discovered that takes course participants to a web site that gives students the opportunity to download a slide viewer. The viewer can enable users to view slides without the need to install an entire software program. This tool gives the instructor the
ability to post slides on a web site without requiring students to purchase a rather expensive product. Unfortunately students are limited to viewing or printing the slides, they cannot create their own presentations.

Development

On August 30th, the course site became active for student use. Students were allowed to enroll in Chemistry 2001 on a voluntary basis. All students have access to the course; a few students did not have a computer or did not have Internet access at home.

Valley View High School is a digital high school in its third year of implementation. All students have access to the Windows NT network with their own username and password. Every classroom has a presentation computer, there are two computer labs on campus, and there are over fifty computers available in the library which can be used before school, at lunch, or after school. By the second day of implementation, forty-six students had enrolled in the class and by the third day, the number had increased to fifty-four. Students seemed to be very enthusiastic about enrolling in the course. Use of this version of the Blackboard site was discontinued in November with an
accumulated total of 147 student users, two teachers, and one course administrator. The two teachers included a physics teacher and another chemistry teacher who were interested in the development of the course.

Lectures, presentations and worksheets were posted on the project site on a weekly basis followed by an electronic mail homework reminder. Creation of the slides has been very time-intensive; over 100 hours have been spent rewriting all of the classroom chemistry notes for placement into a slide format. In addition, all worksheets and handouts have been retyped and saved in rtf format before being placed on the assignments page. During the days following the initial postings, a number of students reported that they had trouble downloading several documents and printing the slides.

The students who had difficulty with documents reported that they were getting symbols instead of words. Upon questioning, it was discovered that these students were all using an incompatible word processing program. The solution was to repost all electronic documents using the Rich Text Format, or .rtf extension. The printing problems were usually a result of students not being able to download the slide viewer. An explanation was offered to
students to explain how they could import the slides to another program for printing, or use the handouts feature to print from 1 to 9 slides per page. It was determined that the slides should contain very little background color. (One student used up a complete color printer cartridge in attempting to print several slides.)

Several students were discovered creating downloadable files and making them available for other students to use. The decision was made to encourage this type of collaborative participation. Chris Martin, a chemistry student, created a very useful notebook template, his posting carried the following message, "This is an Excel document of a Table Of Contents that is very organized and neat. You can easily edit it or change the title, include a heading, etc. Please take advantage of it and print out 6 of them for your folder".

An electronic message was received from a person who was upset because he was getting messages from the course administrator. This person threatened to send all enrolled persons graphic adult photographs if he was not removed from the e-mail list. Apparently, one of the students had entered an e-mail address in error and this address happened to match a prominent pornography web site. This
computer user was immediately deleted, and no further correspondence was received. This situation brought to light the necessity for course administrators to closely monitor the registration process of the student users. Since many teachers are using these products for the first time, it becomes imperative that a watchful eye be kept on all aspects of this new communication medium. It is obvious that course administrators must be willing to take some risk when they venture into new territory.

"Back to School Night" was held at Valley View High School in September. Parents visited each of their student's classrooms and the teachers were given ten minutes to make a presentation. The course administrator used this time to describe how parents could utilize the project site. The presentation was well received and there were no negative comments about the program.

Occasionally students were asked to read a passage from the textbook and report on the passage via electronic mail. The purpose of these assignments were to encourage students to enroll and participate more fully on the Blackboard (BI, 1997) course site, with the realization that students could still send e-mail by other means.

One of the main goals for implementing an on-line
supplement is to encourage students to learn on their own. The external links page was not showing a growth in the number of accesses over time. Table 1 shows where students went after main page entry and compares only two of several possible navigation routes. The course documents page "hit numbers" increased by 2.2 percent over a fifteen-day period while the external links page showed a decline of 0.7 percent over the same time interval.

Table 1. Blackboard Hit Statistics

<table>
<thead>
<tr>
<th></th>
<th>9-1 to 9-15</th>
<th>9-16 to 9-30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Page</td>
<td>680</td>
<td>626</td>
</tr>
<tr>
<td>Course Documents</td>
<td>358</td>
<td>343</td>
</tr>
<tr>
<td>External Links</td>
<td>132</td>
<td>117</td>
</tr>
</tbody>
</table>

A strategy was put into place to increase the number of hits occurring on the external links page. The external links page contains a number of resources; one of which is a page that contains links to a number of web sites that provided student access to tutorial resources. A web quest was created to direct students through these resources. The web quest contained a number of hyperlinks to web sites that could be found on the chemistry 2001 resources page.
The web quest was placed under the assignments page serving a dual purpose. In order for students to access the web quest assignment, they would have to enroll in the Blackboard (BI, 1997) course and explore the chemistry resources found within.

In October, an assignment was created to increase the use of the group pages area of Blackboard.com. Students were asked to create a slide show which explained how the Drinking Happy Bird functioned. The Happy Bird is a toy that bobs up and down into a glass of water. Students were required to use the group pages to exchange files and discuss theories concerning its operation. The group was then required to drop off the slides electronically.

In November, it was decided that virtual tutoring would be offered on Tuesday evenings. The virtual whiteboard would be used to draw diagrams and explain chemistry problems. The mouse can be used to draw, but this tool required a great deal of manual dexterity. A hyperpen that connected to a USB port was purchased for this task; it did not function properly. A series of pens were tried until a brand from Wacom met all specifications.

The Moreno Valley Unified School District purchased a new commercial Blackboard program in November of 2000,
which was entitled Blackboard 5. The school district placed the program (http://blackboard.mvusd.k12.ca.us) on the district server. This program serves the same basic functions that the non-commercial program does, but with some enhancements. Blackboard 5 (Bl, 1997) has an entry page containing a personal organizer that allows its users to create a calendar that sends electronic mail reminders. Students and teachers found it easier to log-on to courses because the courses all appeared on the same page and were organized through the same portal. The buttons can be customized and electronic books from various publishers can be purchased. Course administrators can create a new section for each discussion thread, and can allow users to retract, change, or post responses anonymously. Course administrators can also shut out certain users and only allow them to correspond to selected discussion threads. The virtual chat page will log and archive all discussions, an important tool for teachers because they can now document remediation and tutorial practices that they have been engaged in. Virtual chat continued on Blackboard.com until March 6th, 2001. The school district firewall did not allow students to access the virtual chat program on Blackboard 5. The problem was finally rectified in March of
The course design and development from November 7th, 2000, to April 6th, 2001, consisted of enrolling students in Blackboard 5, continuing to post lecture notes in the course documents area and posting handouts on the assignments page. E-mail reminders concerning class assignments were sent on a weekly basis from the Blackboard portal to encourage students to access the site. Usage of the site constantly increased as students continued to view Blackboard 5 as an integral part of the course.
CHAPTER FOUR
EVALUATION

Student Essays

Analysis and reflection was carried out on an ongoing basis, but there were three benchmark assessments that were used for evaluation purposes. Student essays, student surveys, and course statistics were used to evaluate this project.

Valley View High School requires all students to keep a portfolio of major assignments. At the end of the first semester, students wrote a portfolio essay, documenting their learning. Chemistry students were assigned the task of writing a two-page essay that detailed the positive and negative impacts of Blackboard (BI, 1997) technologies.

The student essays were collected in December. The assignment was posted on Blackboard.com. Students were required to write about the positive and negative aspects of using this program as an on-line supplement for teaching chemistry. The instructor was careful to direct the students to be honest in reporting both the negative and positive aspects of the program, and that all negative and critical responses would be greatly appreciated. One
hundred and four students completed the assignment and the results were coded into themes which served as an interim analysis of Blackboard.com usage from the start of the 2000-2001 school year until mid December. This particular method of evaluation had a distinct advantage over the survey method: students generated the positive and negative aspects without teacher prompting. The instructor was very careful to acknowledge neither positive nor negative aspects of using the program.

Negative Themes

The negative themes have been categorized into three general strands: technical problems with a computer, lack of computer/Internet access, and assignments that required the use of a computer.

All students were required to register and comment on at least one negative aspect of using Blackboard in the chemistry classroom. It was interesting to note that none of these themes reflected a problem with the course or its stated goals. Students were required to elicit negative comments and they often strained to come up with legitimate concerns. The lack of constructive criticism of the stated goals of this project has given evidence of a successful implementation of the project.
The most important and most widespread of the negative comments centered on technical difficulties. Some of these difficulties were due to a lack of computer expertise. The following student comment is indicative of the situation.

Not everything about blackboard was good. It also had problems. Sometimes it was hard logging on and other times it just wouldn’t let me in. This didn’t happen too often, but it happened enough times to irritate me. Other times things just wouldn’t appear on the screen and it was hard locating them. There were also times when it was running really slow and I spent hours just trying to get the assignment for that night. There were also some glitches with the system, but none are really big enough to make a fuss out of.

There were concerns about servers being down and some home computers seemed to either have slow, or antiquated modems. These problems were legitimate and could not be easily resolved. Other technical difficulties were a result of the lack of computer expertise on the part of the students. Browser problems, printing problems, navigation problems, and software difficulties had both a positive and negative aspect. These problems partially derailed the chemistry learning process, but for students who were
engaged in active learning, this experience provided them with an opportunity to become critical thinkers and problem solvers. A typical student concern is found below.

I had a lot of worries to using a computer so much in class, I was kind of scared of computers, and second of all was that my computer at home is not the fastest one in the world, and I thought everyone else probably had a state-of-the-art computer and would be able to keep up easily. My fears slowly faded, as I would probably learn about computers in the long run from this program.

Another student remark showed evidence of the struggle with technology, "I think I spent more time trying to learn how to use PowerPoint than I did actually researching and learning what thermodynamics is".

The Blackboard web site may help students gain experience with using computers. Some students are still learning how to use a computer and now have a reason to learn more.

The difficulties that students had with technology pointed out the need for instructors to be ready to help students overcome their frustrations.

The lack of computer or Internet access was a
recurrent theme in student essays. Most students had computers and Internet access, but students saw this issue as a matter of fairness. All students could access the computers at school, but clearly these students were at a disadvantage compared to other students who had computer and Internet access at home. The following quote comes from a frustrated student without a computer at home.

Now if someone, like me doesn’t have a computer that is easily available, then this site does not help. I think that it is unfair to assign work over the Internet and expect people to go to the library on their ‘free time’ and do the assignment. Some people do not have time to go [to the library] because of sports or work. Another thing that doesn’t make this [Blackboard] a good thing is the fact that the teaching and handing out of assignments should be in the classroom, not at home and on a computer.

And finally a student remarked, “The only reason that I don’t log on more is because I do not have a computer, so when I have to use it I have to schedule my time to make time after school.”

Anytime an assignment required the use of Blackboard, the instructor not only allowed at least three weeks for
its completion, but he was also open to negotiation on its final due date. This solution did not ameliorate the hostility that was felt by several students. The following comment is characteristic of many student concerns.

There were times that Mr. Coulombe would assign the class a project that required Internet access. Sometimes this was a difficult task because I don’t always have access to the Internet. This [project] would require that I stay after school for 2-3 hours to work on a particular assignment. By the time I got home at 6 P.M., I had to complete the rest of my homework for my other classes.

The response to these concerns are summed up very nicely by Ivan Garcia: “I consider Blackboard to be a great resource, and helpful to students. I’d like to say that the cons I found with Blackboard were not detrimental to my grade”.

The positive comments were categorized into several themes, which centered on increased availability of course materials and improved communication between the students and their teacher.
Positive Themes

The positive comments outnumbered the negative comments by a three-to-one ratio. The first category to be considered was the increased availability of course materials. A large number of students found Blackboard to be a useful tool for gathering information about class assignments. The following quotes are representative of the average student.

One of the greatest advantages that Blackboard gave us is that, it allowed us to get our assignments and our notes from the Internet. Sometimes I would forget my folder at school and I wouldn’t have my homework. All I had to do was to log on to Blackboard and get my assignment from there. This was a great advantage for me since I almost always forget to bring my binder home with me. Instead of trying to write down the notes in class, which was hard because Mr. Coulombe goes too fast, I would go home and get them from Blackboard. This allowed me to concentrate more on the lecture, instead of spending most of my time writing down the notes and not paying attention. Another student remarked, “Some advantages to this website are you can figure out your homework if you were absent, It is
better to know your homework when you are sick so you won’t fall behind in the class”. And another student adds, “It’s almost like having a chemistry class at home, but without the most important thing: the teacher”.

The following statement shows how one student uses the site as a personal organizer.

It [Blackboard] is always there to remind me of due dates and assignments from my chemistry class. As soon as I log on to Blackboard, the first thing that pops up is the announcements section that almost always has upcoming dates and assignments posted. This is probably one of the last reasons Blackboard was made, but it is one of the things that I treasure most, since I like to be responsible and turn in my work on time.

One student quote illustrated the frustration that was felt from knowing that all excuses were taken away, “All of the class material is just a click away. Your parents can get on-line and check to see if you are lying to them about homework assignments”.

One comment illustrates how important it was for a student to stay connected to the classroom when absent.

For myself, Blackboard.com has become synonymous with
chemistry. The website can be used to access assignment due dates, printouts and homework. I can access my chemistry class even when I am sick and at home. As anyone who has taken chemistry knows, if you miss one day, you have missed out on something important.

One student was using the supplement as a complete distance education course, "Blackboard was very helpful to me. I was injured in football a few weeks into the school year. I would have had to drop the class had it not been for Blackboard". Another student endorsed this remark.

Students are not restricted to learning just at school, now they can expand the learning process into their homes and be comfortable and not feel pressured to do things that they normally would have to worry about if they were not at school.

And finally the following quote sums up the benefits that a Blackboard course can offer.

From my perspective, I believe that the greatest advantage of having this program is its convenience. With all the different activities going on in the lives of students, it is nice to know that Blackboard is always available to print notes, questions,
answers, etc. With my busy schedule of work, and school, having this program makes life a little less stressful when it comes to chemistry.

One could argue that having these resources available might create laziness or irresponsibility. Students might take fewer notes, and forget their work more often because they had a back-up system. The other side of this argument portrays this supplement program as a tool, making it more likely for students to behave in a responsible manner, especially when they are unable to come to class because of illness, fieldtrips, or extracurricular activities such as sporting events, dance, and band competitions. One student had an answer for this, "To the students plagued by laziness and procrastination, Blackboard is a serious threat that cancels out many excuses and causes them to take more responsibility for their work". And another student adds, "By posting notes or assignments early, it enables me to be better prepared for a difficult new lesson that will follow".

A number of students wrote positive remarks about the organizational benefits that were derived from using the Blackboard system. The following comments were indicative of those feelings.
The tasks and calendar are my favorite features. The tasks page enables each student to become organized not only in chemistry, but also in other areas of life. As an example, I posted an appointment for a babysitting job on November 28th and when I went on Blackboard, I received a message that I needed to baby-sit that night.” Another student wrote, “The assignments section allows me to get ahead and manage my time”.

The last theme centers on positive statements that were made about communication between the teacher and student. One of the major goals of this project was to take chemistry and teacher-student relationships outside of the limitations of space and time. Students can learn and carry on relationships with their teacher and other peers on a twenty-four hour-a-day time schedule whether they are in a physical classroom or a virtual classroom. Students learn from each other by using the Blackboard portal as a virtual platform, which provides the opportunity for students and their teacher to communicate asynchronously across time and space. “Blackboard.com increases both student-teacher relations and student to student relations”.

The student who made this remark was very active on
the discussion board and posted a lot of questions, but was rarely heard from during class. The Blackboard venue seemed to create a type of anonymity that gave some students the feeling that they had more freedom to speak out. One student comment endorsed this idea,

The best part about the discussion board is that it gives students the mask that they may need to ask questions. What I mean by this is that Blackboard’s discussion board is perfect for those students that may be afraid to ask questions in class for whatever reason. The privacy of the Internet comforts the student and keeps them from struggling in the class. It seems quite ironic that students would consider a public electronic forum as a place where you can have an increased amount of privacy! Another student wrote,

I think the discussion board is a nice thing to have available to get help from your peers. For some people, it is intimidating to ask questions during class, and some people can’t always make it to tutoring. This way, people can ask questions in an anonymous way and hopefully get some help from someone who knows more about the subject that they do. The following comments illustrate more student
perspectives on how communication was facilitated by the Blackboard portal.

Another advantage to the program is the easy access to instructors. Whenever I need help or just have a simple, yet important question, I can always e-mail my instructor or post a question for him on the discussion boards. The program is available 24 hours a day, and that is very reassuring.

The following comments exemplify Blackboard's utility in allowing students to collaborate more effectively.

You can interact with other students who have the same teacher as you. On the discussion board, you can post your questions, comments, or concerns and other students will contact you if they have the answer. This serves as a very useful tool because you can get the opinions and ideas from your fellow peers.

One student observed, "Another pro to the website is that you can chat with other students and form your own discussion board in order to help others". And another student responds, "Interacting with one another is obviously a more entertaining outlet to education than reading problems and taking notes out of a textbook".

Peer-to-peer communication was important to many
students. The following comment emphasizes this point,

One of the best things about Blackboard is the fact
that when I have a question about something, or I
don’t understand something I don’t have to wait until
class to get help. I can ask the teacher directly, or
I can post the question and other students who
participate can help me if they know how to answer my
questions. The teacher cannot be online all of the
time, so the best thing about communication on
Blackboard is that I can communicate with my peers.
Communication will continue to improve as more
students obtain computers, faster Internet access, and
become more familiar with the technology. One student
observed that participation was the key to effective
utilization of the program,

To further show the benefits of Blackboard, I must
talk about the best tool on the site, the discussion
board. With this board, you are in class 24-7 and can
ask a question which can be answered by fellow
students or the teacher. All a student has to do is go
to the site and post in the forum and someone will
usually respond. Some people do not participate and
this makes the discussion board worthless to them and
a valuable resource is wasted. A student can also e-mail all of their fellow students with questions, responses or concerns.

A few other comments are noteworthy and sum up the positive aspects of Blackboard. One student stated, "With this new technology, I would hope that some of the other teachers that I have would jump onto the bandwagon". Another student notes, "It's free, it's easy to use, and its sole purpose is to help. Blackboard has been a lifesaver for me". And finally a student reasons, Blackboard supports both independent and collaborative learning. Sometimes teachers get too carried away with group work and they forget to concentrate on the individual. With Blackboard we have the chance to take the initiative and learn on our own. If I am having trouble, all I have to do is log on to Blackboard and use the various resources. Blackboard opens up a new approach to learning; students are afforded the opportunity to work together through using the discussion board and group pages.
Student Surveys

The second phase of evaluation involved the analysis of survey results. The survey consisted of twenty-one true/false questions, three multiple answer questions, four fill-in-the blank questions, and six short-essay questions. One hundred and fifteen students were asked to answer the survey questions; ten points extra credit was offered as an incentive. Students were given a two-week window to answer the questions either at home or after school. Students had to log-on to Blackboard 5 in order to respond. Eighty-five percent of all students enrolled in chemistry answered the questions, and only a few surveys were incomplete. Seventy-four percent of Blackboard registered students responded. The following analysis will concern itself with the survey questions that relate to the goals of this project: to improve communication, encourage independent learning and to extend the reach of the classroom. A complete list of all the survey questions can be found in appendix B.

Improved Communication

Eighty-six percent of surveyed students believed that the Blackboard platform made the instructor more accessible. Blackboard allows teachers and students to communicate through e-mail, file exchange, discussion
boards and synchronous chat. Students can e-mail their teacher, drop off assignments electronically and they can communicate over the discussion board and through the chat room.

Ninety-two percent of responding students found the e-mail reminders useful. The instructor would often send messages home, with the purpose of reminding students to study for a test, or to complete a homework assignment.

It is noteworthy that Ninety-nine percent of surveyed students were thankful that the chat room was available for tutoring. There were only ten students that used this feature on a regular basis, but this figure is higher than the number of students who came in for direct tutoring. For a few student-athletes, this was the only way they could receive tutoring on a regular basis.

Sixty-five percent of responding students welcomed the opportunity to communicate with their peers and to get help from each other on worksheets and other assignments. The discussion board contained a number of separate threads in which students were found to be collaborating. One student made the following observation, "overall, I think Blackboard is a very good feature, it gives students a chance to interact with their peers and their teacher"
outside of class”.

Independent Learning

Successful students will develop the ability and experience to learn on their own. Blackboard gives students the ability to access course materials over the Internet. Students were asked to give their opinion on the most useful feature of this web site and could only choose one feature as their favorite.

Table 2. Most Useful Feature

<table>
<thead>
<tr>
<th>Feature</th>
<th># of responses</th>
</tr>
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<td>Announcements</td>
<td>7</td>
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<tr>
<td>Assignments</td>
<td>9</td>
</tr>
<tr>
<td>Course Documents</td>
<td>37</td>
</tr>
<tr>
<td>Discussion Board</td>
<td>12</td>
</tr>
<tr>
<td>External Links</td>
<td>1</td>
</tr>
<tr>
<td>E-mail</td>
<td>2</td>
</tr>
<tr>
<td>Virtual Chat</td>
<td>4</td>
</tr>
</tbody>
</table>

The most popular page on Blackboard was the course
documents page. Students were able to download notes from every lecture that was presented in class. The instructor posted the notes at least one day before they were reviewed in class. Many students reported to class with the notes already printed out.

Many students found the assignments page to be the most useful feature of Blackboard. Students were able to download worksheets from this page and often started on these worksheets before they were officially given a due date. Students were asked to respond to the following yes or no statement: I have downloaded a worksheet and started on it before it was handed out in class. Fifty-one percent answered yes to this question. This is another indication that students were learning independently.

The announcements page was also popular. One of the survey questions asked students whether or not they used this page to find out when assignments were due. Ninety-seven percent of survey respondents answered yes to this question.

The Extended Classroom

The successful student will attempt to access curricular materials that go beyond the textbook and lecture information. An extended classroom provides an
access point for further explorations and gives students
the ability to communicate with each other and the teacher
outside of the school day.

The slide presentations contained hyperlinks to web
sites that provided additional information that was not
presented in class. Seventy-four percent of respondents
asserted that they used these hyperlinks and found them
useful. One student made the following remark, "There are
times when I don't understand something and there is a
hyperlink to it and I read the hyperlink. After I read it I
understand the information a whole lot more". The external
links page was designed to lead the user to web sites that
could provide help to students in their study of chemistry.
Seventy-one percent of survey respondents claim to have
used this resource.

One question asked students to respond to the
following statement: I was reminded to turn in a homework
assignment by electronic mail. Seventy-six percent of
students answered yes to this question. It is interesting
to note that a number of students that are enrolled never
received email because they had registered an incorrect
email address and have not bothered to fix it. There is
probably a high correlation between the number of students
who cannot, or will not correct their addresses with the number of students who have not received a reminder that enabled them to turn in an assignment that they otherwise would have missed.

Students that are absent from school can reach the extended classroom. One person made the following remark on his survey, "I use Blackboard each and every time I am absent. I find it a very useful tool in the aid of understanding chemistry".

Students often found it useful to peruse the discussion board when they were at home. "Even though I don't post questions on the discussion board, there are many other people that do. I read their responses and get help and answers that way".

The extended classroom brought the teacher and students together and provided more discourse and opportunities for communication. The computer was not being used as a tool that isolated the individual; it was being used to bring people together.

Hit Statistics

The final evaluative stage consisted of a report and an interpretation of hit statistics that were provided by
Blackboard. One hit represented a single access to one of the pages on the Blackboard program. It did not represent the number of visits to the site. The hit totals included accesses by students, parents, guests, and instructor.

Findings

From June 20th to April 6th, there were a total of 19,819 hits on the Blackboard.com web site. From November 7th to April 6th, there were 43,554 hits on the Moreno Valley Unified Blackboard 5 site. The total number of hits from both sites is 63,373 hits.

Figure 1 shows how the number of hits has changed over time. Day 0 represents a date of August 30th. The last data point corresponds to a date of November 6th. Series one represents the total number of hits, Series two represents course documents and series three represents external links.
These results show a consistent and regular growth of course accesses on the original Blackboard.com site. Figure 2 represents the total number of hits on Blackboard 5 from January 2\textsuperscript{nd} to April 6\textsuperscript{th}. This graph illustrates the continued growth of hits, but it also illustrates a leveling off process. These dates were chosen to negate the effects of Winter break.
The slowing in the rate of growth can be explained in a number of ways. During the first semester, extra credit was offered to students for using Blackboard.com. Students were aware that statistics would be recorded. Some students obviously registered a large number of hits in order to push their extra credit numbers up. The instructor did not offer any extra credit for participation on Blackboard 5. The fact that over 43,000 hits were registered despite the lack of extra credit is quite significant in declaring the popularity of the Blackboard 5 second semester program.

During the first semester, a number of strategies were instituted to increase Blackboard use. This included setting up group pages for a project in which students had
to communicate with each other over the Blackboard site. The students were also required to drop off their assignments electronically. A web quest was also assigned in the second semester, which could only be accessed through the course documents area in Blackboard. These strategies and the novelty of Blackboard contributed to the large growth in hits. The instructor rarely mentioned the program during the second semester, and yet it still remained popular. This is evidenced by the student surveys.

Appendix C details statistics from Blackboard 5 from November 7th, 2000, through April 12th, 2001. This result shows that the two most popular areas were the communication area with 46.3% of hits and the main content area with 48.7% of the hits.

Eighty-one percent of the hits in the communication area were from the discussion board, 10.9 percent were students attempting to access student rosters, presumably to find email addresses. Virtual chat registered only 173 total hits, which was 0.85% of the hits in the communication area.

Group area shows a total of only 1,145 hits. Students preferred to communicate during school hours; they did not seem to see the need to form special areas to communicate.
The student area shows only 1,062 hits. Grades are not posted because no on-line quizzes or tests have been administered. The instructor has not used the calendar feature. Some students have decided to create a home page. Most of these pages are not popular.

**Significance**

The hit statistics were significant because they pointed out the success of this project. The two most popular pages were the main content and communications areas. The main content area provided the resources that extended the reach of the classroom and promoted independent learning. The communication area brought the teacher and students together for discussions that led to meaningful learning.
CHAPTER FIVE

DISCUSSION

Conclusion

This project has been a success. Student essays, student surveys and hit statistics indicate that the goals have been met. Participants in this project reported evidence that has shown enhanced communication among students and between students and teacher. Students have learned both independently and in collaborative modes. The classroom has transcended time and space and is accessible at any hour of the day.

The use of Blackboard as an on-line supplement for teaching chemistry has shown promising results. The essays and surveys have pointed out that students want more teachers to use this platform. One chemistry teacher at Valley View enrolled in this course during the end of the first semester. This particular teacher was new to Valley View. When worksheets and slides were sent via e-mail to students, he received the same messages. He then decided whether or not to incorporate the same notes and worksheets into his course. This feature has facilitated the alignment of all of the chemistry classes at Valley View. Several
chemistry students have now enrolled in both chemistry classes in order to receive extra information. At least seven other teachers from Valley View High School have enrolled in this course, including a teacher from LAUSD. These teachers have used this course as a model for how to incorporate new methods into their instruction.

In order to use this platform effectively, all notes have had to be re-written, all worksheets have been retyped, and countless hours have been spent researching various web sites and materials. This process has facilitated a restructuring of the course and has provided the foundation for the incorporation of a fresh vision into the teaching of chemistry.

Recommendations

The discussion board is a communication area that allowed students to communicate with each other and with their instructor. Facilitating the discussions was very time-consuming. Teachers will find it difficult to find the necessary time required to monitor all of the activity. Teachers should consider appointing moderators that can serve as a liaison between students and the instructor. The student moderators will gain experience in identifying the
needs of other students and will benefit from being afforded the opportunity to take responsibility for teaching others.

The synchronous virtual chat has been a limited success. The first few months have seen the instructor search for an appropriate tool to use for drawing on the whiteboard. A variety of drawing pens were used and discarded as ineffective. The "Wacom" drawing tablet was found to operate effectively on the Blackboard interface. Many students were involved in activities that prevented them from participating in the chat room on the instructor's time schedule. Student moderators who have tutoring skills can be assigned as moderators to expand weekly chat time. The Blackboard 5 site records and stores all chat sessions, allowing the instructor to monitor the conversations.

Instructors are encouraged to set rules for the appropriate use of the Blackboard site. Instructors are encouraged to monitor the discussion board and other communication areas for inappropriate comments. Students who do not abide by the rules should be removed from the course.

Instructors are encouraged to participate on the
discussion boards on a regular basis, even if they use moderators. Students enjoy and look forward to reading responses from their teacher, and they are less likely to post inappropriate responses.

The use of an on-line supplement has other applications. A course was created to manage the business of the Valley View School Site Council. This format afforded parents, students, and teachers the opportunity to read the minutes and correspond to matters such as the school site plan. Teachers can download the school plan and identify areas that were targeted for professional development.

The Western Association of Schools and Colleges (WASC) report for Valley View High School was completed in April of 2001. One of the items in the action plan centered on the need for Valley View High School to track its graduates. The chemistry 2001 Blackboard course will continue to operate, e-mail will continually be exchanged, and the discussion board will contain topics that will function to track the disposition of all graduates. The Blackboard system allows the instructor to maintain contact with former students indefinitely.

Instructors should make sure students know how to
change their e-mail address. Teachers who have large numbers of enrolled students will have large numbers of miss-directed messages sent back to them. With current e-mail addresses, teachers can continue to monitor the disposition of graduates.

The success of on-line distance education is partially dependent on familiarity. Instructors will find it useful to assign activities to their students that promote active engagement. The success of the on-line supplement increases as students become more comfortable using the program.

Chemistry has now left the physical classroom and has been extended into virtual space. Students can learn chemistry at their leisure, on their time schedule, and with more materials. Students work with other students and students work with the teacher to develop and search for new ways to re-invent curriculum delivery. This project has been successful and there has been a great deal of participation. Over 64,000 hits were recorded in the eight-month evaluation period. Students reported increased access to course materials. Electronic dialog between students and their instructor has increased access to the curriculum and improved its delivery.
APPENDIX A:

COURSE BUTTONS
Assignments
1) Concept map chapters 5/6/7-to topic 10
due Friday. Linking words are required.
2) Butane Lab is due Wednesday Nov 22nd
3) Concept map chapter 8 is due Nov. 22nd
4) Cumulative Review pg. 140-141 due
   January 2nd. Questions 1-33 all.

Worksheets
Worksheets 6 through 9 are due Wednesday
11/14

Lab is due Tuesday November 21st

Test is Friday Nov 17th

Exploration activity is due Wednesday 11/14
APPENDIX B:

SURVEY QUESTIONS
Question 1: How many times have you used Blackboard when you are absent from school?

Question 2: Some students may have learned computer skills as a result of using Blackboard. Rate yourself from 0 (no skills learned) to 5 (many skills learned).

Question 3: Do you feel that Blackboard makes the instructor more accessible? Has communication been improved?

Question 4: I would recommend that Chemistry use Blackboard again next year.

Question 5: I would recommend that other teachers use Blackboard.

Question 6: What is the most useful feature of Blackboard?

Question 7: What is least useful feature of Blackboard?

Question 8: Do you find it useful to download PowerPoint slides?

Question 9: Do you use the hyperlinks found in PowerPoint slides?

Question 10: I have used external links.

Question 11: I have used Blackboard to find out when assignments were due.

Question 12: I was reminded to do an assignment that I might have forgot to do otherwise.

Question 13: I have a computer at home.

Question 14: I can use the Internet at home.

Question 15: My parents have checked Blackboard to find course information.

Question 16: I have received help from other students through Blackboard.
Question 17: This is the first course in which I have used Blackboard.

Question 18: I have downloaded a worksheet and started on it before it was handed out in class.

Question 19: I have downloaded or looked at posted answers to worksheets.

Question 20: I believe my chemistry grade is better that it would have been if I didn't use Blackboard.

Question 21: Using Blackboard has made me more computer literate.

Question 22: I have found the personal organizer useful.

Question 23: I have downloaded a periodic table.

Question 24: I have answered a question on Blackboard or I have posted something in an effort to help another student.

Question 25: What is the most useful aspect of Blackboard?

Question 26: Why do you not use Blackboard more often?

Question 27: Do you find the e-mail feature useful?

Question 28: Rate the usefulness of Blackboard from 1 to 5.

Question 29: Evaluate the discussion board in terms of its effectiveness.

Question 30: Rate the effectiveness of the discussion board from 1 to 5.

Question 31: Evaluate the virtual chat in terms of its effectiveness.

Question 32: Do you like the idea of having the instructor available for virtual chat even if you do not always take advantage of this feature?

Question 33: Do you have any final remarks concerning Blackboard?
### Overall Statistics

Statistics Generated on Thursday, April 12, 2001 3:31:17 PM

#### Total Number of Accesses per Area

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### Total Number of Accesses per Area

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REFERENCES


Wernet, S., Olliges, R & Delicath, T.A. Postcourse evaluations of WebCT (web course tools) classes by social work students. Research on Social Work Practice, 10(4), 487-495.