REASSERTING THE PROMINENCE OF PEDAGOGY

IN THE

TECHNOLOGY-ENHANCED LEARNING ENVIRONMENT

By

Frederick Thomas Keers III

A Dissertation Submitted to the Faculty of the

COMMITTEE ON BUSINESS ADMINISTRATION

In Partial Fulfillment of the Requirements
For the Degree of

DOCTOR OF PHILOSOPHY
WITH A MAJOR IN MANAGEMENT

In the Graduate College

THE UNIVERISTY OF ARIZONA

2006

THE UNIVERSITY OF ARIZONA
GRADUATE COLLEGE

As members of the Dissertation Committee, we certify that we have read the dissertation

prepared by Frederick Thomas Keers

entitled Reasserting the Prominence of Pedagogy in the Technology-enhanced Learning Environment

and recommend that it be accepted as fulfilling the dissertation requirement for the

Degree of Doctor of Philosophy

____ Date: May 26, 2006
Suzanne Weisband

____ Date: May 26, 2006
David Meader

____ Date: May 26, 2006
Daniel Bernardi

Final approval and acceptance of this dissertation is contingent upon the candidate's submission of the final copies of the dissertation to the Graduate College.

I hereby certify that I have read this dissertation prepared under my direction and recommend that it be accepted as fulfilling the dissertation requirement.

____ Date: May 26, 2006
Dissertation Director: Suzanne Weisband

STATEMENT BY THE AUTHOR

SIGNED: Frederick Thomas Keers III____________

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

ABSTRACT

As universities transition from instructor-driven to student-centered learning environments, the institutional learning structure is being redesigned to emphasize active learning. Instructional technologies, employing active learning models, have been a critical component in the redesign. The active learning model suggests that the student engages in various activities, and uses various strategies, to gather information and achieve understanding. Technology-driven learning environments therefore often instill activities that direct the student's learning. Use of on-line technologies, such as the Internet, is one method for creating active learning activities that direct the student's learning. This experiment explores how active learning activities, specifically how a student engages in research by accessing on-line information, affects their understanding of the material. The experiment is a 2 (Task Complexity) x 2 (Data Resource) design testing a student's (N=194) ability to synthesize information as they traversed through a specified set of resources. The findings indicate that students who access topic-specific resources engage in more research activities than students who access broad-topic resources. Furthermore, the findings indicate that students who access topic-specific resources will synthesize the relevant material into a more clear and concise response than students who access broad-topic resources. Suggestions and further research are posited to further understand how instructors can engage use of on-line resources, specifically the Internet, and instructional technologies, such as Distance Learning, to facilitate student learning.

CHAPTER 1:

INTRODUCTION

From institutional, instructional and student perspectives, a focused pedagogical structure is critical to a successful educational experience. In brief, a pedagogical structure is the method by which information is organized, labeled and navigated for the purpose of knowledge transference. A focused pedagogical structure is one that establishes a high degree of knowledge transference by embracing established learning theories. As universities embed technology into learning spaces, pedagogical structures, built around the student learner, must embrace the capabilities of technology while ensuring an effective and efficient means of knowledge transference.

The technology driven learning space often fails to produce a synergy between the educational tool, specifically the capabilities of interactive design, and student-centered pedagogy, including the predisposition of today's "wired" learners. This problem becomes particularly significant as the learning structure, with its increasing dependence on technology, transitions from an instructor-driven to a student-centered learning environment. In a student-centered environment, technology should complement, even facilitate, pedagogical structures – not overwhelm them. Far too many universities simply use the tool that best meets their administrative needs rather than the needs of the student; others simply embrace the utilization of technology based on its availability without considering its teaching implications.

The result is mixed findings on the effectiveness and efficiency of the technology driven learning environment. The reason for this is that technology is the impetus behind the design of the learning space. The learning space is more effective with respect to knowledge transference if designed with pedagogy in mind rather than the tool's capabilities alone. When complemented by the principles governing active learning, students direct their personal learning experiences within the confines of the established task domain rather than the slippery slope of the larger technological environment (e.g., the Internet). The instructor must control the process by which students expect to interact with the learning environment, putting pedagogy and the student's predisposition before the technology. Consequently, enforcing pedagogy over technology, the instructor is capable of creating a learning synergy specific to the student's needs, optimizing the true utility of the technology.

Learning pedagogy embedded within the technology-driven learning environment needs to embrace student learning traits. This takes into account, for example, that students using an Internet-based technology, the focus of this experiment and most university technology-driven learning spaces, may have developed habits of skimming rather than reading the material or they may quickly click to the next screen in hopes of shortcutting the learning objective in favor of less time in the "classroom." Technology can improve the student's interaction with and inside the task domain; however, it is incapable of ensuring learning objectives. A student-focused pedagogical structure developed to guide rather than follow or even complement the learning space should not only focus on learning objects in relation to learning traits, but also ensure that those objects are presented in a form that will reach a variety of student learners.

Pedagogy is employed along one of two tracks: 1) Construct Development (Declarative) – a defined set of rules and procedures are passed to the student with the expectation that the student body, as a group, will grasp the fundamental basis of the task domain; and 2) Concept Development (Procedural) – the student works within a broader set of rules and procedures with the expectation that he or she will grasp the nuisances of the task domain specific to their individual learning abilities and needs. In the rush to implement new technology, these two tracks are often combined in favor of a single technology-based learning template. This overlooks the interactive and self-governing relationship between the student and the learning environment. A well-defined pedagogical structure, irrespective of the technology, distinguishes betweens these two tracks and, thus, facilitates a successful learning experience through a focused understanding of student-learning relationship.

One way to embed technology into the learning space without overwhelming the learning process is by efficiently managing the task domain or the interface that mediates learner and learning task based on established pedagogical and design principles. For example, digital libraries have implemented technological improvements that have allowed for the presentation of data in a rich context and from varied sources, including multimedia and hyperlinks. By using technology in this manner, to manage rather than overwhelm the presentation of the learning task, the pedagogical structure directs learning toward the needs of the student.

Pedagogical models are capable of using technology to complement the learning process within the learning structure. Moreover, mediated learning environments embrace the student-centered from of instruction through interactivity, multimedia and student autonomy. With this in mind, this dissertation looks to establish two objectives: 1) provide a theoretical basis that will shed light on the relationship between the students and technologically-informed, student-focused pedagogical structures; 2) present experiment results that will demonstrate how this relationship can be effectively implemented within the learning space. The overarching goal is to reassert the significance of sound pedagogy in the contemporary technology-driven learning environment by relaxing the dominance and precedence of technology and, instead, focusing it on student knowledge transference.

To meet these objectives, this dissertation first presents an in-depth review of the learning process and learning theories. These theories are then overlaid onto the traditional form of learning within the institutional learning structure – that being the instructor-driven classroom lectures. The shortcomings of this form of learning are discussed. Finally, a viable alternative, active learning, is discussed with the intention of highlighting its comparability to the traditional learning method and its complimentary relationship to the technologically driven learning space.

Then an experiment is presented that tests the efficiency and effectiveness of the student's ability to navigate a task domain designed to facilitate his or her ability to insightfully and accurately respond to subject-specific questions. The experiment will focus on the data used in conveying or establishing knowledge transference and the process the student undertakes in accessing that data. The experiment looks at the interaction of the student's task (independent variable) and the presentation/treatment of the task domain (dependent variable). The tool employed in any learning environment cannot overcome student apathy; to achieve knowledge transference, the student needs to interact with the learning environment in ways congruent with the culture of active learning. This interaction is monitored through control of the data resources, a critical component in the development of the pedagogical structure.

Finally, the results of the experiment are discussed as it relates to this specific learning structure and within this specific learning environment. The implications are further discussed as to its compatibility to other learning structures and other learning environments. Given the findings presented in this experiment, future studies are discussed.

CHAPTER 2:

LITERATURE REVIEW

Learning

Learning is the process of acquiring knowledge through study that causes a change of behavior that is measurable and allows an individual to formulate a new mental construct. Learning is sense making that enables manifestation of purpose (Hudgins, 1977). The study of learning, therefore, is deconstructing the process for which an individual is capable of acquiring, disseminating, assembling and extrapolating knowledge for the purpose resolving issues placed before them. It is within this experiment that learning is deconstructed; from the standpoint of the learner and from the standpoint of the utilization of technology employed to facilitate learning.

Learning comes in two basic forms: 1) anthropological or informal and 2) subject-related or formal (Walker, 1996). Anthropological learning is the basis of human evolution, self-determinism and survival. Its basis is rooted in human-instinct and physiology. This form of learning is characterized as occurring naturally within the environment; specifically through the natural course of activity that increases ones ability to develop concrete skills (Pessler, 1991). Subject-related learning is a formal attempt to broaden one's abilities through knowledge attainment. Its basis is rooted in human psyche and intellect. This form of learning is deliberate teaching, taking place in context removed from the environment and emphasizing the development of skills across contexts (Pessler, 1991).

Anthropological learning is rooted within Maslow's hierarchy (Appendix A). Teaching others satisfies the need for safety, for social acceptance and provides a sense of self-realization and transcendence. Learning is the acquisition of cultural norms, values and beliefs, and rules of how to interact with others (Pessler, 1991). Communication is a prerequisite for the shared construction of knowledge, which promotes democratic approaches to social maturity. Learning, therefore, is the promotion of the social structure and the advancement of those within the social structure.

The most basic of the anthropological learning processes is imitation, one's personal repetition of an observed process. Through copying, individuals learn how to hunt, feed and perform most basic tasks necessary for survival – the bottom, most fundamental layer within Maslow's hierarchy. This method of learning becomes a fundamental underpinning of the institutional learning structure, specifically instructional form of teaching. Even though its influences are only indirectly contributing to this learning structure - a byproduct, per se, of the social structure from which the institutional learning structure is based upon, these influences are finding a resurgence in the form of active learning and the technology driven learning environment.

The learning form studied within this dissertation is subject-related learning. Subject-related learning is the conscious attempt to promote learning in others by creating a safe, viable, productive learning environment. Learning is the structured process meant to transact principles and skills to be applied to numerous situations and in various contexts (Pessler, 1991). From the institutional perspective, this is characterized within the classroom. Students gather to learn principles and skills that will be applied in various work-related situations. Within this classroom context, the learning process is narrowed to focus on the institutional learning structure. This is accomplished through the process called education.

Education is the interaction between a teacher, one who posses knowledge, and the student, one who wishes to obtain knowledge. Learning is the absorption of specific knowledge, beliefs, and skills (Hudgins, 1977). Traditionally, the primary form of education, within the institutional learning structure, comes in the form of lectures. Through lectures, the experiences and wisdom of the teacher are imparted onto the students. The goal is aiding the growth of student so that they become a productive member of the social structure. An imparting of knowledge from generation to generation promotes a greater awareness and responsiveness through social maturity (Pessler, 1991).

There are various ways to approach the study of learning but for this dissertation, learning, as it relates to education, will be presented among the following three perspectives: 1) behavioral, 2) cognitive and 3) constructive (Appendix B). These three learning methods are intertwined with the institutional learning structure and thus need to be presented on a single platform.

Behavioral Learning

A behavioral approach to studying learning views the mind as a “black box” and, as such, responses to stimuli can be physically observed (Mower, 1989). In this instance, the mind is void of thought processing and learning is an instinctual or trained response.

Greek philosophers are credited with developing the concept of behavioral learning. Aristotle, for instance, presented the concept of behavioral learning in his essay "Memory." "Memory" focused on the association of events such as lightning and thunder. Since thunder often follows a lightning strike, people are conditioned to listen for the thunder when they see lightning strike.

However, the formal study of behavioral learning, and thus behavioral learning theory, can be attributed to scientists such as Ivan Pavlov and B.F. Skinner (Smith, 1999). They tested stimulus-response, or classical, conditioning in animal behavior. Ivan Pavlov set-forth the concept of learned response from stimuli conditioning in his experiments with dogs. His experiment demonstrated how stimuli, the ringing of a bell, could induce a learned response, salivation, in a dog. B.F. Skinner set-forth the concept of positive and negative stimuli conditioning attributes. His experiments demonstrated how different forms of reinforcements relating to the stimuli would induce different learned behavior: a positive response to a stimulus would induce repeatable behavior while a negative response to the stimuli would induce suppressed, non-repeatable, behavior.

Behavioral Learning Theory posits that organisms need reinforcements to keep them interested and that the use of stimuli can be very effective in controlling behavior. Since the stimulus is a basis for learning, the environment directly shapes behavior, and complex learning requires a series of small, progressive steps (Mower, 1989). This form of learning is the most common form of learning in the institutional learning structure because the behaviors of the learners can be easily measured through exams and essays. In this context, the behavioral learning process is simple: show and repeat.

Within the institutional learning structure, the primary responsibility of the teacher, from a behavioral learning perspective, is to identify and sequence the presentation of information that will help the students to learn. Furthermore, teachers enforce the behavior and the actions that set that behavior into action (Shuell, 1976). An example of how this is accomplished within the traditional classroom is a lecture being reinforced with presentation of the lecture high points be-it on a white-board or overhead projector and, finally, distributing the lecture outline to the students for note-taking purposes. The knowledge is imparted in the same fashion in all three-presentation methods. Finally, the teacher presents exams and essays, regurgitating the material in the same fashion as the lecture, to test the student's conditioning to the learning environment.

Cognitive Learning

A cognitive approach to studying learning views the mind as integral to the learning process and, as such, learning is a byproduct of how humans process and store information (Smith, 1999). Like behavioral learning, cognitive learning establishes a relationship between repetition and reinforcement. However, cognitive learning theorists posit that learning is an internally based process or mental construct and is understood as a change in knowledge as it is stored in memory and not, as behavioral theorists' believe, an external process.

In similar fashion to the introduction of behavioral learning, Greek philosophers first presented the concept of cognitive learning. Plato, for instance, professed the need for mathematics and reading to further a person's "internal absolutes." Aristotle, for another, considered the pursuit of an ideal life one of an intellectual pursuit.

The development of Cognitive Learning Theory, as a science, arose from the biological mapping of perception or how the brain imposes patterns on the perceived world. Gestalt theory, like the aforementioned theory of perception, evolved into the understanding of how human development affects comprehension (Walker, 1996). Gestalt theory encourages the learner to discover the underlying nature of a topic or problem and not, necessarily, the straightforward solution. By understanding why the problem exists, the learner comes to a better understanding of how the solution provides ends to the means.

Since Cognitive Learning theory is interested in the internal means in which a human learns, cognitive theorists look to understand how people interpret information in aptitude and capacity and through which learning style people are best atoned to learning (Walker, 1996). Like Behavioral Learning, Cognitive Learning involves associations established through contiguity and repetition. Also like Behavioral Learning, Cognitive Learning is more effective if positively reinforced. However, providing feedback about the correctness of responses acts as a stronger motivator than reinforcement. Therefore, even allotting for behaviorist concepts, cognitive theorists view learning as involving the acquisition or reorganization of the mental constructs through which the human processes and stores information.

The Key concepts of Cognitive Learning Theory (Appendix C) emphasize the computational manner in which information is stored. There are three types of memory:

1) sensory, 2) short-term and 3) long-term. Sensory memory is the storage of information by the reflective memory created by the stimulus. By analogy, it is the resultant “spot” that a person “sees” after the flash of a photographer’s camera. This memory has a short-lived time span of, at most, a few seconds. Short-term memory is the ability to retain information for a short period of time. This is evidenced through amnesia. A person with amnesia can remember things they immediately hear, feel or see but cannot remember what they did yesterday, last week or last year. Finally, long-term memory is the deep active processing of information that is held until it can be recalled at some distant, future date.

In understanding how learning transitions from sensory and short-term memory into long-term memory, cognitive learning theory posits five principles of Cognitive Learning. The first principle is that knowledge is built as received information is processed. The second principle is that how knowledge is constructed is dependent on mental states as well as context. The third principle is that conceptual change is difficult but possible. The fourth principle is that individuals have varying learning styles. The fifth principle is that learning is most productive in social environments (Ormrod, 2003).

Within the institutional learning structure, these five principles are integrated into the learning process through modified lecture/discussion methods (Appendix D). Similar to the behavioral learning process, this is accomplished within the traditional classroom with a lecture being reinforced with presentation of the lecture high points be-it on a white-board or overhead projector and, finally, distributing the lecture outline to the students for note-taking purposes. However, the three presentation methods impart the knowledge in a differing fashion, each one adhering to the same context but conveying differing concepts. Finally, the teacher presents exams and essays, focusing on the concept as opposed to the context of the relevant material, to test the student's conditioning to the learning environment.

Constructivist Learning

A constructivist approach to studying learning views the learner's environment as critical to the process since the learner actively constructs knowledge based on the learner's own personal experiences (Smith, 1999). Through social negotiation, the learner embraces their current surroundings and, therefore, responds in kind with the other members of the current social norm, a process called meaningful learning. Therefore, constructivist learning is a result of the changes in a student's comprehension as reflected through the perceptive influences of the environment in which they operate. Furthermore, constructivist learning promotes a student's free exploration within a given framework or structure. In finality, constructivist learning is the internalization of concepts, rules, and general principles that are applied in a practical real-world context through social negotiation and from a historical introspective.

As with the other two learning theories, the concept of constructivist learning can be found in philosophy. Kant, for example, states in "Copernican Revolution," that it is the representation that makes the object possible rather than the object that makes the representation possible. Kuhn, for another, stated that we judge the quality of a theory by comparing it to a paradigmatic theory.

Constructivist Learning Theory, as a science, is an extension of the cognitive learning theory. Constructivism is based on cognitive learning and thus many cognitive theorists have been attributed to Constructivist Learning Theory. Jean Piget is credited with cognitive constructivism or how children acquire knowledge. Lev Vygotsky is credited with social constructivism or the effects of social interaction and development on the learning process. Jerome Brunner studied how the organization of mental events was assembled into meaningful patterns. These theorists collectively define constructivist learning (Davies, 2001). Their research surmised that memory is not a perfect copy of events that we experienced, but a reconstruction, assembled when the brain needs to recall the past.

Constructivist learning theory posits "learners construct their own reality or at least interpret it based upon their perceptions of experiences, so an individual's knowledge is a function of one's prior experiences, mental structures, and beliefs that are used to interpret objects and events. What someone knows is grounded in perception of the physical and social experiences which are comprehended by the mind." (Jonasson, 1991).

Although Constructivist Learning is perceived as a personal endeavor, its basis is actually a community based understanding of knowledge. According to Constructivism there exists a physical world that is subject to physical laws that we all know in pretty much the same way because those physical laws are perceivable by humans in pretty much the same way. Reality, and thus knowledge, is shared through a process of social negotiation – a process whereby humans collectively define wisdom and knowledge. (See Appendix E)

Within the institutional learning structure, the teacher acts as a facilitator who encourages students to discover principles for themselves and to construct knowledge by working to solve realistic problems. Benefits of this learning process are 1) students can work to clarify and organize their ideas so they can voice them to others, 2) it gives them opportunities to elaborate on what they learned, 3) they are exposed to the views of others and 4) it enables them to discover flaws and inconsistencies (Ormrod, 2003).

Traditional Form of Learning

The traditional form of learning, like the previously mentioned learning theories, has an origin in philosophy. Socrates is accredited with establishing the traditional form of lecture through his method of oral instruction the public. The traditional lecture methods, in which professors talk and students listen, dominate college and university classrooms. These traditional lecture methods embrace all of the aforementioned learning theories. Behavioral learning arises from the lecturer's audio inflection of certain ideas; students are conditioned to make notes based on those inflections. Cognitive learning arises from the use of the white board or overhead projector, followed with the lecturer's presentation; students are conditioned to follow the topics the lecturer highlights and browse other topics assigned – but not lectured. Finally, Constructivist learning is implemented into the traditional lecture through discussion forums or student presentations; the basic Q&A scenario (Travers, 1972).

This form of learning does present some problems (Shakarian, 1995). First, establishing a deep active processing of information needed to place the knowledge into long-term memory requires a level of engagement by the learner. Lecture, chalk-talk or speech colloquy, is inherently a passive from of learning with the students focused on note-taking. As such, students are subjected to an influx of new ideas and methods without the opportunity to process or ponder the information.

Second, listening patterns required in the lecture form of learning is only effective for short periods of time. Student's attention is effective for only the first 10 to 15 minutes of a class then drops continuously throughout the remaining lecture period. Consistent with the students listening ability is their note taking ability; therefore there will be degradation in the amount of lecture information that will appear in students' notes. Consequently, if students use their notes as a primary study strategy when preparing for class exams, information gleaned from those notes will be incomplete. This type of listening pattern may produce a typical primacy-recency effect, where students may only be able to accurately recall information that was presented at the very beginning and very end of a lecture.

Finally, contemporary learning methods emphasize the process of learning over and above the transfer of information. As such, learners are expected to engage critical and creative thinking in their presentation of the information through test taking and essay writing. This creates a disparity between the transference of knowledge through lecture and demonstration of knowledge-attainment through the test/essay submission.

For this reason, and the others listed, educators are challenging the traditional lecture method and advocating the increased use of active learning strategies in the classroom.

Active Learning

To compensate for the deficiencies apparent in the traditional lecture methods, the institutional learning structure has redesigned the learning space, making use of active learning. Consequently, within the institutional learning structure, active learning has transformed the learning process from “show and repeat” to “disseminate and advance” (Stern, 2005).

Active learning embeds personal accountability and academic activity on the shoulders of the learner. Moreover, the student assumes responsibility because they perceive themselves as the learning catalyst. The student can use learning strategy and engage in various activities to create environments that are conducive to their learning objectives (Zimmerman, 1989).

The active learning model suggests that the student engages in various activities and uses various strategies to gather information and achieve understanding. According to the model, activities that engage self-regulated learning contribute to academic achievement whereas activities void of self-regulated learning do not contribute to academic achievement. Activities that engage self-regulated learning are time dedicated to studying and the pursuit of knowledge. Activities that do not engage in self-regulated learning are participation in extracurricular activities such as sports, work, social organizations and non-learning based “escapes” such as television and video games.

According to theory and research, participation in some of these latter activities may even dissuade academic achievement. (Zimmerman, 1989)

Self-regulated studying has a positive effect on academic achievement as defined by grade point average and the student's perceived level of knowledge transference. Studying includes organization and review of the material (Dickinson, 1990), study effort (Davis, 1993), time spent studying (Schultz, 1994), method of study and level of involvement in the course (Franklin, 1995). Consequently, studying is an activity that engages the student in the self-regulated learning process and, thus, reflects the student's acceptance of the active learning concept.

Negative effects were observed for participation in sports, participation in part-time work, interaction with friends, and use of the media. Negative effects on academic achievement were reported, particularly for television viewing, listening to radio and records, off-campus employment, and total hours worked (Franklin, 1995). From the perspective of active learning, these activities represent disturbances outside of the learning space and the social environments where these interactions take place are not conductive to the learning activities. Consequently, participation in outside activities reflects the student's rejection of the active learning concept.

Interestingly, researchers have reported both null and mixed findings regarding effects of interaction with faculty, interaction with family and participation in academic organizations (Hatcher, 1991) on academic achievement. However, these activities do not engage the student's effort to learn and, therefore, are excluded from the active learning model (Zimmerman, 1989).

In the creation of the learning environment, the active learner distinguishes between studying and self-regulated learning. Self-regulated learning emphasizes quality over quantity. The quality of intensive study, review, and elaboration should increase learning (Schunk, 1989). Active learning, therefore, involves reflection and reconstruction of facts in accordance with directed questions, to enhance understanding. This process should strengthen long-term memory (Schunk, 1989).

Finally, since students differ in their emphasis on immediate versus delayed gratification of alternative goals, the underlining concept within the active learning model is the student’s intrinsic motivation to seek knowledge (Schunk, 1989). For example, a student who places more emphasis on immediate gain in grades than on delayed gain in genuine learning may achieve high grades by copying classmates' work rather than taking time for studying. Hence, because reinforcing values of activities are different, students choose different activities. Consequently, seeking information does not necessarily lead to learning or understanding, which involves organization of information that has been compiled (Zimmerman, 1989).

In summary, active learning is a process whereby learners are independently pursuing knowledge and are actively engaged in the learning process, rather than "passively" absorbing lectures. Active learning involves reading, writing, discussion, and engagement in solving problems, analysis, synthesis, and evaluation. Learners are presented with varied sources of information and are expected to formulate their own concepts and ideas based on how they traverse through the learning space (Bonwell, 1991).

Recent advances in technology are a means for employing the active learning model, thereby providing a viable alternative to the traditional form of lecture. As such, instructional technologies with active learning methodologies are being implemented into the institutional learning structure. Consequently, instructional technology is driving the transition from an instructor-driven, lecture based process to a student-centered active-learning process (Waxman, 2003). Through the use of instructional technology, the learning structure has become dissemination through active participation (Knowles, 2001). However, does the technology-enhanced learning space rectify the shortcomings of the traditional form of learning? This new system of learning leads to the following Research Question: In a technology enhanced learning environment, how does presentation of and access to knowledge facilitate the learning experience?

PRESENTATION OF KNOWLEDGE

The modification of traditional lectures (Shakarian, 1995) is one way to incorporate active learning in the classroom and yet retain control over the learning environment from the perspective of the teacher. An instructional strategy based on this active learning model is multimedia-presentation and Guided Design (Oliver, 2000).

Internet access in the learning space is a viable means for creating meaningful multimedia learning activities for the students. Through the Internet, students are able to access a rich array of learning resources such as libraries, museums and multi-media presentations about events and study topics. Access to such Internet-based resources provides value to the learning process (McArthur, 1998). Exposure to real-time Internet-based information provides students with environments that support active learning (Oliver, 2000). Moreover, the student's ability to question concepts, while the knowledge is fresh in the student's memory, improves student test performance and develops intellectual capacity (Schunk, 1989). However, simple exposure to the Internet is not sufficient in establishing knowledge transference (Reynolds, 2003). Quality instructional design of learning tasks and learning environments is necessary for improving student learning (Jonassen, 2002).

Empirical evidence on the effectiveness of Internet-enhanced instruction for student learning in college courses is slim. Meta-analysis on the use of technology in teaching suggests that there is "no significant difference" in the learning outcomes of students who use technology and those taught in a traditional classroom setting (Waxman, 2003).

Internet-based materials and learning activities provides statistically significant benefits to learning and students' perceptions of instructor effectiveness. However, the overall effect on cognitive learning outcomes is minimal (Waxman, 2003). Internet-assisted instruction (e-mail, discussion boards, simulations, and tutorials) generally increases students' enjoyment of classes but finds no solid evidence of improvement in student performance when compared with students taught using traditional methods (Maddux, 2000). The general consensus is "In regards to the use of technology in the educational process, physical capital may be a poor substitute for human capital in education."

These studies exemplify that what matters most is not the medium by which information is delivered but how that medium is used to deliver the information. Simply making new instructional technologies such as the Internet available to students will not generate increased learning. Learning will be enhanced only when instructors embed these technologies into their teaching pedagogy in ways that direct students through the learning of concepts and get the students actively involved in the learning process.

A major reason why exposure to the Internet is not sufficient is that student use of hypermedia oriented Web sites is correlated to their ability to navigate through the site, finding the information needed to solve problems and complete tasks. The students' ability to use hypermedia organized information systems are influenced by factors such as prior knowledge and self-regulation strategies (Maddux, 2000). Surfing the net is not the same as possessing strategies necessary to efficiently and effectively negotiate the plethora of available information.

The Internet has had little effect on teaching strategies (Goffe, 1997). The primary use of the Internet is to provide articles, course information, and data, as well as supplementing traditional communication with e-mail, on-line chat, and listservs. The production of these resources are often static and without direction. Despite the wide variety of Internet resources available to instructors, no consensus currently exists on the best way to incorporate those resources into the teaching pedagogy. Instructors lack a starting point to effectively integrate Internet-based active-learning activities into their own courses. It is likely that the use of the Internet in teaching will continue to grow, in the process changing both the medium and the method of instruction. The continuing challenge will be learning how to combine the use of this technology with active-learning-teaching strategies to make learning more accessible and more relevant to students, while yielding improved learning.

In creating meaningful activity-based strategies, Internet based learning activities could employ the concept of guided design. Guided design is an Information architecture that involves the design, organization and navigation systems to help people find and manage information more successfully (Wales, 1978; White, 1986)

Digital libraries are implementing this concept as they transition to from a brick-and-mortar based learning resource to an Internet based learning resource. The ubiquity of the Internet has changed the way that most students access information. Internet-driven Digital Library portals harness the power of databases to create dynamic pages listing resources by department, subject areas, audience, and format in order to facilitate exploration and browsing by Web site visitors. The digital-library is a visual medium that presents the students with active learning resources (Dong, 2001).

Similar to what digital libraries have done, instructors can apply active learning activities using the Internet as a resource. First, making the web pages easy to scan will make it possible for the students to quickly identify the words or phrases that relate to their learning goals. The Poynter eyetrack studies[1] show that people scan the first two to three words of the article's headline. The resources within the learning space, therefore should contain the keywords of the material and be void of the pomp and circumstance. Secondly, position the keyword items prominently with the learning space. Consider the

[1] www.poynterextra.org/eyetrack2004

screen to that of a newspaper. If you place the most important information in the upper-left-hand area of the content region of the page, almost everyone will scan that area. Finally, content is important. To avoid content pitfalls, spell out exactly what in needed to be accomplished and what content will meet this goal. The design of the active learning space provides the path to knowledge attainment and thus successful active learning (Marcus, 1994).

The individual aspects of the design adhere to the learning theories previously discussed, and thus create an alternative method of learning, through guided design, to the traditional form of lecture.

From a behavioral learning perspective, this learning space provides a click-and-progress conditioning through the simplicity of the web site design. Students found sites with menus to be cumbersome, they preferred hyperlinks and navigation buttons. Moreover, students preferred to remain within the initial screen as opposed to opening additional widows. The active learning space, using frames, accomplishes this feat. Students are conditioned to a one-link navigation path where the information was "just a click away." (Bramall, 2000)

From a cognitive learning perspective, the aesthetic appearance of the interface contributes to students' perceptions of the site usability. Text enclosed in frames is a way of presenting information in a functional manner. Also, multimedia features are important to students as they search for information relevant to their task. Finally, the ability to sift and filter within the resource is necessary because of the vastness of the information held on the Internet (Bramall, 2000).

And finally, from a constructivist learning perspective, the delivering information that is structured and organized, interfaces that had simple navigation buttons and contained only relevant multimedia elements such as sound and videos provides a valuable educational tool (Bramall, 2000).

The design of the site establishes usability of the resource in the active learning environment based on the confines of the aforementioned learning theories but in what manner does this site design facilitate learning?

Internet-based resources used in active learning require an understanding of how these features facilitate student use in achieving learning objectives. Design features provide usability support for the students, as indicated by the study discussed above, but to what extent do different features such as hypertext, multimedia, and interactivity within the same learning space affect learning? Different features in Internet-based resources places different demands on the learner (Sosin, 2005). Learning is facilitated when resource features are geared to the learning objective (Ardito, 2004).

Active learning endeavors should work on moving students through the course content (Oliver, 2000). Active learning helps increase learning and retention of class material (Zimmerman, 1989), but there is also some research that suggests that students may not appreciate these approaches as much as they do a traditional lecture approach, perhaps because they are unaccustomed to them or do not understand how they relate to class material. Students exposed to active learning approaches in their class tended to learn more than their counterparts in a regular lecture section of the course, yet they rated the instructor effectiveness lower than did students in the lecture section; some students made comments expressing doubts that they had really been "taught" anything (Lake, 2000). Student dissatisfaction can be avoided by emphasizing the relationship between the activity and the course content (Oliver, 2000); thus, one of the goals in an active learning environment should be to establish a clear relationship between the activity and the material to be understood, leading to Hypothesis 1:

> Hypothesis 1: Students who are directed to the relevant research material will have a more favorable perception as to the effectiveness of the learning environment than students who are directed to a collection of relevant research material.

The Internet is a rich source of news, data, and information that can make learning relevant and understandable for students in ways that lectures and textbooks alone cannot (Erickson, 2000). Instructors can use up-to-the-minute data and direct the students to Internet-based examples that illustrate concepts (Alexander, 1999). Students can view news clips, listen to speeches, and access on-line resources from a variety of Internet sources (Johassen, 1999; Gannon, 2004; McArthur, 1998). These resources provide the basis for a wide variety of active-learning exercises. For example, students can use information from the Internet to define specific concepts or to construct insightful responses to open-ended topic-related questions. These types of activities directly involve students in the learning process and make learning come alive, providing a richer learning experience than traditional teaching methods can.

Use of the Internet as a method of instruction highlights the active learner and the teacher-pedagogy paradigms (Wegner, 1999). The role of the instructor becomes one of preparing the instructional environment, anticipating the needs of the students in advance and providing contingencies. The student works to develop their own meaning for the material rather than interpreting the material based in the teacher’s perspective. Internet-based delivery of coursework has little or no negative effect on student achievement or on students' perception of their learning (Waxman, 2003). It is important, however, to recognize that to ensure student success in Internet-based courses requires the same careful attention to instructional design, the same level of diligence on the part of the instructor and the same opportunity for meaningful communication that traditional in-class models require (Wegner, 1999).

Research suggests that although individual students learn in different ways, all meaningful learning--learning that emphasizes understanding and the acquisition of knowledge--requires direction (Shuell 1976). To the extent that the Internet provides resources to engage students actively in the learning process, its use in knowledge transference is likely to improve learning provided it presents a directed knowledge attainment path for the student (Erickson, 2000). This path becomes even more important as students shoulder the burden of traversing their own learning path and instructors present the Internet as a learning tool without considering how the students will use the new resource, leading to Hypothesis 2:

> Hypothesis 2: Students who are provided direct-access to relevant research material will undertake a greater level of research than students who are given broad-access to a collection of relevant research material.

ACCESS TO KNOWLEDGE

The active learning model suggests that the student engages in various activities, as discussed above, *and* uses various strategies to gather information and achieve understanding (Bonwell, 1991). So, simply presenting information or providing a means for learning isn't going to get the student to successfully comprehend the material. A strategy to gather information is required to achieve understanding.

The Internet has the potential to increase our ability to perform research tasks quickly and easily. From any Internet capable computer, researchers can access a library's and other knowledge-based datastores (Fosmire, 2002). The difficulty is to find accurate information that is reliable in content and efficient to access (Latchman, 1999). Information made available on the Internet is increasing at a rate faster than the ability to manage it (Jansen, 2003). Every new resource added increases the time needed to locate the requisite information.

Storing data is only beneficial if it can be retrieved at a time when it is relevant to the task and can be retrieved in a more efficient manner than re-creating the data in absentia. As such, the storing and organization data must be from the searcher's perspective (Jansen, 2003). The challenge, therefore, is dealing with the organization of the information that will be most beneficial for the student. In the retrieval of relevant facts, the instructor employs a pedagogical design – one of his/her personal choice. Therefore, for students doing the research, information presented is relevant based on the instructor's learning methodology (Latchman, 1999). Information systems are capable of modeling the instructor's approach to research activities and to the tasks and interactions involved (Fosmire, 2002).

The use of information changes as the individual's understanding of the problem change (Hudgins, 1977). Information retrieval is but one component of this process of information seeking and can be viewed as a means of communication (McArthur, 1998). Relevance is about finding the appropriate information to resolve such a problem or need. Understanding relevance in the context of the learning structure can be narrowed to the teaching pedagogy. This places searchers in specific contexts and how they judge the relevance of information sources, which is fundamental to the use of all information retrieval systems. Although judgment of relevance is dynamic, multidimensional and is a complex mental activity involving quality judgments of relationships between information and a person's information need (Miller, 1996), the meaning of relevance is defined as a result of the learning objective (Maddux, 2000). For the student, relevance is intimately related to learning processes and information used to establish the learning path as presented within the learning structure.

The situation of the information user is examined in a range of contexts with the user's information need the intended point of departure. For this dissertation, the situation of the information user is narrowed to the learning space and access to knowledge. A well-organized learning space, therefore, looks to limit the paths, or information resources, on which the active learner can traverse.

As access to the Internet becomes commonplace, it is becoming a standard practice for students to use data and findings from Internet sites in their research. As this practice grows, the ability to judge the validity of the data and the related findings is important. Considering that the number of Internet hosts continues to grow exponentially (Zakon, 2005), judging the value and reliability of the information available on an Internet site is becoming difficult. The possible harm that can result from the use of dirty data, misinterpreted information, and incorrect conclusions can be far-reaching. Unfortunately, although some data are reviewed and efforts are made to maintain data integrity, not all available data and information found on Internet sites are reviewed by peers or someone in authority within the discipline (Alexander, 1999). Since the use of the Internet is integral to the active learning process, this places the burden of judging the Internet-available data on the instructor.

Uses of on-line technologies have been effective within the active learning environment (Gannon, 2004). Students tend to participate in the activities and complete assignments. Providing access to specific web-links that provide the relevant material has met with success (Clark, 2003). Providing unstructured access to the Internet is akin to a visit to the "brick-and-mortar" library but without the added benefit of library index cards. Pedagogical structure is necessary for learning to happen (Dong, 2001).

Separating the content from the learning process affords the student the security of applying learning strategies to the related subject matter without the uncertainty of not knowing the validity of the material. Students, while surfing or accessing the Internet, are so accustomed to the plethora of information and the abundance of material that they forget that anyone who accesses the Internet can also place data on the Internet (Reih, 2002). Consequently, even the simplest assignments, in which students are asked to visit a particular Internet site and simply report back on what they find, can present problems of information validity (Maddux, 2000).

Hypertext is a valuable means of representing and organizing information. It can be used to create a set of presentation materials that can be easily shared with both students and colleagues. More importantly, since the instructor establishes the hypertext link, hypertext can be integrated into the student's active learning strategies while retaining data validity (Gannon, 2004). Through the use of hypertext, learning can be viewed from a reorganizational and generative perspective (Marsh, 1992). Since learning requires the student to be actively engaged, the knowledge must be reorganized as required. Learning through transitioning along a predetermined path is more effective than learning from programmed instruction. Hypermedia promotes effective learning in so far as users are engaged, actively, and making their own connections and integrations at the conceptual level (Moore, 1995). Also, learning is the process of constructing knowledge. In the study of a new concept, students can be actively encouraged to form a hypothesis, construct a model to make predictions, design and construct a corresponding experiment and analyze the results. Both perspectives are valuable in the design of a technology-enhanced learning environment. The reorganizational perspective is useful as a means of modeling the theoretical aspects of the knowledge domain. The generative perspective is valuable in modeling the experimental aspects of the course (Moore, 1995).

This presents the following hypotheses:

> Hypothesis 3a: Students who are directed to the topic-specific research material will provide more concise answers than students who are directed to broad-topic research material.

> Hypothesis 3b: Students who are directed to the topic-specific research material will provide more accurate answers than students who are directed to broad-topic research material.

Effective use of the Internet requires an understanding of whatever media is being used and whether its utilization is effective. The extension of teaching dimensions to include measures of active learning and media use is necessitated by what is already occurring in the classroom as referenced by journals devoted to just such teaching methods. For instance, Academy of Management Journal – December 1997 was devoted to Teaching Effectiveness in the Organizational Sciences and MIS Quarterly – September 1995 was devoted to Curricula and Pedagogy. Although the selection and use of new media improves the students' educational experience, they do not substitute for instructor pedagogy (Serva, 1999).

Internet-based information seeking can be rather difficult for students engaging in active learning. This indicates that there still is much room for improvement in Internet-based searching. Search engine users, referencing a search-based open system such as Excite or Google, are a heterogeneous crowd and may need to be catered to differently (Holscher, 2000). Novice users had severe problems with formulating a reasonable query and use of tools that support the query formulation process.

Because a successful search on the Internet turns out to be so difficult for novice users, the active learning process needs to eliminate the complexity of the resource. The Internet has the technical capabilities to implement any instructional strategy, and therefore posses the means for delivering resources more in-line with the capabilities of the student. The most obvious instructional use is the limitless hyperlinked information that students can access for any Internet-connected computer (Sugrue, 2000).

The hypertext capabilities of the Internet have shown to possess powerful learning stimuli. Learning is enhanced if information is organized, which is the defining principle of hypertext instructional design (Merrill, 1992). However, the benefits of hypermedia are evident only when combined with pedagogical strategies (Jacobson, 1996, Jonassen, 1992). For this dissertation, pedagogy is a directed hypertext-learning path, leading to the Hypothesis 4:

> Hypothesis 4: Students who engage in research using topic-specific resources will have a stronger comprehension of the learning objectives than students who engage in research using a broad-topic resource.

The technology-driven learning environment is flexible in that the instructional styles can take many forms to present differing classroom learning styles addressing how and where content is delivered to students. Pedagogy in technology-driven learning environments changes from a structured knowledge transmission strategy (instructor-driven) to a pedagogy that promotes problem solving (student-centered active learning). The roles of the teacher and students change in a technology-supported and mediated-learning environment. The teacher changes from one who transmits content and directs students to a mentor and a guide. The teacher helps students develop skills (Michau, 2001).

However, some learning appears to occur incidentally and through unplanned venues, in the course of doing something else. Within the technology-driven learning environment, people fail to recognize this as a form of learning. For instance, a student's prior knowledge of the learning environment might affect the choices about the sequence for reading information in the hypertext. Moreover, when reading hypertext, the student's focus can be at a more global level of processing, as opposed to the micro processing orientation typically adopted when reading printed text (Shapiro, 2004). When reading hypertext, readers often focus on navigating the complex system rather than deriving meaning at the word, sentence or paragraph level (Trumball, 1992).

Some of this incidental learning is formalized in the sense that there is some explicit instruction and very commonly some assessment of learning outcomes. A very large proportion of this incidental learning is planned, managed and embedded into the learning environment through the instructor's pedagogy. To some extent this is because information in the technology-driven learning environment is at least partly an artifact of the technology itself (Moore, 1996). The technology-driven learning environment is programmed to reflect some element germane to the learning activity. The content may be altered by the course instructor and returned to the student via the same URL. This focuses on the nature of hypertext links themselves. In pursuing an inquiry, a student will characteristically follow a number of links, and to some extent the information subsists in the links themselves (Shapiro, 2004). The evaluation of information in the technology-driven learning environment is a challenging matter and one that cannot readily be separated from the technological competence of the student (Sugrue, 2000).

With the reliance on the Internet as an active learning tool, a great deal of such learning is occurring in technologically mediated forms. Accordingly, it is increasingly necessary for people to be technologically ‘literate’ so that they are able to access and to use the technology fluently. The skills needed to retrieve information are quite different and separable from those required making informed judgments about information. This leads to the Hypothesis 4 (post-script):

> Hypothesis 4 (post-script): Having already interacted with the technology-driven learning environment, students using a topic-specific resource for their research in the second task would show greater improvement in material comprehension than students using the broad-topic resource for their research.

CHAPTER 3:

METHODS

Participants:

The test subjects were recruited from Arizona State University's College of Liberal Arts and Sciences. The students were enrolled in *Race, Sex and Identity Online* or *Race & Ethnicity in American Film.* The experiment was offered in both classes during the Fall semester and Winter session 2005. The experiment was run during the last two weeks of the respective semester to provide a stronger enticement for extra credit and to ensure that students were aware of the grading criteria to be employed in the essay submissions.

The experiment comprised of 194 samples, 68 (35%) were male and 126 (65%) were female. The sample population was primarily junior and senior level students (162 of 194 samples or 84%). Finally, the sample population spent, on average, 13 hours per week on the Internet and 16 hours per week on the computer (Appendix F).

Students were able to access the experiment on-line and were randomly assigned to one of four conditions: 1) complete two research tasks using a broad-topic resource, 2) complete the 1st research task using a broad-topic resource and the 2nd task using multiple topic-specific resources, 3) complete the 1st research task using multiple topic-specific resources and the 2nd task using a broad-topic resource, and 4) complete two research tasks using multiple topic-specific resources.

Design:

The experiment is a 2 (construct, concept) x 2 (broad-topic, topic-specific) test of task complexity and access to data resources (Table 1). The experiment measured the student's ability to synthesize information as they traversed through a specified set of resources. Each student was presented with two tasks. Each task required the student to submit an essay response. In providing the response, the students were allowed to research the relevant material using the available resources.

		Data Resource	
		Broad-Topic	Topic-Specific
Task	Construct	Given access to a broad-topic resource, define a set of principles.	Given access to a set of topic-specific resources, define a set of principles.
	Concept	Given access to a broad-topic resource, discuss a concept.	Given access to a set of topic-specific resources, discuss a concept.

Table 1: Research Design

In researching the relevant material, the students had access to either: 1) a single broad-topic resource or 2) multiple topic-specific resources. The single broad-topic resource comprised of one dynamic content webpage that contained all of the relevant material the student needed to provide a scholarly response to the research questions. Each topic-specific resource was organized to present one specific topic related to a specific research question – the content of each topic fit into one webpage sized to fit on a standard 17" monitor screen. There was one broad-topic resource and four topic-specific resources created for this experiment. The content in the broad-topic resource was identical to the overall content presented in the four topic-specific resources.

Procedures:

The student began the experiment by answering a set of demographic questions. Then each student completed two tasks. The first task focused on a specific set of constructs, requiring the student to provide a specific set of responses. The second task focused on a specific concept, requiring the student to synthesize the information from the available resource(s) into an illustrative, yet narrow – concise, answer. In both tasks, students were randomly assigned to either the broad-topic or topic-specific resource, expected to research a question and provide a written essay-style response. After each task, the responses were submitted, saved, and scored by the instructor. Once the student completed a task and submitted their responses, they were unable to return to that task. At the end of the experiment, when both tasks were completed, the students evaluated the learning process and learning environment by answering a set of survey questions.

The experiment is started when the student elects to enter the research space and answer a set of demographic survey questions. With the student electing to enter into the research space, they agree to have their movement within the research space logged, the responses they submit analyzed and results reported, and agree to complete the experiment, in totality, once they have begun (Figure 1). After they submit their responses to the demographic survey, they enter into the first phase of the experiment.

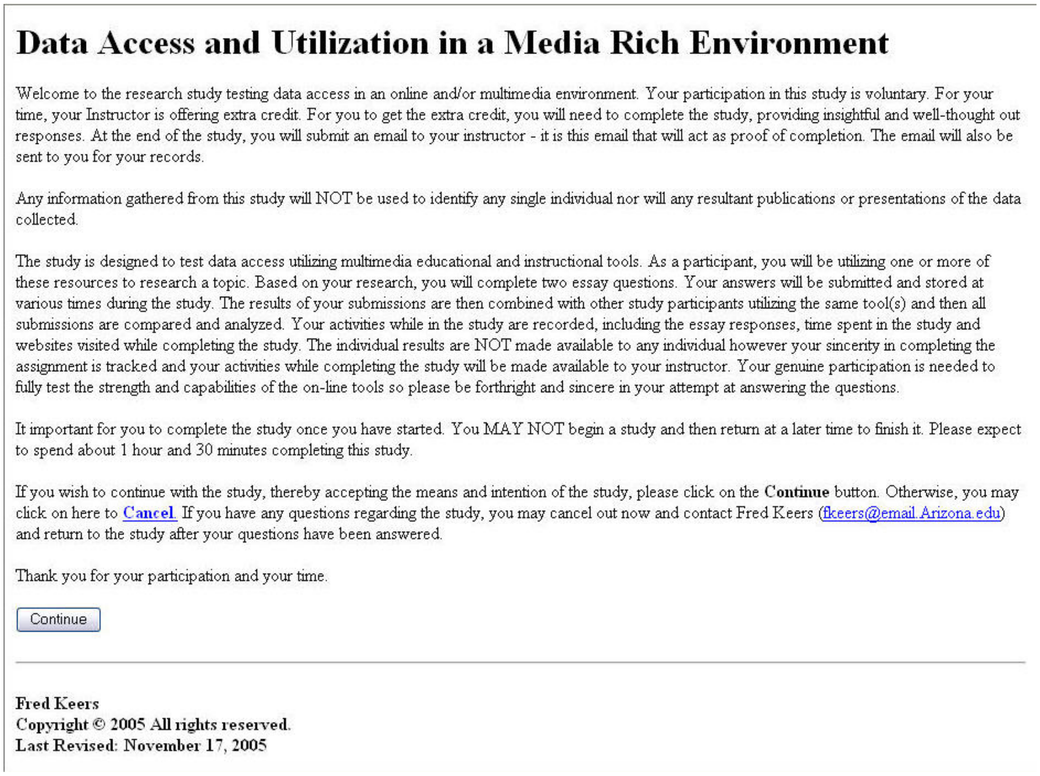


Figure 1: Initial Screen

In the first phase of the experiment, the students were given a task to research and respond to three construct-specific questions. The three questions and three corresponding response fields were located in the left-frame of the webpage. In answering the questions, students in the broad-topic resource condition were provided access to one resource through a hyperlink located in the right-frame (Figure 2) while students in the topic-specific resource condition were provided access to three resources (Figure 3). The students in both conditions were instructed to cite the reference in their essay response – an example of how to cite the reference was also provided in the right-frame.

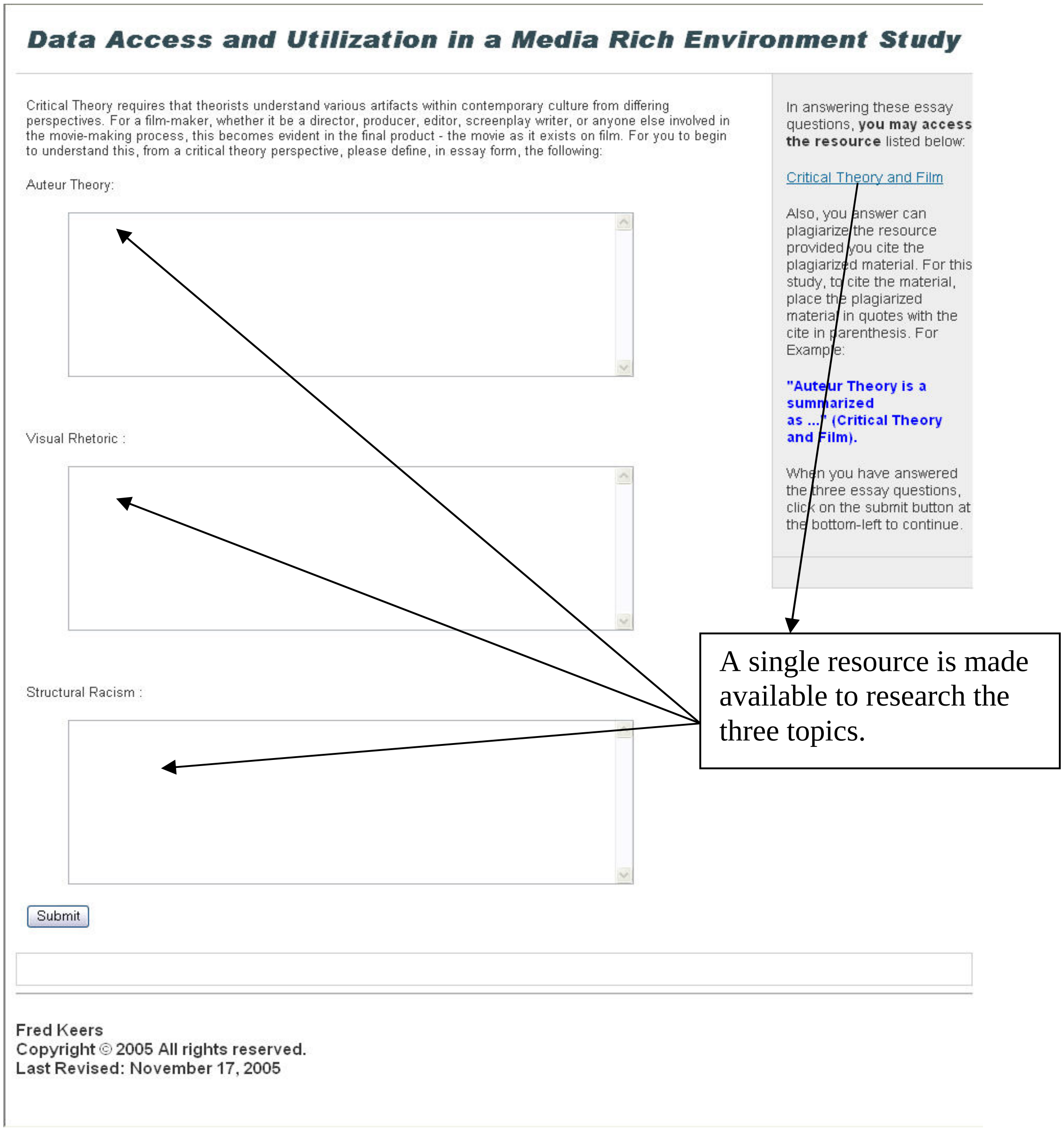


Figure 2: Task 1 w/Broad-topic Resource input screen

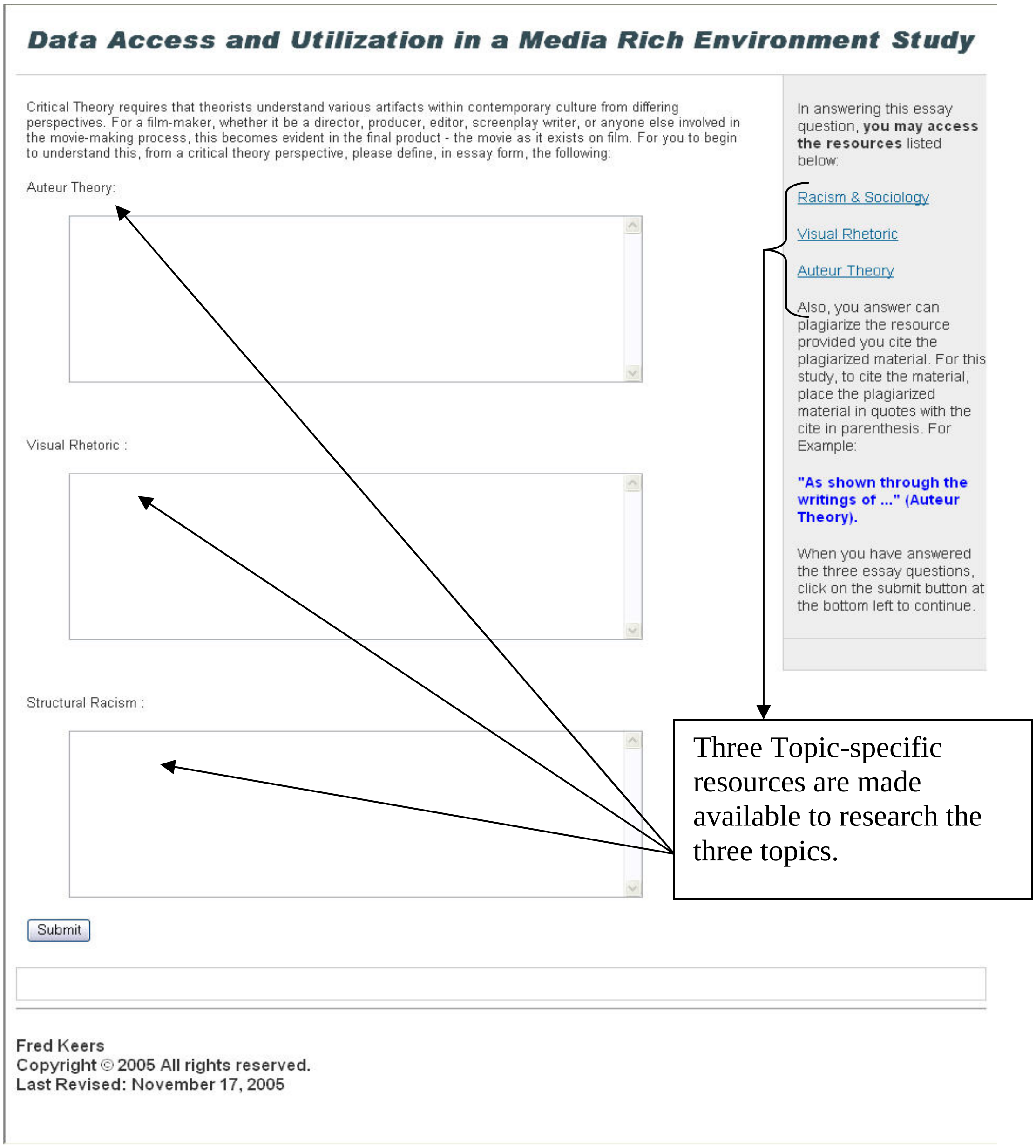


Figure 3: Task 1 w/Topic-specific Resources input screen

In selecting the hyperlink, the resource would open in the left-frame with a "return-to-essay" button displayed in the right-frame. (Figure 6, 7) By clicking on the "return-to-essay" button in the right-frame, the left-frame would re-display the construct-specific questions and the corresponding response fields – with any information the student had previously provided populating those fields; while the right-frame would re-display the hyperlink(s) to the available resources.

Once the student had finished answering the three questions, the student, irrespective of the condition, would click on the “submit answer” button located at the bottom of the left frame. Clicking on this button would save the student’s response in a text file, along with demographic data that identifies who is submitting the data. Also, clicking the “submit answer” button randomly assigned the student to either the broad-topic or topic-specific resource condition for the second phase of the study.

With the conclusion of the first phase of the study, the experiment immediately moves into the second phase where students competed the second task. The second task focused on a specific concept, requiring the student to synthesize the information from the available resource(s) into an illustrative, yet narrow – concise, essay-style answer. The responses were recorded and scored by the instructor.

In this phase of the experiment, the students researched and responded to one concept-based question. The question and corresponding response field was located in the left-frame of the webpage. In answering the question, students in the broad-topic resource condition were provided access to one resource through a hyperlink located in the right-frame (Figure 4) while students in the topic-specific resource condition were provided access to four resources (Figure 5). The students in both conditions were instructed to cite the reference in their essay response – an example of how to cite the reference was also provided in the right-frame.

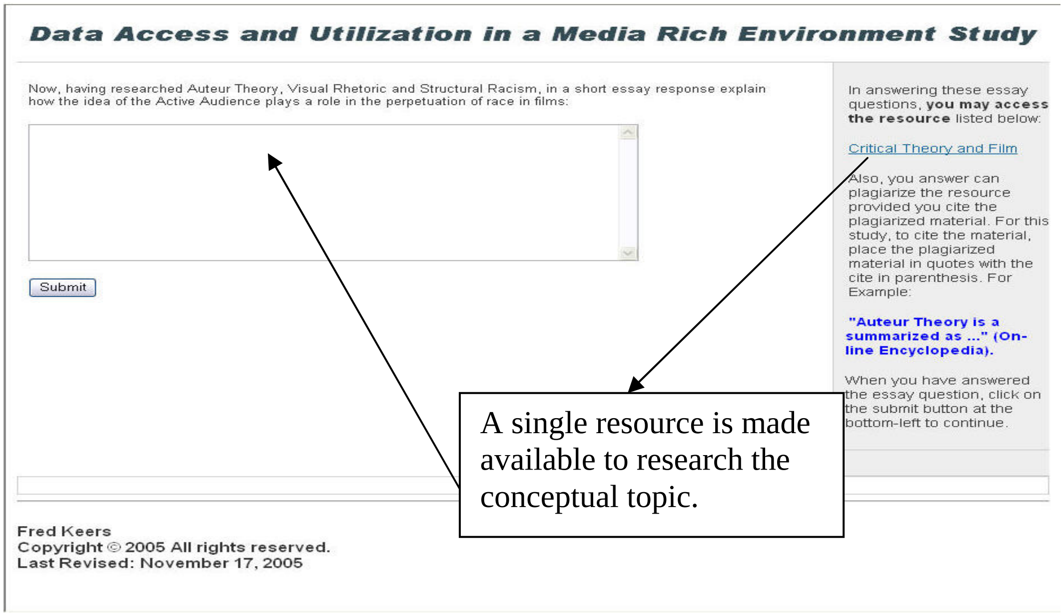


Figure 4: Task 2 w/Broad-topic Resource input screen

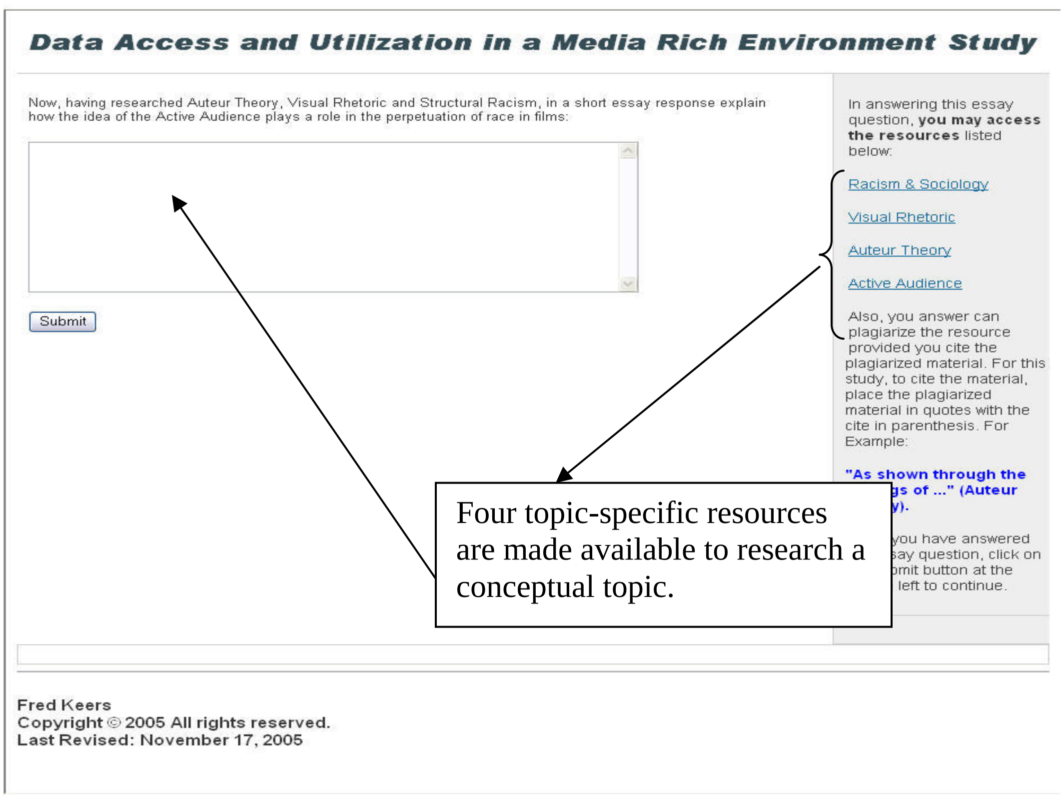


Figure 5: Task 2 w/Topic-specific Resources input screen

In selecting the hyperlink, the resource would open in the left-frame with a "return-to-essay" button displayed in the right-frame (Figure 6, 7). By clicking on the "return-to-essay" button in the right-frame, the left-frame would re-display the concept-style question and the corresponding response field – with any information the student had previously provided populating the field; while the right-frame would re-display the hyperlinks to the available resource(s).

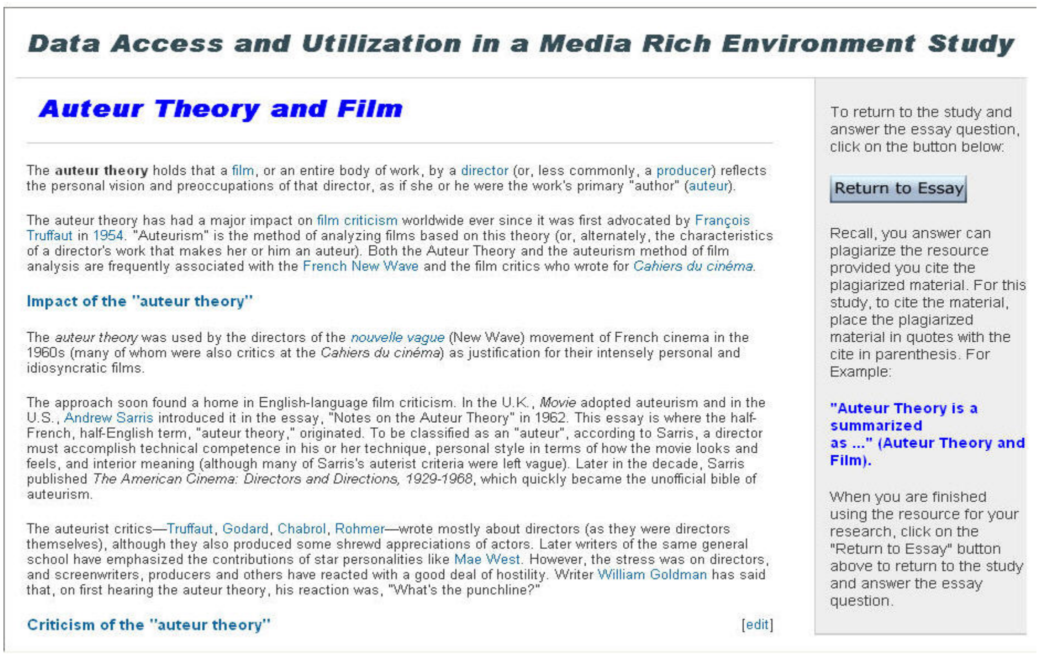


Figure 6: Example of a Specific Resource – Auteur Theory

Figure 7: Example of a Broad Topic Resource highlighting Auteur Theory

Once the student had finished answering the question, they would click on the "submit answer" button located at the bottom of the left frame. Clicking on this button would save the student's response in a text file, along with demographic data that identifies who is submitting the data.

In completing the second task, half of those assigned the broad-topic resource condition for the first task were provided access to the topic-specific resources condition, with the other half remaining in the broad-topic resource condition. The converse holds true for those in the topic-specific resources condition. Assignment to the resources for the second task was random within each condition, given their assignment in the first condition. Therefore, student access to data resources in completing both tasks was approximately: 25% had access to a broad-topic resource in completing both tasks, 25%

had access to topic-specific resources in completing both tasks, 25% had access to a broad-topic resource in completing the first task and topic-specific resources in completing the second task and 25% had access to topic-specific resources in completing the first task and a broad-topic resource in completing the second task.

After submitting their responses to the second research question, the students answered a set of exit survey questions. These questions measured the student's perception on the use of resources, the difficulty in answering the questions and the overall learning process. The experiment concluded with the submission of the student's survey responses.

Measures:

Student Demographics: Student demographics were collected at the beginning of the experiment through a user survey. The data collected was provided through a drop-down list of choices (Appendix G).

Student Survey Responses: Student survey responses were measured using a multi-item scale. Both Likert-type and semantic differential responses were scored on a 7-point scale. The questions were coded for each scale so that positive responses were higher valued scores.

Items within the Likert-type scale were specifically addressed to the overall learning space and the student's perception of knowledge transference. The scale ranged from "Strongly Disagree" to "Strongly Agree." The Semantic Differential Scales were used to measure task complexity and student use of resources. Items tracked were areas such as: “I find that in answering the Essay Questions, being able to copy the information into the answer makes the topic: (Difficult to Understand /Easy to Understand)” or “The “Copy and Paste” feature made the Resource(s) an: (Ineffective Research Tool/Effective Research Tool).” (Appendix H)

Grading of Essays: Essay submissions were captured in a text file using a PHP script. Students submitted their responses to the first essay question before starting work on the second essay ensuring that changes to the first essay question could not be made once the student moved onto the second phase of the experiment.

Essay responses were graded according to a four tier grading system (Appendix I). The four tier grading system scores essay responses based on relevance to answering the question, writing coherence, application of relevant research materials and writing style (Appendix I). Students were familiar with the grading scale having previously submitted two assignments as part of their normal class assignments that were graded in the same manner. The essay response grade is an average of the four scores. Both essay scores were average to create an overall assignment score.

Two teaching assistants with experience using the four-tier grading system graded the essays. The two graders each had three semesters of teaching experience where this form of grading was used. The graders, separately, graded a sample of the essays (n=15) and the Cronbach’s alpha, a reliability measure, was determined for each of the four grading criteria, the essay response grade and the overall assignment score. The alpha for all scores was above 0.70 and is included in the detailed statistical analysis listed in the appendix.

Student Tracking Measures: Student movement within the experiment was tracked through PHP scripts and a third party provider. The information was logged in a text file and used for statistical analysis.

The PHP scripts tracked the URL and time the student accessed each area of the experiment. The tracking began when the student elects to enter the research space, as referenced when they access the demographic information survey. The tracking ceased when the student submitted their user survey responses. Furthermore, whenever any information was saved to a text file (e.g. demographic information, essay responses or exit survey), the condition being tested, the URL and the time was included with the submitted information.

Experiment activity was also tracked through a third party, StatsCounter.com. StatsCounter.com provides a web tracker, a small piece of code to be placed on your website, that when executed, logs visitor's public details. This log file is stored and available for use at a later time. StatCounter.com's web tracker offers web site statistics such as visitor's referring link and visitor movement/time spent within the site. For this experiment, the student's movement was tracked. A text file logged what web pages were accessed and in what order.

Participation:

Students were assigned extra-credit for their participation in the experiment. The extra-credit amounted to approximately 10% of one assignment grade, or 3% of the student's course grade. The extra-credit was contingent on the student successfully completing the entire experiment and submitting insightful and well thought-out responses.

Students were told that the experiment would take approximately 1.5 hours to complete. Moreover, they were not allowed to exit the experiment to return at a later time. However, the experiment, itself, was not a timed experiment and the participant was not constrained to a set time limit.

Students were told before entering the experiment that their movements, within the study website or should the student access other URLs while participating in the experiment, would be tracked, as well as time spent within each phase of the experiment.

Statistical Analysis:

The raw data was captured through a PHP script and a third party web log file. Both data files were made available as a text file. The data, in text format, was then imported into Excel for data enhancement – specifically the determination of essay score averages and the two-essay overall average score. Finally, some data, specifically the number of URLs visited and during what phase of the experiment the URL was accessed, was tallied. All other data were left unchanged. The Excel file was then imported into SPSS for statistical analysis. The results of the analysis, in support of or counter to the previously identified hypotheses, follow.

CHAPTER 4:

RESULTS

Hypothesis 1 posited that students who are directed to the relevant research material would have a more favorable perception as to the effectiveness of the learning environment than students who are directed to a collection of relevant research material. To test this hypothesis, the experiment established two tracks for conducting research, one track providing the students a set of topic-specific resources that the students would access in researching the material and the other track providing the students a single broad-topic resource that the students would access in researching the material. Hypothesis 1, therefore, predicted that those students that are provided access to the topic-specific resources would have a more favorable perception of the learning environment than those students that are provided access to the broad-topic resource. The data supports Hypothesis 1 as analysis revealed significance for the qualitative perception measures the students provided regarding the learning processes as they pertain to specific learning features involved in the experiment (Appendix J for detailed results).

Hypothesis 2 predicted that students who are provided direct-access to relevant research material would undertake a greater level of research than students who are given broad-access to a collection of relevant research material. To test this hypothesis, the experiment tracked the student’s research method; recording time spent doing research and number of times the student accessed the research resources. Moreover, the students were divided between those who had access to the topic-specific resources and access to the broad-topic resource. Hypothesis 2, therefore, predicted that those students that are provided access to the topic-specific resources would spend more time conducting research and re-access the resources more than those students that are provided access to the broad-topic resource.

The data supports Hypothesis 2 as analysis revealed significance for the amount of time spent researching the topic (Essay 1: [$F(3, 190) = 26.412$, $p < 0.05$, sig = 0.000] and Essay 2: [$F(3, 190) = 84.6112$, $p < 0.05$, sig = 0.000]) and the numbers of times the student re-accessed the material while researching the topic (Essay 1: [$F(3, 190) = 34.312$, $p < 0.05$, sig = 0.000] and Essay 2: [$F(3, 190) = 14.490$, $p < 0.05$, sig = 0.000]). See Appendix J for full results. As the left chart in figure 8 indicates, in completing the first research task, students using topic-specific resources (Groups 3 and 4) revisited the resource more times than students using a broad-topic resource (Groups 1 and 2). The same is indicated in right chart of figure 8 for the second research task. Students using topic-specific resources (Groups 2 and 4) revisited the resource more times than students using a broad-topic resource (Groups 1 and 3).

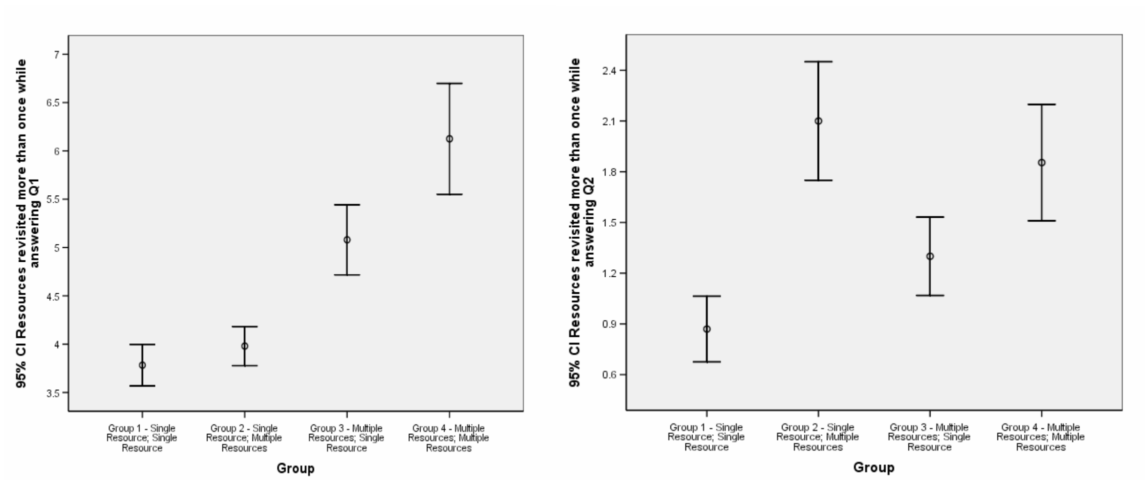


Figure 8: Resources Accessed while Conducting Research

Hypothesis 3a predicted that students who are directed to the topic-specific research material would provide more concise answers than students who are directed to a broad-topic research material. To test this hypothesis, the experiment graded the two essay submissions based on a 'written relevance' grading criteria (Appendix I). This grading measure is based on how well the research material supports the essay submission. It is expected that the two essay responses will show significance between the two types of resources used in conducting the research. Hypothesis 3a, therefore, predicted that those students that are provided access to the topic-specific resources would have a higher 'written relevance' score on the essays than those students that are provided access to the broad-topic resource.

The data supports Hypothesis 3a as analysis revealed significance for the 'written relevance' scoring measure used in grading both essay submissions. As table 2 indicates, the first essay 'written relevance' scores [$F(3, 190) = 2.490$, $p < 0.05$, sig = 0.042, α=0.988] are higher for those groups who are given access to a topic-specific resources (Group 3: mean = 80.12 and Group 4: mean = 84.04) than those given access to a broad-topic resource (Group 1: mean = 79.96 and Group 2: mean = 78.16). The same holds true for the second essay 'written relevance' score [$F(3, 190) = 3.366$, $p < 0.05$, sig = 0.020, α=0.986] as those given access to topic-specific resources (Group 2: mean = 87.76 and Group 4: mean = 87.67) have a higher essay scores than those given access to a broad-topic resource (Group 1: mean = 83.34 and Group 3: mean = 82.44). See Appendix J for full results.

		N	Mean	Std. Dev.	Std. Error	95% Confidence Interval for Mean		Min	Max
						Lower Bound	Upper Bound		
Relevance Score on Essay Question 1	Group 1	46	79.96	10.673	1.574	76.79	83.13	63	97
	Group 2	50	78.16	11.118	1.572	75.00	81.32	63	97
	Group 3	50	80.12	11.228	1.588	76.93	83.31	63	97
	Group 4	48	84.04	10.758	1.553	80.92	87.17	63	97
	Total	194	80.55	11.081	.796	78.98	82.12	63	97
Relevance Score on Essay Question 2	Group 1	46	83.43	10.249	1.511	80.39	86.48	67	97
	Group 2	50	87.76	11.182	1.581	84.58	90.94	67	97
	Group 3	50	82.44	11.234	1.589	79.25	85.63	67	97
	Group 4	48	87.67	9.687	1.398	84.85	90.48	67	97
	Total	194	85.34	10.819	.777	83.81	86.87	67	97

Table 2: H3a Results

Hypothesis 3b predicted that students who are directed to the content-specific research material would provide more accurate answers than students who are directed to a collection of relevant research material. To test this hypothesis, the experiment graded the two essay submissions based on a 'written research' grading criteria (Appendix I). This grading measure is based on the how thoroughly the research material is used within the essay submission. It is expected that the two essay responses will show significance between the two types of resources used in conducting research. Hypothesis 3b, therefore, predicted that those students that are provided access to the topic-specific resources would have a higher 'written research' score on the second essay than those students that are provided access to the broad-topic resource.

The data supports Hypothesis 3b as analysis revealed significance for the 'written research' scoring measure used in grading both essay submissions. As table 3 indicates, the first essay 'written research' scores [$F(3, 190) = 5.508$, $p <0.05$, sig = 0.001, α=0.993] are higher for those groups who are given access to a topic-specific resources (Group 3: mean = 77.52 and Group 4: mean = 82.58) than those given access to a broad-topic resource (Group 1: mean = 76.046 and Group 2: mean = 71.60). The same holds true for the second essay 'written research' score [$F(3, 190) = 12.193$, $p <0.05$, sig = 0.009, α=0.992] as those given access to topic-specific resources (Group 2: mean = 86.64 and Group 4: mean = 86.79) have a higher essay scores than those given access to a broad-topic resource (Group 1: mean = 83.48 and Group 3: mean = 81.92). See Appendix J for full results.

		N	Mean	Std. Dev.	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Min	Max
Use of Material Score on Essay Question 1	Group 1	46	76.04	13.385	1.973	74.07	82.02	63	97
	Group 2	50	71.60	13.182	1.864	67.85	75.35	63	97
	Group 3	50	77.52	13.802	1.952	73.60	81.44	63	97
	Group 4	48	82.58	13.079	1.888	78.79	86.38	63	97
	Total	194	77.37	13.835	.993	75.41	79.33	63	97
Use of Material Score on Essay Question 2	Group 1	46	83.48	10.601	1.563	80.33	86.63	63	97
	Group 2	50	86.64	12.147	1.718	83.19	90.09	63	97
	Group 3	50	81.92	11.926	1.687	78.53	85.31	63	97
	Group 4	48	86.79	10.705	1.545	83.68	89.90	63	97
	Total	194	84.71	11.494	.825	83.08	86.34	63	97

Table 3: H3b Results

Hypothesis 4 predicted that students who engage in research using a topic-specific resource would have a stronger comprehension of the learning objectives than students who engage in research using a broad-topic resource. To test this hypothesis, the experiment tested the overall grade of the student's essay submissions. It is expected that the average of the two essay responses, which requires a specific construct response followed by an insightful, illustrative conceptual response, will show overall significance between the two research methods. Hypothesis 4, therefore, predicted that those students that are provided access to the topic-specific resources (Group 4) in answering both essay questions would have a stronger level of material comprehension than those students that are provided access to the broad-topic resource (Group 1) in answering both questions. The data did not support Hypothesis 4 as analysis revealed no significance between groups for the overall scoring of the essay submissions [$F(1, 92) = 2.537$, $p < 0.05$, sig = 0.115, $\alpha=0.996$]. See Appendix J for full results.

As a post-script analysis to Hypothesis 4, statistical analysis was conducted on the level of improvement between the first task, researching and responding to a set of construct questions, and the second task, researching and responding to a conceptual question. This was performed post-script but deemed significant since the second task of the experiment was topically related to the first task. Therefore, as a corollary, Hypothesis 4(post-script) predicted that students using a topic-specific resource for their research in the second task would show greater improvement in material comprehension than students using the broad-topic resource for their research. To test this hypothesis, the experiment compared the student's essay grade improvement between first essay score and the second essay score. It is expected that the level of improvement will be statistically different since the students will already be familiar with the research process and, in accordance with Hypothesis 3a and 3b, the topic-specific resources provides heightened levels of comprehension.

The data did support Hypothesis 4(post-script) as analysis revealed significance for within-subject effects for the overall scoring of the essay submissions [$F(1, 190) = 43{,}790$, $p < 0.05$, sig = 0.000, $\alpha = 0.996$]. As table four indicates, students using a topic-specific resources (Groups 2 and 4) for their research showed the greatest level of improvement in completing the second task in the experiment than students using a broad-topic resource (Groups 1 and 3) for their research. Moreover, Group 2, those assigned a broad-topic resource for conducting research in the first task and a topic-specific resource for conducting research in the second task, had the greatest level of improvement in essay scores, increasing their average for a 77.95 on the first essay submission to a 87.05 on the second essay submission. See Appendix J for full results.

	Group	Mean	Std. Deviation	N
Graded Score on Essay Question 1	Group 1 - Single Resource; Single Resource	83.1957	9.19207	46
	Group 2 - Single Resource; Multiple Resources	77.9500	10.65136	50
	Group 3 - Multiple Resources; Single Resource	83.3900	9.48215	50
	Group 4 - Multiple Resources; Multiple Resources	86.5521	9.76927	48
	Total	82.7242	10.21225	194
Graded Score on Essay Question 2	Group 1 - Single Resource; Single Resource	85.4348	9.00346	46
	Group 2 - Single Resource; Multiple Resources	87.0500	11.48435	50
	Group 3 - Multiple Resources; Single Resource	85.1900	8.97325	50
	Group 4 - Multiple Resources; Multiple Resources	88.0104	9.64171	48
	Total	86.4253	9.83982	194

Table 4: H4(post-script) Results

CHAPTER 5:

DISCUSSION OF RESULTS

The data in support of Hypothesis 1 continues to validate the idea that students embrace the active learning process. The active learning model suggests that the student engages in various activities and uses various strategies to gather information and achieve understanding (Zimmerman, 1989). This experiment focused on the active learning process of topical research. As such, the students' use of the active learning tools, specifically the type of resource presented to the student, could have played a role in support for Hypothesis 1. Active learning endeavors should work on moving students through the course content (Oliver, 2000), and, as such, creating a directed learning path through the creation of topic-specific learning resources is a means for moving the students through the course content.

Interestingly, a vast majority of the student responses to the first essay question were "copy and paste" submissions. More that 90% of the students submitted their responses to the construct-based question as a "carbon copy" of the resource they used in researching the question. Yet, only 60% of them cited the resource, a requirement in the experiment if the student copied information into their response.

Students exposed to active learning approaches in their class tended to learn more than their counterparts in a regular lecture section of the course, yet they rated the instructor effectiveness lower than did students in the lecture section; some students made comments expressing doubts that they had really been "taught" anything (Lake, 2000).

For this experiment, the use of the "copy and paste" feature as an active learning activity established a relationship between the activity and the material to be understood, however since the first task in the learning process was construct development, very defined and rigid in knowledge transference, the activity seem to embrace "get it copied" as opposed to "get it understood." It was only through the second task, the conceptual task, which required the students to engage in various activities and use various strategies to gather information and achieve understanding. It is here where the type of active learning arises above the idea that students weren't "taught" anything since there was a clear distinction between those students who were given a generic (broad-topic) resource for conducting research and students who were given defined, topically-relevant (topic-specific) resources for conducting research.

Hypothesis 2 predicted that students who are provided direct-access to relevant research material would undertake a greater level of research than students who are given broad-access to a collection of relevant research material. The data supports this hypothesis. To the extent that the Internet provides resources to engage students actively in the learning process, its use in knowledge transference is likely to improve learning provided it presents a motivational learning activity for the student.

Students researching a topic, and using the web, tend to possess two motivational traits: goal-directed and experiential (Hoffman, 1996). For the purpose of this experiment, goal-directed usage of the Internet suggests that online users use the Internet in a way that is intentional and selective, and this usage reflects a purposive exposure to specific content (Stafford, 2001). As students engage in research, they have a specific goal in mind. The focus, therefore, is more on the use medium than on particular content and focuses on the gratifications offered by the medium itself (Stafford, 2001). Recognizing that the active learner is engaged in the learning process, their movement within the site as well as the time spent at the site indicates that medium is purposeful.

Students given direct access to the relevant material tend to spend more time researching the topic. On average those students spent 24 minutes researching the answer to the concept essay question, the second question in the experiment. Students directed to the collection of relevant material spent, on average, 17 minutes researching the answer to the second essay question. Since the information within both resources contains identical information and those directed to the relevant material do not need to search for the material, it is reasonable that those students spending more time are in fact using that time to absorb the material.

Furthermore, students given direct access to the relevant material tend to review the material more often when researching the topic. On average those students revisited the topic specific material 4 times, after their initial visit, when researching the answer to the concept essay question. Students directed to the broad-access collection of material revisited, on average, 2 times when researching the answer to the second essay question. Similar to time spent researching the material, it is reasonable that those students revisiting the site that contains the material are in fact revisiting the topic to absorb the material.

Hypotheses 2 was directed towards understanding how students access Internet based information and its relationship to their active learning strategies. Active learning embeds personal accountability and academic activity on the shoulders of the learner. Moreover, the student assumes responsibility because they perceive themselves as the learning catalyst. The student can use learning strategy and engage in activities to create environments that are conducive to the learning objectives (Zimmerman, 1989). The experiment supports this presupposition.

The active learning model suggests that the student engages in various activities, as discussed above, and uses various strategies to gather information and achieve understanding. So, simply presenting information or providing a means for learning isn't going to get the student to successfully comprehend the material. A strategy to gather information is required to achieve understanding. Hypotheses 3 and 4 analyze this assertion.

Hypothesis 3 predicted that students who are directed to the content-specific research material would provide more concise and accurate answers than students who are directed to general-purpose collection of relevant research material. The data supports this hypothesis. To the extent that the Internet provides hyperlinks as a means to engage students actively in the learning process, its use in knowledge transference is likely to improve learning if the learning path is directed as demonstrated through the responses students provided when submitting the essay answers.

Hypertext is a valuable means of representing and organizing information. It can be used to create a set of presentation materials that can be easily shared with both students and colleagues. More importantly, since the instructor establishes the hypertext link, hypertext can be integrated into the student's active learning strategies while retaining data validity. Through the use of hypertext, learning can be viewed from a reorganizational and generative perspective (Marsh, 1992). Since learning requires the student to be actively engaged, the knowledge must be reorganized as required. Learning through transitioning along a predetermined path is more effective than learning from programmed instruction. Hypermedia promotes effective learning in so far as users are engaged, actively, and making their own connections and integrations at the conceptual level (Moore, 1995). Also, learning is the process of constructing knowledge. In the study of a new concept, students can be actively encouraged to form a hypothesis, construct a model to make predictions, design and construct a corresponding experiment and analyze the results. Both perspectives are valuable in the design of a technology-enhanced learning environment. The reorganizational perspective is useful as a means of modeling the theoretical aspects of the knowledge domain. The generative perspective is valuable in modeling the experimental aspects of the course (Moore, 1995). The experiment supports this presupposition.

Significance between groups is present when considering the ‘written relevance’ score and ‘written research’ score. Students accessing the content-specific research material had higher average scores along both measures. All students had similar a means for answering the construct question, the first task. As shown in analysis of Hypothesis 1, this would be the “copy and paste” feature. The task required the students to define three constructs. However, based on the results, those provided topic-specific resources faired-better than those provided a broad-topic recourse, on both grading criterion. Moreover, answering the conceptual question, the second task in the experiment, use of the “copy and paste” feature could not be effectively utilized. The students accessing the topic-specific resource, again, had a higher aptitude in applying the material, demonstrating an increased abstract reasoning as indicated by the higher essay scores. This supports previous referenced assertions about the need for the pedagogical structure to embrace interactivity within a student-centered learning environment. For this experiment, the more effective learning-pedagogy was directing the students to the relevant resources using topic-specific resources. This strategy was effectively applied to both construct and conceptual development.

Hypothesis 4 predicted that students who engage in research using topic-specific resources would have a stronger comprehension of the learning objectives than students who engage in research using a broad-topic resource. A possible reason why the data does not support the hypothesis reverts back to the “copy and paste” ability in the experiment. Use of “copy and paste” in answering the first question might have tainted the student’s expectations in answering the second question. The experiment explicitly stated that the student should use the available resources to research the topic and, should the resource provide adequate material in response to the question, that the student should cite the resource. However, the grading criteria of the submission were not explicitly stated, nor were any active learning strategy in place to aid the student in writing their responses. Therefore, it is possible that the student presupposed that the experiment was meant to measure the use of the resource and not the student’s level of active learning.

What is interesting, however, is what falls out of aforementioned assumption – that being the students presupposition that the experiment was meant to measure the use of the resource. If the use of the resource was measured, then what is the effect of the use of the resource between task one and task two? This gives use Hypothesis 4 (post-script): identifying the student's level of improvement in answering the essay questions between task one and task two. Analysis of the data shows significance for within-subjects, with students showing the greatest level of improvement being those who were provided a broad-topic resource for task one and topic-specific resources for task two. Information retrieval is but one component of this process of information seeking and can be viewed as a means of communication (McArthur, 1998). Use of resources, therefore is not only a means for knowledge transference, but also a means for enforcing the pedagogy.

CHAPTER 6:

FUTURE DIRECTIONS

One of the shortcomings of Guided Design and Active Learning, as demonstrated in this experiment, is the lack of embracing the true power of the Internet. Evaluation of web sites is a skill that students, users of the Internet, require and thus necessitates additional considerations. Regardless of whether the user is considering use of data or of information, trust in the integrity of the data is contingent upon being able to first establish the legitimacy of the Web site. For example, Web sites that are developed and administered by organizations that are associated with governments are generally assumed to be trustworthy. However, other sites with the same name but a different domain often parody these sites. For example, Whitehouse.gov is a legitimate site that is a representation of the President of the United States but Whitehouse.org and Whitehouse.com are sites that do not necessary represent valid data repositories. Someone accessing these sites needs to learn a means for evaluating the integrity of these sites.

Additional problems that the user may encounter in evaluating the integrity of Web sites include poor documentation of the source of data and information on the Web site. The student should be concerned if there is an absence of information concerning copyright and security. Moreover, the web sites true location may be difficult to ascertain. A site professing to be a U.S. based government resource that contains material specific to some particular research interest may in fact be a web server housed in a small office in the Pacific rim, set up for the sole purpose of garnering and recording web traffic.

If the instructor limits the student's interaction with the Internet, albeit to enforce the pedagogical structure, then they are perhaps doing disservice to the student in the long run. Akin to the library, it is important to not only learn the material, it is also important to learn how to gain access to the material.

Secondly, in traditional courses, students spend an average of only three hours per week attending class but are nevertheless required or expected to spend several additional hours on their own time reading, researching, preparing assignments, and perhaps conferring with other students. And, in recent years, even campus-based students have come to rely on asynchronous e-mail conversations with faculty and other students rather than office appointments and meetings. Learning is now at a distance.

Research suggests that the learning outcomes of students using technology at a distance are similar to the learning outcomes of students who participate in conventional classroom instruction. The attitudes and satisfaction of students using distance learning also are characterized as generally positive. Moreover, regardless of the technology used, distance-learning courses compare favorably with classroom-based instruction and that distance learning students have similar grades or test scores to students in traditional courses.

Computer-based technology in general is changing the face of all education, on campus and off. Because this technology is so new, particularly Web-based instruction delivered over the Internet; there has been insufficient time and inadequate numbers of students and courses to rigorously evaluate distance education or the impact of technology. As such, research in distance education tends to emphasize student outcomes for individual courses rather than complete academic programs. What needs to be addressed is the students' mastery of a body of knowledge or their ability to apply this knowledge to other courses within an academic program. All in all, whether presented on campus or delivered through technology, entire academic programs, not just individual courses, should compare favorably with one another.

Finally, research does not account for the numerous variables that characterize students, such as previous exposure to the subject matter, individual learning styles, and motivation. Instead it tends to assume an illusory typical learner whose attributes are not well defined. The idea that knowledge is static fails to recognize the complexity of culture of understanding. We look to stratify the various component of the learning process in attempts to ease the knowledge transference process however, by doing this, we overlook the importance understanding just whom we are trying to teach. Human cognition is complex, and is evidenced by the various learning theories. There is a great deal of discussion concerning the need to center learning on abilities and not to worry so much about the acquisition of knowledge.

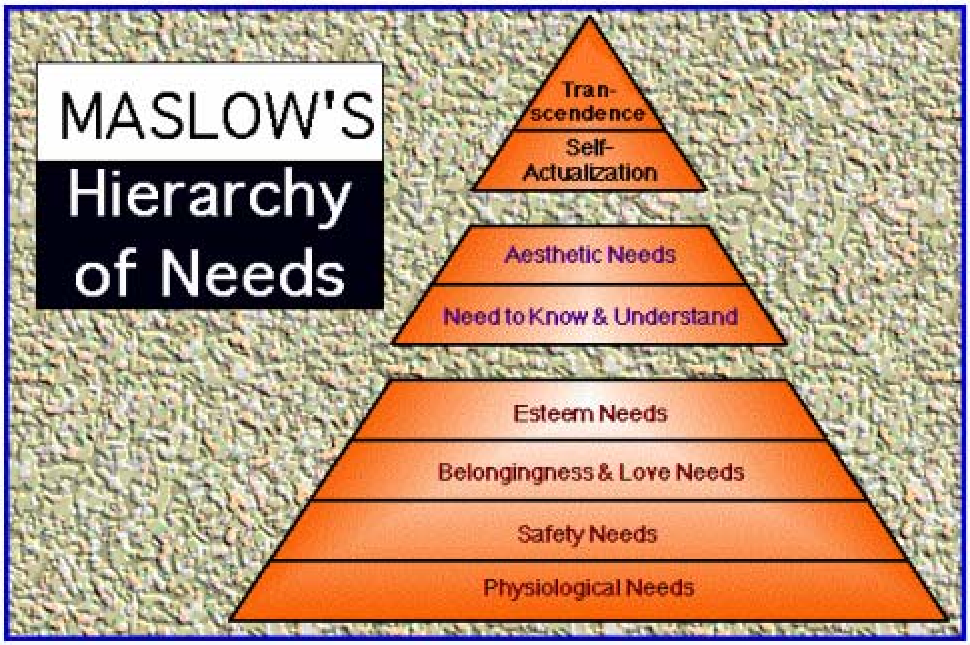
CHAPTER 7:

CONCLUSION

Research that attempts to compare technology-based teaching methods with "traditional" methods may not be asking the right question. The assumption is that traditional teaching methods are somehow a uniformly successful and proven standard against which to measure success in non-traditional classrooms. It attempts to measure technology-based teaching against a norm when there is no norm. Unfortunately, the process of teaching and learning is not generally a tidy or predictable process. Research needs to focus on specific teaching-learning methods, not on questions of media (Ehrmann, 1997). The right questions, therefore, concern instructional goals and classroom strategies for achieving those goals. Which teaching and learning strategies that are best for specific teaching and learning goals must be addressed first. Then which technology best supports these strategies can be addressed, even when addressing learning and teaching strategies that would not even be feasible without the newer technologies (Ehrmann, 1997). In other words, technology should be the servant not the master in the classroom.

The technology-driven learning space is a complex interface – this experiment focuses on a straightforward relationship between the data and the student, a first step in re-defining the learning space focusing on the pedagogy and not the technology. The pedagogical perspective becomes the integral component to a successful learning experience and toward that end implicitly compels the instructor to consider the lecture material from the perspective of the student in conjunction with the requirements of the task domain and the availability of the technology. Studying the presentation of the task domain will begin the arduous process of integrating the students into their own active learning space.

APPENDIX A: MASLOW'S HIERARCHY



Huitt, W. (2004). Maslow's hierarchy of needs. *Educational Psychology Interactive*. Valdosta, GA: Valdosta State University. Retrieved [March 25, 2006] from http://chiron.valdosta.edu/whuitt/col/regsys/maslow.html.

APPENDIX B: LEARNING THEORIES

Orientations to learning:

Aspect	**Behaviorist**	**Cognitivist**	**Constructivist**
Learning theorists	Thorndike, Pavlov, Watson, Guthrie, Hull, Tolman, Skinner	Koffka, Kohler, Lewin, Piaget, Ausubel, Bruner, Gagne	Maslow, Rogers
View of the learning process	Change in behavior	Internal mental process (including insight, information processing, memory, perception	A personal act to fulfill potential.
Locus of learning	Stimuli in external environment	Internal cognitive structuring	Affective and cognitive needs
Purpose in education	Produce behavioral change in desired direction	Develop capacity and skills to learn better	Become self-actualized, autonomous
Educator's role	Arranges environment to elicit desired response	Structures content of learning activity	Facilitates development of the whole person
Manifestations in adult learning	Behavioral objectives Competency -based education Skill development and training	Cognitive development Intelligence, learning and memory as function of age Learning how to learn	Andragogy Self-directed learning

Source: Smith, M. K. (1999) 'Learning theory', The Encyclopedia of Informal Education, Last update: January 30, 2005. Retrieved on March 30, 2006 from http://www.infed.org/biblio/b-learn.htm.

APPENDIX C: KEY CONCEPTS OF COGNITIVE LEARNING THEORY

- Schema - An internal knowledge structure. New information is compared to existing cognitive structures called "schema". Schema may be combined, extended or altered to accommodate new information.
- Three-Stage Information Processing Model - input first enters a sensory register, then is processed in short-term memory, and then is transferred to long-term memory for storage and retrieval.
- Sensory Register - receives input from senses, which lasts from less than a second to four seconds and then disappears through decay or replacement. Much of the information never reaches short-term memory but all information is monitored at some level and acted upon if necessary.
- Short-Term Memory (STM) - sensory input that is important or interesting is transferred from the sensory register to the STM. Memory can be retained here for up to 20 seconds or more if rehearsed repeatedly. Short-term memory can hold up to 7 plus or minus 2 items. STM capacity can be increased if material is chunked into meaningful parts.
- Long-Term Memory and Storage (LTM) - stores information from STM for long term use. Long-term memory has unlimited capacity. Some materials are "forced" into LTM by rote memorization and over learning. Deeper levels of processing such as generating linkages between old and new information are much better for successful retention of material.
- Meaningful Effects - Meaningful information is easier to learn and remember. (Cofer, 1971, in Good and Brophy, 1990) If a learner links relatively meaningless information with prior schema it will be easier to retain. (Wittrock, Marks, & Doctorow, 1975, in Good and Brophy, 1990)
- Serial Position Effects - It is easier to remember items from the beginning or end of a list rather than those in the middle of the list, unless that item is distinctly different.
- Practice Effects - Practicing or rehearsing improves retention especially when it is distributed practice. By distributing practices the learner associates the material with many different contexts rather than the one context afforded by mass practice.
- Transfer Effects - The effects of prior learning on learning new tasks or material.
- Interference Effects - Occurs when prior learning interferes with the learning of new material.
- Organization Effects - When a learner categorizes input such as a grocery list, it is easier to remember.
- Levels of Processing Effects - Words may be processed at a low-level sensory analysis of their physical characteristics to high-level semantic analysis of

their meaning. (Craik and Lockhart, 1972, in Good and Brophy, 1990) The more deeply a word is process the easier it will be to remember.

- State Dependent Effects - If learning takes place within a certain context it will be easier to remember within that context rather than in a new context.
- Mnemonic Effects - Mnemonics are strategies used by learners to organize relatively meaningless input into more meaningful images or semantic contexts. For example, the notes of a musical scale can be remembered by the rhyme: Every Good Boy Deserves Fruit.
- Schema Effects - If information does not fit a person's schema it may be more difficult for them to remember and what they remember or how they conceive of it may also be affected by their prior schema.
- Advance Organizers – Ausebel’s advance organizers prepare the learner for the material they are about to learn. They are not simply outlines of the material, but are material that will enable the student to make sense out of the lesson.

Source: Walker, James (1996). Relationships, Concepts and Thinking; The Psychology of Learning, (p. 269-307). Prentice Hall Publishing

APPENDIX D: ACTIVE LEARNING STRATEGIES

To facilitate student involvement, reflection, interaction, and enjoyment in the learning process, the following describes a number of cognitive learning strategies. These strategies represent modified lecture/discussion methods that require minimal resources.

- Clarification pauses. Break down content for the day's class into three 7 to 10-minute mini-lectures. At the end of each mini-lecture, give students 7 to 10-minutes to review their notes with partners. During this review, handle any questions or disputes and offer further clarification as needed. Strength: This is an excellent method for classes in which large amounts of factual information must be retained.
- Shared paragraph. At the end of a lecture, ask students to write one paragraph (in their own words) that explains the major concepts that were covered in class. Then, pair students with partners to share their paragraphs for clarification and editorial feedback. Upon leaving class, have students turn in their paragraphs, which will be reviewed and returned at the beginning of the next class. Strength: This strategy allows teachers to keep track of student learning in an ongoing fashion. If several of the students, paragraphs miss the point, it may be necessary to review the concepts before moving on.
- Application notes. At the end of a modified lecture, supply students with handouts that contain one to three application questions. Students select one of the three questions and write a paragraph explaining how they would apply the newly learned information to their daily lives (or to the real world). Students share their application paragraphs in small groups (3 to 4 students). At the end of the small group sharing, one application paragraph from each group is shared with the entire class. Strength: This technique requires students to use higher order thinking skills to apply concepts presented in class, and provides teachers with a way to check student understanding of the material.
- Study lecture. Structure lesson content into two short mini-lectures (10 to 15 minutes), each separated by a small group study session that is organized around a teacher - made handout (study guide). At the beginning of the next class, review the study guide and execute additional teaching or reinforcing of the content as needed. Strength: This method gives students the opportunity to reflect on, apply, and clarify concepts presented in class.
- Guided lecture. Students listen to a lecture for approximately half the class time without taking notes. At the end of the lecture, have students write down all the content they remember and then meet in small groups to clarify, elaborate, and rehearse the material. Strength: This method removes the attention-switching conflict between taking notes and listening to lecture, and often results in a better grasp of the interconnection among concepts.
- Fish bowl. Students prepare questions on 3" x 5" cards (one question per card), which are deposited in a fish bowl at the beginning of class. Draw a question from the fish bowl and read it to the class, giving students the opportunity to answer the

question. After class discussion, summarize the information supplied, and if necessary, provide an additional 5-minute mini-lecture to clarify the content. Rules: All students must deposit at least one 3" x 5" question card into the fish bowl, and questions should relate to class content. Strength. This is an excellent method for reviewing content previously covered that may still be unclear to students, or soliciting student questions in classes where students may avoid asking them to save face among their peers (e.g., human sexuality).

- Demonstration/finish the line. Provide a demonstration of a particular concept. Following the demonstration, have students write responses to sentence stems which appear on the chalkboard (e.g., I was surprised..., I learned..., I rediscovered..., I wonder..., I think I will..., etc.). Using a row-polling method, each student in a particular row shares his/her written response to one of the sentence stems. Then introduce, clarify, or discuss the content reflected in the demonstration. Strength. This is an excellent way to spur discussion about class content and involve students in the discovery of concepts.
- Cooperative/collaborative learning structures. While there are many cooperative and collaborative learning strategies, the structure I have used most often is shown in figure 1. As indicated, this strategy involves a circular flow pattern and proceeds in a step-like fashion. Although this structure can be used in different ways, die following example is based on its use as a collaborative learning strategy.

Source: Shakarian, Diana (1995). Beyond Lecture: Active Learning Strategies that Work. Journal of Education, Vol. 66, p.21-24

APPENDIX E: CONSTRUCTIVISM ASSUMPTIONS

The Assumptions of Constructivism - Merrill

- knowledge is constructed from experience
- learning is a personal interpretation of the world
- learning is an active process in which meaning is developed on the basis of experience
- conceptual growth comes from the negotiation of meaning, the sharing of multiple perspectives and the changing of our internal representations through collaborative learning
- learning should be situated in realistic settings; testing should be integrated with the task and not a separate activity

Source: Merrill, M. D. (1992). Constructivism and Instructional Design, Constructivism and the Technology of Instruction: A Conversation (p. 99-114). Lawrence Erlbaum Publishing.

APPENDIX F: DEMOGRAPHIC COMPOSITION OF STUDENTS

Demographic Statistics:

	N	Min	Max	Mean	Std. Dev.
Hours Spent/Week on a Computer	194	1	26	16.16	8.113
Hours Spent/Week on the Internet	194	0	26	12.76	7.511
Hours Spent/Week watching TV	194	0	26	8.51	7.255
Hours Spent/Week Playing Video Games	194	0	26	1.23	3.925
Hours Spent/Week Reading Books	194	0	26	7.21	5.898
Valid N (listwise)	194				

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	126	64.9	64.9	64.9
	Male	68	35.1	35.1	100.0
	Total	194	100.0	100.0	

Class

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Freshman	6	3.1	3.1	3.1
	Graduate	5	2.6	2.6	5.7
	Junior	53	27.3	27.3	33.0
	Other	6	3.1	3.1	36.1
	Senior	109	56.2	56.2	92.3
	Sophomore	15	7.7	7.7	100.0
	Total	194	100.0	100.0	

APPENDIX G: STUDENT DEMOGRAPHIC SURVEY:

- Student Gender (Male/Female)
- Grade Level (Freshman/Sophomore/Junior/Senior/Other)
- Number of on-line classes taken (List range: 0-7)
- Classes where Blackboard or WebCt were used in delivering lecture materials and/or class notes (list range: 0-7)
- Average hours, per week, spent on a computer (list range: 0-26)
- Average hours, per week, spent on the Internet (list range: 0-26)
- Average hours, per week, spent playing video games (list range: 0-26)
- Average hours, per week, spent watching TV (list range: 0-26)
- Average hours, per week, spent reading books or articles (list range: 0-26)
- Method of learning a new process (Mentoring - Watch someone demonstrate and then repeat the process yourself; Reading Manuals - Be instructed on how the process is completed and then repeat the process yourself; Team Learning - Participate as a team member and then try repeating the process on your own; Trial and Error - At first sight, try completing the process yourself; Another - I learn by another process than listed above)

APPENDIX H: STUDENT EXIT SURVEY QUESTIONNAIRE:

Specific to the Essay Questions (1 to 7 Semantic Differential Scale):

- I find that in answering the Essay Questions, being able to copy the information into the answer makes the topic: (Difficult to Understand /Easy to Understand)
- I find that in answering the Essay Questions, reading about the topic makes it a: (Frustrating Topic to Learn/Enjoyable Topic to Learn)
- I find that in answering the Essay Questions, I am: (Unable to provide a complete Answer/Able to provide a complete Answer)
- I find that in answering the Essay Questions, I did: (Did poorly on the Essay Answers/Did well on the Essay Answers)

Specific to the Research Resources (1 to 7 Semantic Differential Scale):

- The Resource(s) I used in answering the essay questions were: (Difficult to use/Easy to Use)
- The "Copy and Paste" feature made the Resource(s) an: (Ineffective Research Tool/Effective Research Tool)
- The Resource(s) I used in answering the essay questions: (Detracted from my Learning Experience/Enhanced my Learning Experience)
- The Resource(s) I used in answering the essay questions were: (Disorganized/Organized)
- The Resource(s) I used in answering the essay questions were an: (Inefficient use of my Time/Efficient use of my time)

Overall Study (1 to 7 Likert Scale):

1) The ability to copy the information from the resources made answering the questions easy and forthright: (Strongly Disagree/Strongly Agree)
2) Access to resources aid in understanding a topic or subject: (Strongly Disagree/Strongly Agree)
3) Having the resources readily available in answering the questions made the topic easier to understand: (Strongly Disagree/Strongly Agree)
4) Being able to "Copy and Paste" the information is the same as transcribing "facts" from a textbook: (Strongly Disagree/Strongly Agree)
5) The available resources were as effective as listening to a lecture in presenting the topics being researched: (Strongly Disagree/Strongly Agree)
6) As a result of my research, I am able to apply the concepts of the topic to another level of understanding such as the effects news media has on race: (Strongly Disagree/Strongly Agree)

7) I did better on the second essay question than the first question, specifically resulting from my access to the available resources: (Strongly Disagree/Strongly Agree)
8) The resources made *understanding* the essay questions easy: (Strongly Disagree/Strongly Agree)
9) The resources made *answering* the essay questions easy: (Strongly Disagree/Strongly Agree)
10) This method of learning helped me to understand the topic: (Strongly Disagree/Strongly Agree)

APPENDIX I: 4-TIER GRADING CRITERIA

Essay Reponses Grading Criteria

Grade	Score	Written Coherence	Written Relevance	Research	Writing Style
A+	97	Well Thought Out / Clear / Concise / Original	Well Supported Thorough and Concise	Thoroughly Covered All Points / Excellent	No Errors
A	95	Well Thought Out / Clear Or Original	Well Supported Thorough	Thoroughly Covered Most Points / Excellent	No Errors
A-	93	Well Thought Out	Well Supported	Thoroughly Covered All Points / Very Good	Error Or Two / Not Obvious
B+	87	Thought Out	Supported & Concise And Fairly Thorough	Covered All Points A Few Errors	Error Or Two / Obvious
B	85	Thought Out / Wordy	Supported & Fairly Thorough	Covered Some Points	Errors
B-	83	Interesting / Not Perfectly Clear	Competent	Competent	Good / A Few
C+	77	Uninspired / Clear	Competent / Bare	Competent / Bare	Fair / A Few Too Many Non-Obvious Errors
C	75	Uninspired / Not Perfectly Clear	Competent / Bare	Competent / Bare	Fair / A Few Too Many Obvious Errors
C-	73	Uninspired / Obtuse	Support Is Tenuous	Required More	Borderline
D+	67	Poorly Structured	Unsatisfactory	Unsatisfactory	Distracting
D	65	Banal / Not Clear	Unsatisfactory Confusing	Unsatisfactory Little Effort Shown	Distracting / Requires Writing Assessment
D-	63	One Or Two Redeeming Qualities	One Or Two Redeeming Qualities	One Or Two Redeeming Qualities	One Or Two Redeeming Qualities
F	0	Lacks Purpose	Lacks Purpose	Lacks Purpose	Lacks Purpose

APPENDIX J: SPSS STATISTICS

H1 Results:

Descriptives

		N	Mean	Std. Dev.	Std. Error	95% Confidence Interval for Mean		Min	Max
						Lower Bound	Upper Bound		
I find that in answering the Essay Questions, being able to copy the information into the answer makes the topic: (Difficult to Understand /Easy to Understand)	Group 1 - Single Resource; Single Resource	46	3.28	1.682	.248	2.78	3.78	1	7
	Group 4 - Multiple Resources; Multiple Resources	48	4.19	1.734	.250	3.68	4.69	1	7
	Total	94	3.74	1.759	.181	3.38	4.11	1	7
I find that in answering the Essay Questions, reading about the topic makes it a: (Frustrating Topic to Learn/Enjoyable Topic to Learn)	Group 1 - Single Resource; Single Resource	46	2.87	1.796	.265	2.34	3.40	1	7
	Group 4 - Multiple Resources; Multiple Resources	48	4.21	1.501	.217	3.77	4.64	1	7
	Total	94	3.55	1.776	.183	3.19	3.92	1	7
The Resource(s) I used in answering the essay questions were: (Difficult to use/Easy to Use)	Group 1 - Single Resource; Single Resource	46	1.74	1.144	.169	1.40	2.08	1	6
	Group 4 - Multiple Resources; Multiple Resources	48	3.13	1.214	.175	2.77	3.48	1	6
	Total	94	2.45	1.365	.141	2.17	2.73	1	6
The "Copy and Paste" feature made the Resource(s) an: (Ineffective Research Tool/Effective Research Tool)	Group 1 - Single Resource; Single Resource	46	1.89	1.286	.190	1.51	2.27	1	6

		N	Mean	Std. Dev.	Std. Error	95% Confidence Interval for Mean		Min	Max
	Group 4 - Multiple Resources; Multiple Resources	48	3.02	1.550	.224	2.57	3.47	1	5
	Total	94	2.47	1.529	.158	2.15	2.78	1	6
The Resource(s) I used in answering the essay questions: (Detracted from my Learning Experience/Enhanced my Learning Experience)	Group 1 - Single Resource; Single Resource	46	1.98	1.406	.207	1.56	2.40	1	7
	Group 4 - Multiple Resources; Multiple Resources	48	3.40	1.512	.218	2.96	3.83	1	6
	Total	94	2.70	1.619	.167	2.37	3.03	1	7
The Resource(s) I used in answering the essay questions were: (Disorganized/Organized)	Group 1 - Single Resource; Single Resource	46	2.11	1.215	.179	1.75	2.47	1	5
	Group 4 - Multiple Resources; Multiple Resources	48	3.19	1.232	.178	2.83	3.55	1	6
	Total	94	2.66	1.332	.137	2.39	2.93	1	6
The Resource(s) I used in answering the essay questions were an: (Inefficient use of my Time/Efficient use of my time)	Group 1 - Single Resource; Single Resource	46	1.93	1.124	.166	1.60	2.27	1	4
	Group 4 - Multiple Resources; Multiple Resources	48	2.98	1.407	.203	2.57	3.39	1	6
	Total	94	2.47	1.373	.142	2.19	2.75	1	6
Access to resources aid in understanding a topic or subject: (Strongly Disagree/Strongly Agree)	Group 1 - Single Resource; Single Resource	46	2.17	1.387	.205	1.76	2.59	1	6
	Group 4 - Multiple Resources; Multiple Resources	48	2.81	1.424	.206	2.40	3.23	1	7
	Total	94	2.50	1.435	.148	2.21	2.79	1	7

		N	Mean	Std. Dev.	Std. Error	95% Confidence Interval for Mean		Min	Max
Being able to "Copy and Paste" the information is the same as transcribing "facts" from a textbook: (Strongly Disagree/Strongly Agree)	Group 1 - Single Resource; Single Resource	46	1.87	1.240	.183	1.50	2.24	1	6
	Group 4 - Multiple Resources; Multiple Resources	48	3.02	1.591	.230	2.56	3.48	1	6
	Total	94	2.46	1.536	.158	2.14	2.77	1	6
The available resources were as effective as listening to a lecture in presenting the topics being researched: (Strongly Disagree/Strongly Agree)	Group 1 - Single Resource; Single Resource	45	2.98	1.685	.251	2.47	3.48	1	7
	Group 4 - Multiple Resources; Multiple Resources	48	4.06	1.961	.283	3.49	4.63	1	7
	Total	93	3.54	1.903	.197	3.15	3.93	1	7
As a result of my research, I am able to apply the concepts of the topic to another level of understanding such as the effects news media has on race: (Strongly Disagree/Strongly Agree)	Group 1 - Single Resource; Single Resource	46	2.54	1.456	.215	2.11	2.98	1	7
	Group 4 - Multiple Resources; Multiple Resources	48	3.29	1.543	.223	2.84	3.74	1	7
	Total	94	2.93	1.540	.159	2.61	3.24	1	7
The resources made answering the essay questions easy: (Strongly Disagree/Strongly Agree)	Group 1 - Single Resource; Single Resource	46	3.35	1.767	.260	2.82	3.87	1	7
	Group 4 - Multiple Resources; Multiple Resources	48	4.13	1.593	.230	3.66	4.59	1	6
	Total	94	3.74	1.716	.177	3.39	4.10	1	7

		N	Mean	Std. Dev.	Std. Error	95% Confidence Interval for Mean		Min	Max
This method of learning helped me to understand the topic: (Strongly Disagree/Strongly Agree)	Group 1 - Single Resource; Single Resource	46	2.57	1.470	.217	2.13	3.00	1	7
	Group 4 - Multiple Resources; Multiple Resources	48	4.06	1.630	.235	3.59	4.54	1	7
	Total	94	3.33	1.719	.177	2.98	3.68	1	7

<u>ANOVA</u>

		Sum of Squares	df	Mean Square	F	Sig.
I find that in answering the Essay Questions, being able to copy the information into the answer makes the topic: (Difficult to Understand /Easy to Understand)	Between Groups	19.234	1	19.234	6.587	.012
	Within Groups	268.639	92	2.920		
	Total	287.872	93			
I find that in answering the Essay Questions, reading about the topic makes it a: (Frustrating Topic to Learn/Enjoyable Topic to Learn)	Between Groups	42.100	1	42.100	15.423	.000
	Within Groups	251.134	92	2.730		
	Total	293.234	93			
The Resource(s) I used in answering the essay questions were: (Difficult to use/Easy to Use)	Between Groups	45.114	1	45.114	32.396	.000
	Within Groups	128.120	92	1.393		
	Total	173.234	93			
The "Copy and Paste" feature made the Resource(s) an: (Ineffective Research Tool/Effective Research Tool)	Between Groups	29.969	1	29.969	14.710	.000
	Within Groups	187.436	92	2.037		
	Total	217.404	93			
The Resource(s) I used in answering the essay questions: (Detracted from my Learning Experience/Enhanced my Learning Experience)	Between Groups	47.202	1	47.202	22.105	.000
	Within Groups	196.457	92	2.135		
	Total	243.660	93			

		Sum of Squares	df	Mean Square	F	Sig.
The Resource(s) I used in answering the essay questions were: (Disorganized/Organized)	Between Groups	27.337	1	27.337	18.255	.000
	Within Groups	137.769	92	1.497		
	Total	165.106	93			
The Resource(s) I used in answering the essay questions were an: (Inefficient use of my Time/Efficient use of my time)	Between Groups	25.621	1	25.621	15.737	.000
	Within Groups	149.784	92	1.628		
	Total	175.404	93			
Access to resources aid in understanding a topic or subject: (Strongly Disagree/Strongly Agree)	Between Groups	9.579	1	9.579	4.844	.030
	Within Groups	181.921	92	1.977		
	Total	191.500	93			
Being able to "Copy and Paste" the information is the same as transcribing "facts" from a textbook: (Strongly Disagree/Strongly Agree)	Between Groups	31.133	1	31.133	15.219	.000
	Within Groups	188.197	92	2.046		
	Total	219.330	93			
The available resources were as effective as listening to a lecture in presenting the topics being researched: (Strongly Disagree/Strongly Agree)	Between Groups	27.328	1	27.328	8.133	.005
	Within Groups	305.790	91	3.360		
	Total	333.118	92			
As a result of my research, I am able to apply the concepts of the topic to another level of understanding such as the effects news media has on race: (Strongly Disagree/Strongly Agree)	Between Groups	13.149	1	13.149	5.835	.018
	Within Groups	207.330	92	2.254		
	Total	220.479	93			
The resources made answering the essay questions easy: (Strongly Disagree/Strongly Agree)	Between Groups	14.188	1	14.188	5.026	.027
	Within Groups	259.685	92	2.823		
	Total	273.872	93			
This method of learning helped me to understand the topic: (Strongly Disagree/Strongly Agree)	Between Groups	52.660	1	52.660	21.811	.000
	Within Groups	222.117	92	2.414		
	Total	274.777	93			

H2 Results:

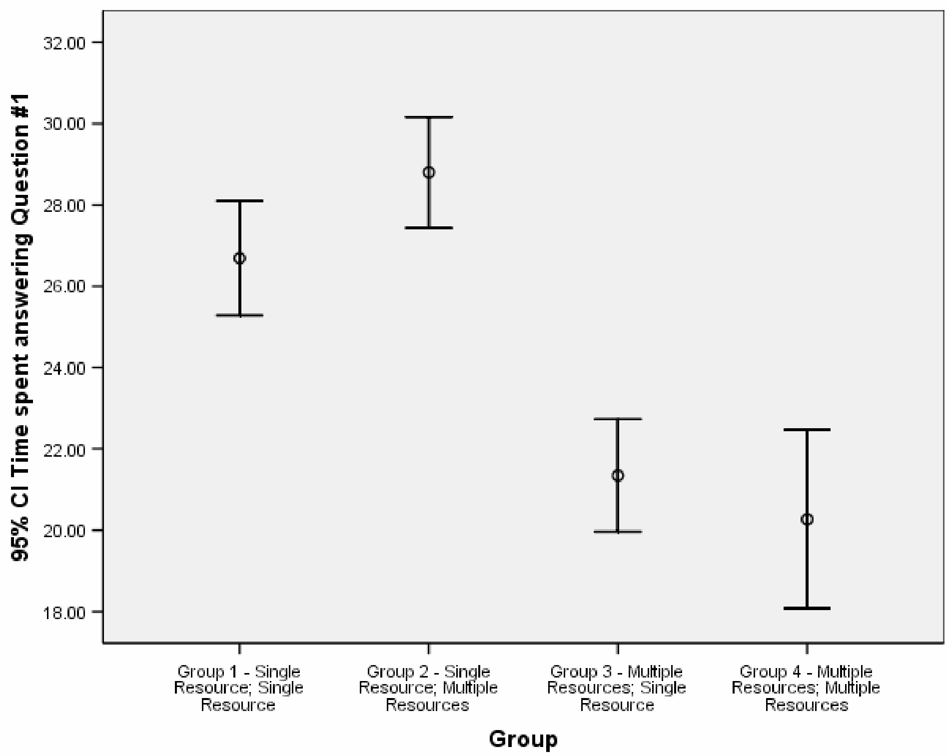
Descriptives

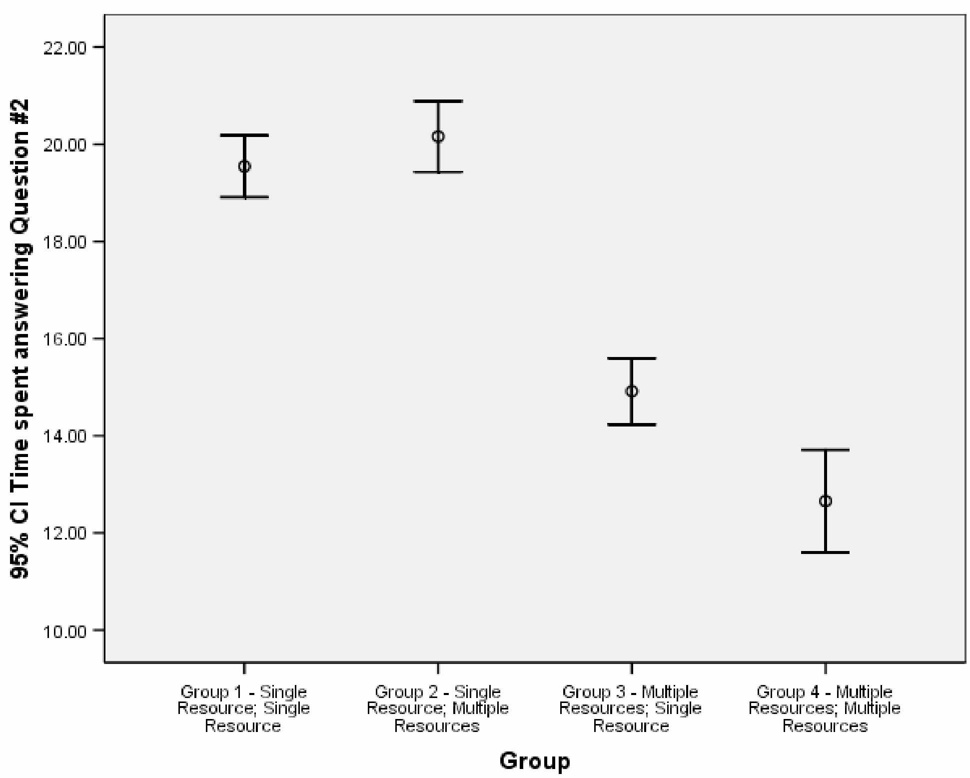
		N	Mean	Std. Dev	Std. Error	95% Confidence Interval for Mean		Min	Max
						Lower Bound	Upper Bound		
Time spent answering Question #1	Group 1	46	26.6884	4.73079	.69752	25.2835	28.0932	15.52	36.00
	Group 2	50	28.8018	4.80877	.68006	27.4352	30.1684	19.41	37.92
	Group 3	50	21.3426	4.85855	.68710	19.9618	22.7233	12.07	32.56
	Group 4	48	20.2678	7.55362	1.0902	18.0745	22.4612	10.62	39.72
	Total	194	24.2667	6.62535	.47567	23.3285	25.2049	10.62	39.72
Time spent answering Question #2	Group 1	46	19.5438	2.14780	.31668	18.9059	20.1816	15.11	23.06
	Group 2	50	20.1588	2.55799	.36175	19.4319	20.8858	16.07	23.81
	Group 3	50	14.9160	2.39862	.33922	14.2343	15.5977	10.16	18.62
	Group 4	48	12.6554	3.63589	.52480	11.5997	13.7112	7.59	21.44
	Total	194	16.8052	4.16240	.29884	16.2158	17.3946	7.59	23.81
Resources revisited more than once while answering Q1	Group 1	46	3.78	.728	.107	3.57	4.00	3	5
	Group 2	50	3.98	.714	.101	3.78	4.18	3	5
	Group 3	50	5.08	1.275	.180	4.72	5.44	3	7
	Group 4	48	6.13	1.975	.285	5.55	6.70	3	9
	Total	194	4.75	1.578	.113	4.52	4.97	3	9
Resources revisited more than once while answering Q2	Group 1	46	.87	.653	.096	.68	1.06	0	2
	Group 2	50	2.10	1.233	.174	1.75	2.45	0	4
	Group 3	50	1.30	.814	.115	1.07	1.53	0	3
	Group 4	48	1.85	1.185	.171	1.51	2.20	0	4
	Total	194	1.54	1.106	.079	1.38	1.70	0	4

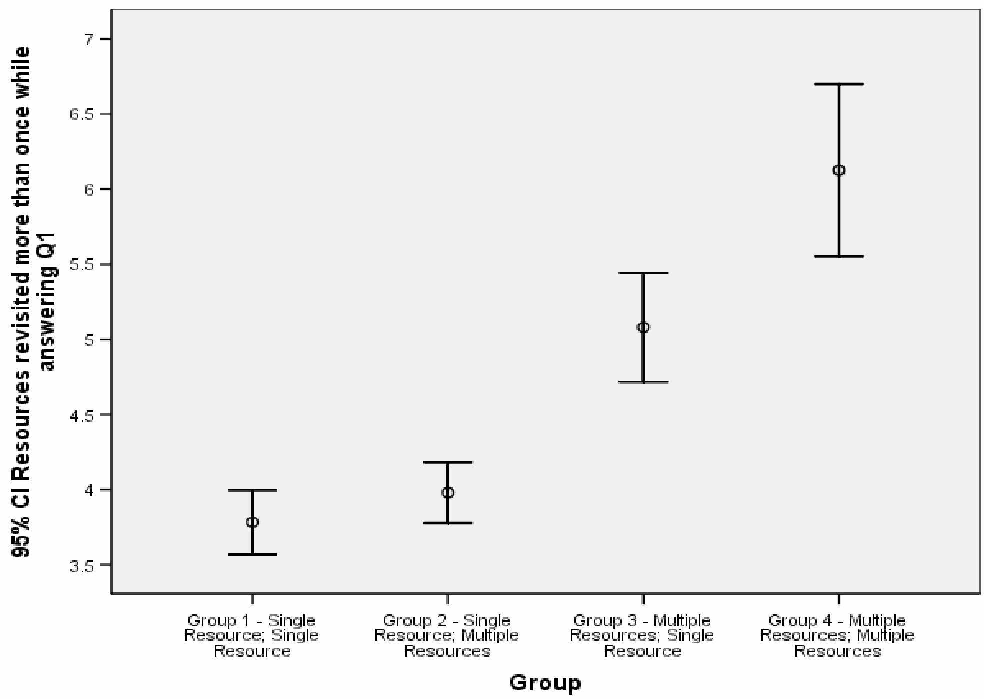
Links outside of the study space accessed while in the study (Most prominent - YAHOO Search and email)	Group 1	46	.07	.327	.048	-.03	.16	0	2
	Group 2	50	.08	.340	.048	-.02	.18	0	2
	Group 3	50	.28	.536	.076	.13	.43	0	2
	Group 4	48	.13	.393	.057	.01	.24	0	2
	Total	194	.14	.415	.030	.08	.20	0	2

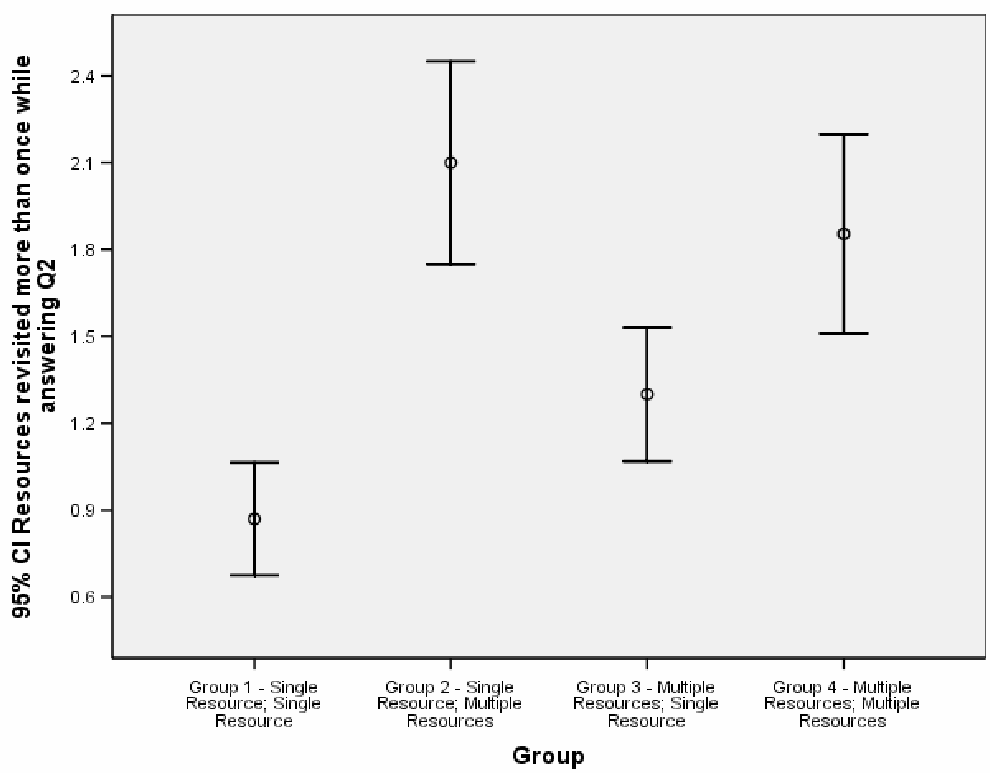
ANOVA

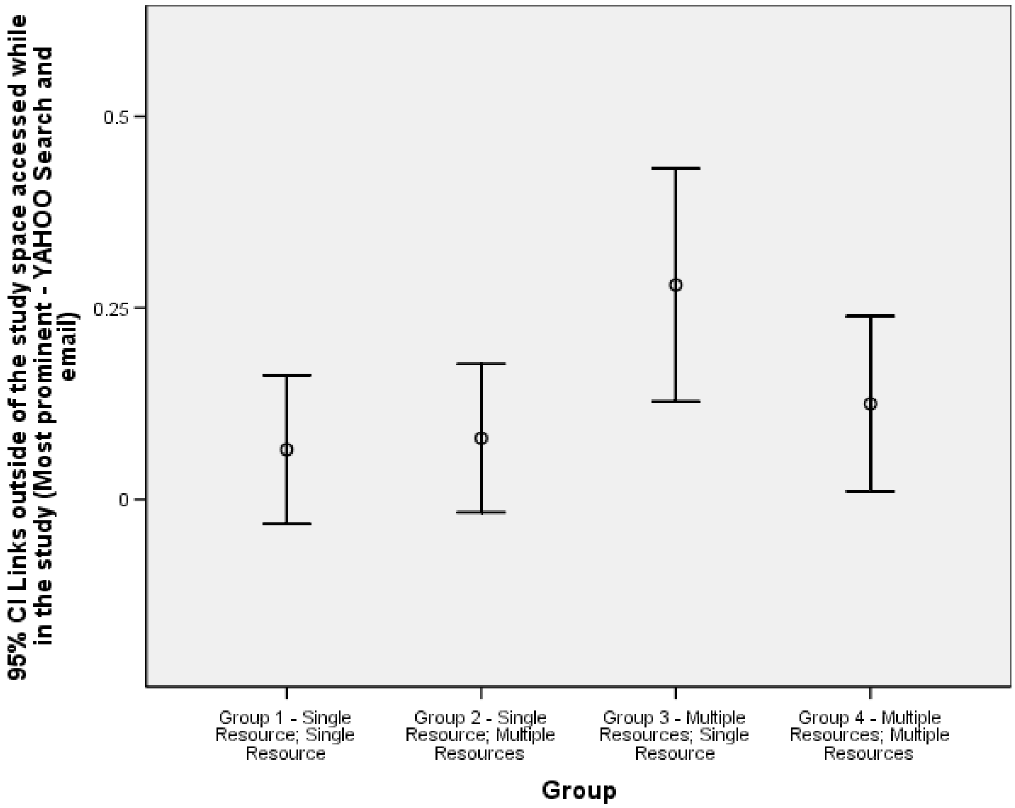
		Sum of Squares	df	Mean Square	F	Sig.
Time spent answering Question #1	Between Groups	2493.218	3	831.073	26.412	.000
	Within Groups	5978.564	190	31.466		
	Total	8471.782	193			
Time spent answering Question #2	Between Groups	1912.382	3	637.461	84.612	.000
	Within Groups	1431.450	190	7.534		
	Total	3343.832	193			
Resources revisited more than once while answering Q1	Between Groups	168.888	3	56.296	34.312	.000
	Within Groups	311.736	190	1.641		
	Total	480.624	193			
Resources revisited more than once while answering Q2	Between Groups	43.974	3	14.658	14.490	.000
	Within Groups	192.197	190	1.012		
	Total	236.170	193			
Links outside of the study space accessed while in the study (Most prominent - YAHOO Search and email)	Between Groups	1.428	3	.476	2.843	.039
	Within Groups	31.814	190	.167		
	Total	33.242	193			


95% CI Time spent answering Question #1
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
Group 1 - Single Resource; Single Resource
Group 2 - Single Resource; Multiple Resources
Group 3 - Multiple Resources; Single Resource
Group 4 - Multiple Resources; Multiple Resources
Group


95% CI Time spent answering Question #2
22.00
20.00
18.00
16.00
14.00
12.00
10.00
Group 1 - Single Resource; Single Resource
Group 2 - Single Resource; Multiple Resources
Group 3 - Multiple Resources; Single Resource
Group 4 - Multiple Resources; Multiple Resources
Group


95% CI Resources revisited more than once while answering Q1
7
6.5
6
5.5
5
4.5
4
3.5
Group 1 - Single Resource; Single Resource
Group 2 - Single Resource; Multiple Resources
Group 3 - Multiple Resources; Single Resource
Group 4 - Multiple Resources; Multiple Resources
Group


95% CI Resources revisited more than once while answering Q2
2.4
2.1
1.8
1.5
1.2
0.9
0.6
Group 1 - Single Resource; Single Resource
Group 2 - Single Resource; Multiple Resources
Group 3 - Multiple Resources; Single Resource
Group 4 - Multiple Resources; Multiple Resources
Group



95% CI Links outside of the study space accessed while in the study (Most prominent - YAHOO Search and email)
0.5
0.25
0
Group 1 - Single Resource; Single Resource
Group 2 - Single Resource; Multiple Resources
Group 3 - Multiple Resources; Single Resource
Group 4 - Multiple Resources; Multiple Resources
Group

H3a Results:

Descriptives

		N	Mean	Std. Dev.	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Min	Max
Relevance Score on Essay Question 1	Group 1	46	79.96	10.673	1.574	76.79	83.13	63	97
	Group 2	50	78.16	11.118	1.572	75.00	81.32	63	97
	Group 3	50	80.12	11.228	1.588	76.93	83.31	63	97
	Group 4	48	84.04	10.758	1.553	80.92	87.17	63	97
	Total	194	80.55	11.081	.796	78.98	82.12	63	97
Relevance Score on Essay Question 2	Group 1	46	83.43	10.249	1.511	80.39	86.48	67	97
	Group 2	50	87.76	11.182	1.581	84.58	90.94	67	97
	Group 3	50	82.44	11.234	1.589	79.25	85.63	67	97
	Group 4	48	87.67	9.687	1.398	84.85	90.48	67	97
	Total	194	85.34	10.819	.777	83.81	86.87	67	97

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Relevance Score on Essay Question 1	Between Groups	896.253	3	298.751	2.490	.042
	Within Groups	22799.830	190	119.999		
	Total	23696.082	193			
Relevance Score on Essay Question 2	Between Groups	1140.135	3	380.045	3.366	.020
	Within Groups	21449.411	190	112.892		
	Total	22589.546	193			

Reliability Analysis: Essay Question #1 – Relevance Score

Case Processing Summary

		N	%
Cases	Valid	15	7.7
	Excluded (a)	179	92.3
	Total	194	100.0

a Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.988	2

Reliability Analysis: Essay Question #2 – Relevance Score

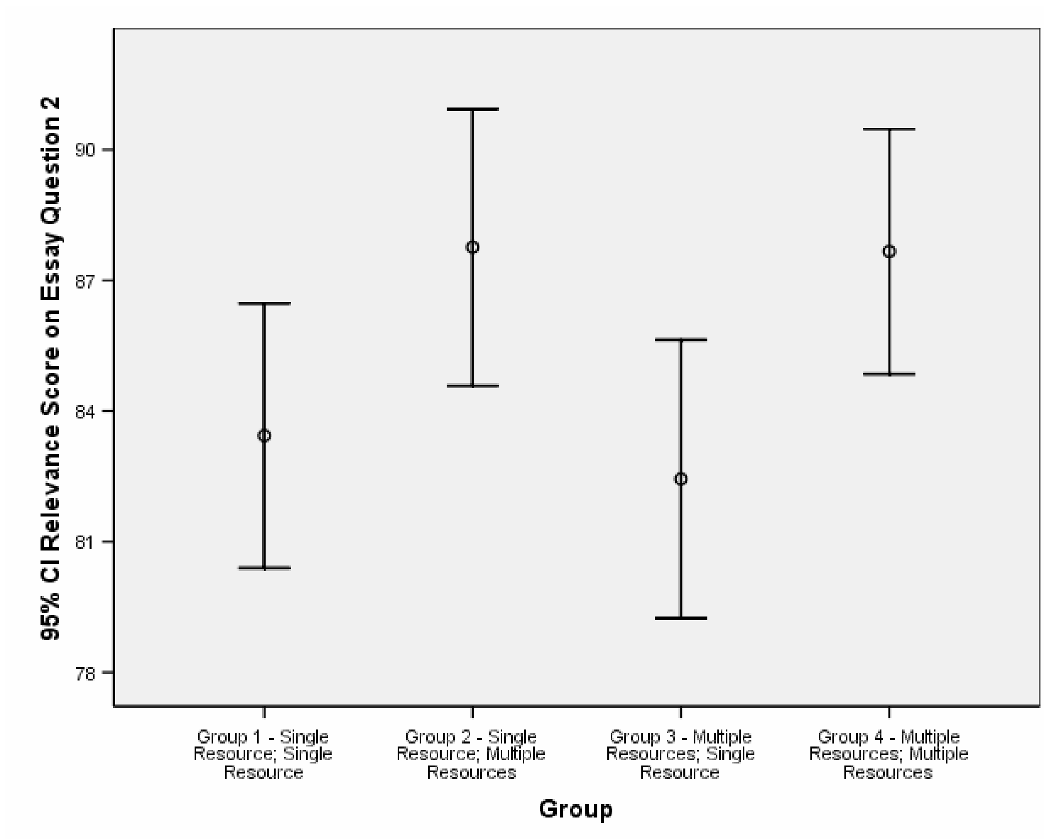
Case Processing Summary

		N	%
Cases	Valid	15	7.7
	Excluded (a)	179	92.3
	Total	194	100.0

a Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.986	2



H3b Results:

Descriptives

		N	Mean	Std. Dev.	Std. Error	95% Confidence Interval for Mean		Min	Max
						Lower Bound	Upper Bound		
Use of Material Score on Essay Question 1	Group 1	46	78.04	13.385	1.973	74.07	82.02	63	97
	Group 2	50	71.60	13.182	1.864	67.85	75.35	63	97
	Group 3	50	77.52	13.802	1.952	73.60	81.44	63	97
	Group 4	48	82.58	13.079	1.888	78.79	86.38	63	97
	Total	194	77.37	13.835	.993	75.41	79.33	63	97
Use of Material Score on Essay Question 2	Group 1	46	83.48	10.601	1.563	80.33	86.63	63	97
	Group 2	50	86.64	12.147	1.718	83.19	90.09	63	97
	Group 3	50	81.92	11.926	1.687	78.53	85.31	63	97
	Group 4	48	86.79	10.705	1.545	83.68	89.90	63	97
	Total	194	84.71	11.494	.825	83.08	86.34	63	97

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Use of Material Score on Essay Question 1	Between Groups	2991.219	3	997.073	5.580	.001
	Within Groups	33950.060	190	178.685		
	Total	36941.278	193			
Use of Material Score on Essay Question 2	Between Groups	853.240	3	284.413	12.193	.009
	Within Groups	24642.595	190	129.698		
	Total	25495.835	193			

Reliability Analysis: Essay Question #1 – Use of Material Score

Case Processing Summary

		N	%
Cases	Valid	15	7.7
	Excluded (a)	179	92.3
	Total	194	100.0

a Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.993	2

Reliability Analysis: Essay Question #2 – Use of Material Score

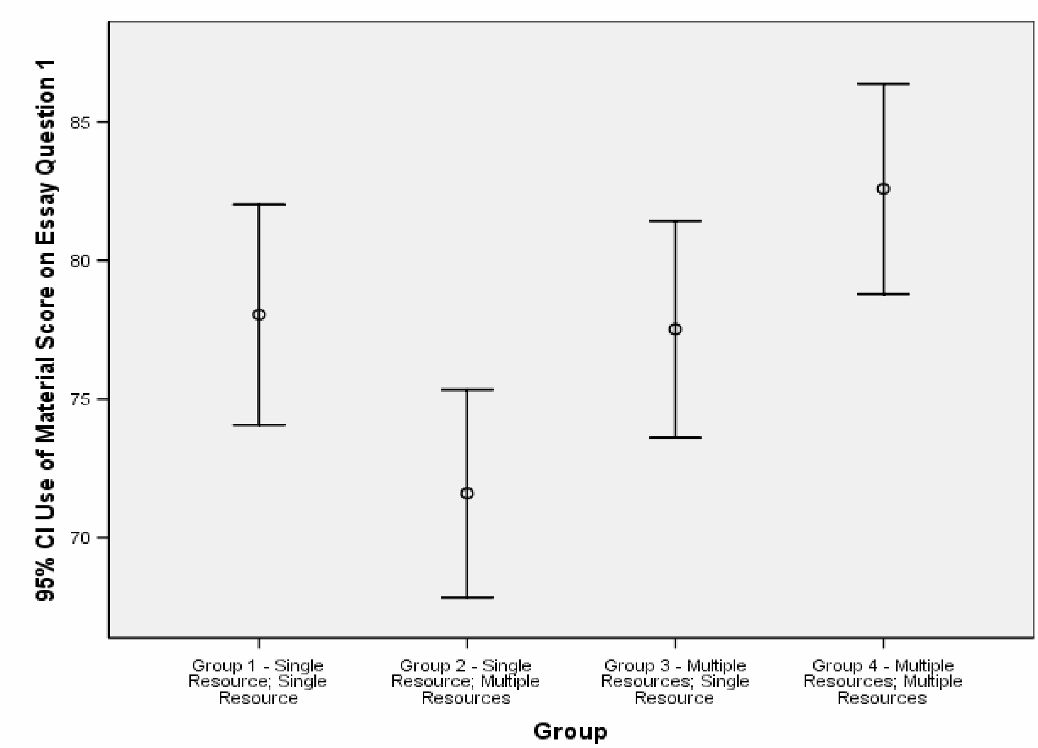
Case Processing Summary

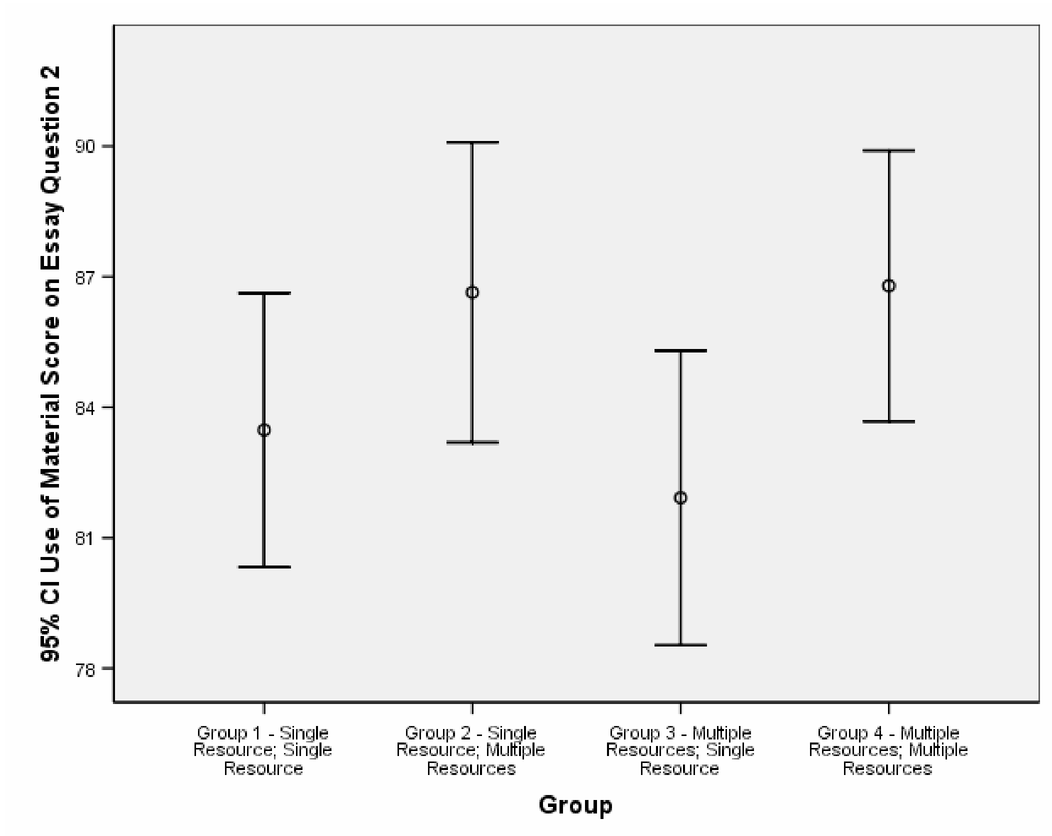
		N	%
Cases	Valid	15	7.7
	Excluded (a)	179	92.3
	Total	194	100.0

a Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.992	2




95% CI Use of Material Score on Essay Question 2
90
87
84
81
78
Group 1 - Single Resource; Single Resource
Group 2 - Single Resource; Multiple Resources
Group 3 - Multiple Resources; Single Resource
Group 4 - Multiple Resources; Multiple Resources
Group

H4 Results:

Descriptives

Combined Average Essay Scores from Questions1 and 2

	N	Mean	Std. Dev.	Std. Error	95% Confidence Interval for Mean		Min	Max
					Lower Bound	Upper Bound		
Group1	46	84.3152	8.54391	1.25973	81.7780	86.8524	66.25	97.00
Group4	48	87.2813	9.46306	1.36588	84.5335	90.0290	67.00	97.00
Total	94	85.8298	9.09945	.93854	83.9660	87.6935	66.25	97.00

ANOVA

Combined Average Essay Scores from Questions1 and 2

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	206.644	1	206.644	2.537	.115
Within Groups	7493.757	92	81.454		
Total	7700.402	93			

Case Processing Summary

		N	%
Cases	Valid	3	3.2
	Excluded (a)	91	96.8
	Total	94	100.0

a Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.996	2

H4 (post-script) Results:

Within-Subjects Factors

Measure: MEASURE_1

factor1	Dependent Variable
1	Q1S – Overall Essay Score for Question #1
2	Q2S – Overall Essay Score for Question #2

Between-Subjects Factors

		Value Label	N
Group	1	Group 1 - Single Resource; Single Resource	46
	2	Group 2 - Single Resource; Multiple Resources	50
	3	Group 3 - Multiple Resources; Single Resource	50
	4	Group 4 - Multiple Resources; Multiple Resources	48

Descriptive Statistics

	Group	Mean	Std. Deviation	N
Graded Score on Essay Question 1	Group 1 - Single Resource; Single Resource	83.1957	9.19207	46
	Group 2 - Single Resource; Multiple Resources	77.9500	10.65136	50
	Group 3 - Multiple Resources; Single Resource	83.3900	9.48215	50
	Group 4 - Multiple Resources; Multiple Resources	86.5521	9.76927	48
	Total	82.7242	10.21225	194
Graded Score on Essay Question 2	Group 1 - Single Resource; Single Resource	85.4348	9.00346	46
	Group 2 - Single Resource; Multiple Resources	87.0500	11.48435	50
	Group 3 - Multiple Resources; Single Resource	85.1900	8.97325	50
	Group 4 - Multiple Resources; Multiple Resources	88.0104	9.64171	48
	Total	86.4253	9.83982	194

Multivariate Tests (b)

Effect		Value	F	Hypothesis df	Error df	Sig.
factor1	Pillai's Trace	.187	43.790(a)	1.000	190.000	.000
	Wilks' Lambda	.813	43.790(a)	1.000	190.000	.000
	Hotelling's Trace	.230	43.790(a)	1.000	190.000	.000
	Roy's Largest Root	.230	43.790(a)	1.000	190.000	.000
factor1 * Grp	Pillai's Trace	.150	11.188(a)	3.000	190.000	.000
	Wilks' Lambda	.850	11.188(a)	3.000	190.000	.000
	Hotelling's Trace	.177	11.188(a)	3.000	190.000	.000
	Roy's Largest Root	.177	11.188(a)	3.000	190.000	.000

a Exact statistic
b Design: Intercept+Grp
Within Subjects Design: factor1

Mauchly's Test of Sphericity(b): Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon(a)		
					Greenhouse-Geisser	Huynh-Feldt	Lower-bound
factor1	1.000	.000	0	.	1.000	1.000	1.000

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.
a May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.
b Design: Intercept+Grp

Within Subjects Design: factor1/Tests of Within-Subjects Effects: Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
factor1	Sphericity Assumed	1290.297	1	1290.297	43.790	.000
	Greenhouse-Geisser	1290.297	1.000	1290.297	43.790	.000
	Huynh-Feldt	1290.297	1.000	1290.297	43.790	.000
	Lower-bound	1290.297	1.000	1290.297	43.790	.000
factor1 * Grp	Sphericity Assumed	988.937	3	329.646	11.188	.000
	Greenhouse-Geisser	988.937	3.000	329.646	11.188	.000
	Huynh-Feldt	988.937	3.000	329.646	11.188	.000
	Lower-bound	988.937	3.000	329.646	11.188	.000
Error(factor1)	Sphericity Assumed	5598.393	190	29.465		
	Greenhouse-Geisser	5598.393	190.000	29.465		
	Huynh-Feldt	5598.393	190.000	29.465		
	Lower-bound	5598.393	190.000	29.465		

Tests of Within-Subjects Contrasts: Measure: MEASURE_1

Source	factor1	Type III Sum of Squares	df	Mean Square	F	Sig.
factor1	Linear	1290.297	1	1290.297	43.790	.000
factor1 * Grp	Linear	988.937	3	329.646	11.188	.000
Error(factor1)	Linear	5598.393	190	29.465		

Tests of Between-Subjects Effects: Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	2773452.458	1	2773452.458	16955.177	.000
Grp	1147.978	3	382.659	2.339	.025
Error	31079.355	190	163.576		

Estimated Marginal Means

1. Grand Mean: Measure: MEASURE_1

Mean	Std. Error	95% Confidence Interval	
		Lower Bound	Upper Bound
84.597	.650	83.315	85.878

2. Group

Estimates: Measure: MEASURE_1

Group	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Group 1 - Single Resource; Single Resource	84.315	1.333	81.685	86.945
Group 2 - Single Resource; Multiple Resources	82.500	1.279	79.977	85.023
Group 3 - Multiple Resources; Single Resource	84.290	1.279	81.767	86.813
Group 4 - Multiple Resources; Multiple Resources	87.281	1.305	84.706	89.856

Pairwise Comparisons: Measure: MEASURE_1

(I) Group	(J) Group	Mean Diff. (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
Group 1 - Single Resource; Single Resource	Group 2 - Single Resource; Multiple Resources	1.815	1.848	.327	-1.829	5.460
	Group 3 - Multiple Resources; Single Resource	.025	1.848	.989	-3.619	3.670
	Group 4 - Multiple Resources; Multiple Resources	-2.966	1.866	.114	-6.647	.715
Group 2 - Single Resource; Multiple Resources	Group 1 - Single Resource; Single Resource	-1.815	1.848	.327	-5.460	1.829
	Group 3 - Multiple Resources; Single Resource	-1.790	1.809	.324	-5.358	1.778
	Group 4 - Multiple Resources; Multiple Resources	-4.781(*)	1.827	.010	-8.386	-1.177
Group 3 - Multiple Resource; Single Resource	Group 1 - Single Resource; Single Resource	-.025	1.848	.989	-3.670	3.619
	Group 2 - Single Resource; Multiple Resources	1.790	1.809	.324	-1.778	5.358
	Group 4 - Multiple Resources; Multiple Resources	-2.991	1.827	.103	-6.596	.613
Group 4 - Multiple Resource; Multiple Resources	Group 1 - Single Resource; Single Resource	2.966	1.866	.114	-.715	6.647
	Group 2 - Single Resource; Multiple Resources	4.781(*)	1.827	.010	1.177	8.386
	Group 3 - Multiple Resources; Single Resource	2.991	1.827	.103	-.613	6.596

Based on estimated marginal means
* The mean difference is significant at the .05 level.
a Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Univariate Tests: Measure: MEASURE_1

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	573.989	3	191.330	2.339	.025
Error	15539.677	190	81.788		

The F tests the effect of Group. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

3. factor1

Estimates: Measure: MEASURE_1

factor1	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	82.772	.704	81.383	84.161
2	86.421	.707	85.026	87.817

Pairwise Comparisons: Measure: MEASURE_1

(I) factor1	(J) factor1	Mean Difference (I-J)	Std. Error	Sig.(a)	95% Confidence Interval for Difference(a)	
					Lower Bound	Upper Bound
1	2	-3.649(*)	.551	.000	-4.737	-2.562
2	1	3.649(*)	.551	.000	2.562	4.737

Based on estimated marginal means
* The mean difference is significant at the .05 level.
a Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Multivariate Tests

	Value	F	Hypothesis df	Error df	Sig.
Pillai's trace	.187	43.790(a)	1.000	190.000	.000
Wilks' lambda	.813	43.790(a)	1.000	190.000	.000
Hotelling's trace	.230	43.790(a)	1.000	190.000	.000
Roy's largest root	.230	43.790(a)	1.000	190.000	.000

Each F tests the multivariate effect of factor1. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.
a Exact statistic

4. Group * factor1: Measure: MEASURE_1

Group	factor1	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Group 1 - Single Resource; Single Resource	1	83.196	1.445	80.345	86.046
	2	85.435	1.452	82.571	88.299
Group 2 - Single Resource; Multiple Resources	1	77.950	1.386	75.216	80.684
	2	87.050	1.393	84.303	89.797
Group 3 - Multiple Resources; Single Resource	1	83.390	1.386	80.656	86.124
	2	85.190	1.393	82.443	87.937
Group 4 - Multiple Resource; Multiple Resource	1	86.552	1.415	83.762	89.343
	2	88.010	1.421	85.207	90.814

Reliability – Grader Overall Scores on Essay #1

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	15	7.7
	Excluded (a)	179	92.3
	Total	194	100.0

a Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.995	2

Reliability – Grader Overall Scores on Essay #2

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	15	7.7
	Excluded (a)	179	92.3
	Total	194	100.0

a Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.996	2

Reliability – Grader Overall Scores on Both Essays

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	15	7.7
	Excluded (a)	179	92.3
	Total	194	100.0

a Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.996	2

REFERENCES

Alexander, J., Tate, M. (1999). Web Wisdom: How to Evaluate and Create Information Quality on the Web. Erlbaum Publishing

Ardito, C., De Marsico, M., Lanzilotti, R., Levialdi, S., Roselli, T., Rossano, V., Tersigni, M. (2004). Usability of E-learning tools. In Proceedings of the Working Conference on Advanced Visual interfaces (Gallipoli, Italy, May 25 - 28, 2004. AVI '04. ACM Press, New York, NY, p. 80-84).

Bonwell, C., Eison, J. (1991). Active Learning: Creating Excitement in the Classroom, ASHE-ERIC Higher Education Report No. 1. Washington, D.C: The George Washington University.

Bramall, S. (2000). The Educational Significance of the Interface, Enquiries at the Interface: Philosophical Problems of On-line Education, (p. 79-94). Blackwell Publishing.

Clark, E. (2003). Research on Web-based learning: A half-full glass, Web-based learning: What do we know? Where do we go? (p. 1-22). Information Publishing.

Davies, T., (2001). Students' perceptions of constructivist learning in community college, Community College Review (Vol. 29, No. 2, p. 54-79)

Davis, T., Murrell, P. (1993). A Structural Model of Perceived Academic, Personal and Vocational Gains Related to College: Student Responsibility. Research in Higher Education (Vol. 34, p. 267-289).

Dickinson, D., O'Connell, D.(1990). Effect of Quality and Quantity of Study on Student Grades. Journal of Educational Research, (Vol. 83, p. 227-231).

Dong, A., Agogino, A. (2001). Design Principles for the Information Architecture of a SMET Education Digital Library, JCDL (p. 314-321).

Erickson, J., Lehrer, R. (2000). What's in a link? Student Conceptions of the Rhetoric of Association in Hypermedia Composition; Computers as Cognitive Tools (Vol. 2, p. 197-226). Lawrence Erlbaum Associates Publishing.

Fosmire, M., Macklin, A. (2002). Riding the active learning wave: problem-based learning as a catalyst for creating faculty-librarian instructional partnerships. Issues in Science & Technology Librarianship (Vol. 34). Retrieved on July 15, 2006 from http://www.istl.org/02-spring/article2.html.

Franklin, M. (1995). The Effects of Differential College Environments on Academic Learning and Student Perceptions of Cognitive Development. Research in Higher Education, (Vol. 36, p. 127-153).

Gannon, E, (2004). Bringing Active Learning into a Hybrid Course, Academic Exchange Quarterly, 2004.

Goffe, W., Robert P. (1997), The Future Information Infrastructure, Journal of Economic Perspectives, (Vol. 11, Summer, p.75-94)

Hatcher, L., Prus, J., Englehard, B., Farmer, T. (1991). A Measure of Academic Situational Constraints: Out-of-Class Circumstances That Inhibit College Student Development. Educational and Psychological Measurement, (Vol. 31, p. 953-962).

Hölscher, C., Strube, G.; (2000). Web Search Behavior of Internet Experts and Newbies; International Journal of Computer and Telecommunications Networking, (Vol. 33, pp. 337-346).

Hoffman, D., Novak T. (1996). Marketing in Hypermedia Computer-Mediated Environments: Conceptual Foundations. Journal of Marketing, (Vol. 60, March 1996, p 50-68).

Hudgins, B. (1977). The Generality of Learning: Issues in Transfer; Learning and Thinking, (p. 142-172). F.E. Peacock Publishing.

Jacobson, M., Maouri, C., Mishra, P., Kolar, C. (1996). Learning with hypertext learning environments: theory, design, and research. Journal of Education, Multimedia Hypermedia; (Vol. 5, No. 3-4 p.239-281).

Jansen, B., Spink, A. (2003). An analysis of Web information seeking and use: documents retrieved versus documents viewed. Proceedings of the 4th International Conference on Internet computing, (pp. 65–69).

Jonassen, D., (1992). Designing hypertext for learning, New directions in educational technology (p. 123-130). Springer-Verlag Publishing

Jonassen, D., Peck, K., Wilson, B. (1999) Learning by Doing: Immersion in Constructivist Learning Environment, Learning with Technology: A Constructivist Perspective, (p. 193-216). Prentice Hall Publishing

Knowles, A. (2001) Implementing web-based learning: Evaluation results from a web-enhanced mental health course. Journal of Technology in Human Services; (Vol. 18, No. 3 / 4, p. 171-187).

Lake, D. (2000). Active learning: Student Performance and Perceptions Compared with Lecture, Selected papers from the 11th International Conference on College Teaching and Learning (pp. 119-124).

Latchman, H.; Salzmann, C.; Gillet, D.; Bouzekri, H.; (1999) Information technology enhanced learning in distance and conventional education; IEEE Transactions on Education, (Vol. 42, No. 4, p. 247-254).

Maddux, C., Cummings, R. (2000). Developing Web Pages as Supplements to Traditional Courses, Instructional and Cognitive Impacts of Web-Based Education. (p. 147-155)

Marcus, A. (1994). Managing Metaphors for Advances User Interfaces, ACM Proceedings of International Workshop AVI'94 (p.12-18)

Marsh, E., Kumar, D. (1992). Hypermedia: A Conceptual Framework for Science Education and Review of Recent Findings, Journal of Educational Multimedia and Hypermedia (Vol. 1, p.25-37),

McArthur, D., Lewis, M. (1998). Untangling the Web: Applications of the Internet and Other Information Technologies to Higher Learning. Rand Publishing.

Merrill, M. D. (1992). Constructivism and Instructional Design, Constructivism and the Technology of Instruction: A Conversation (p. 99-114). Lawrence Erlbaum Publishing.

Michau, F., Gentil, S., Barrault, M. (2001). Expected benefits of Web-based learning for engineering education: Examples in control engineering. European Journal of Engineering Education, (Vol. 26, No. 2, p.151-169).

Miller, J., Groccia, J., Wilkes, J. (1996). Providing structure: The Critical Element, Using Active Learning: A Range of Options for Faculty (pp. 17-30). Jossey-Bass Publishing

Moore, T. (1995). Active Use of Hypertext to Aid Learning and Classroom Instruction, SIGCSE, (Vol. 27, March 1995, p 297-301).

Moore, D., Burton, J., Myers, R. (1996). Multiple-Channel Communications: The Theoretical and Research Foundations of Multimedia, Research for Educational Communications and Technology (p. 851-875). MacMillian Press Publishing.

Mower, R.; Klein, S. (1989). Traditional Learning Theory and the Transition to Contemporary Learning Theory; Contemporary Learning Theories, (p. 3-17). Lawrence Erlbaum Associates Publishing.

Oliver, K. (2000). Methods for Developing Constructivist Learning on the Web. Educational Technology (Vol. 40 Nov-Dec 2000, p. 5-16)

Ormrod, J. (2003), Educational Psychology: Developing Learners, Fourth Edition, (p. 204-232). McGraw Hill Publishing.

Pessler, C. (1991). The Anthropology of Teaching and Learning. Annual Review of Anthropology (Vol. 20, p. 75-95).

Redish, E. (1999), Making Sense of What Happens in Physics Classes: Analyzing Student Learning. Retrieved February 7, 2006 from http://www2.physics.umd.edu/~redish/Talks.htm.

Rieh, S. (2002). Judgment of Information Quality and Cognitive Authority in the Web, Journal of the American Society for Information Science and Technology, (Vol. 53 No. 2, p.145-161)

Reynolds, D., Treharne, D., Tripp, H. (2003). ICT-the Hopes and the Reality. British Journal of Educational Technology, (Vol. 34 March 2003, p. 151-167)

Schunk, D. H. (1989). Social Cognitive Theory and Self-Regulated Learning, Self-Regulated Learning and Academic Achievement: Theory, Research, and Practice (p. 83-110). Springer-Verlag Publishing.

Schultz, P., Lanehart, S. (1994). Long-term Educational Goals, Subgoals, Learning Strategies Use and the Academic Performance of College Students. Learning and Individual Performance (Vol. 6, p. 399-412).

Serva, M., Fuller, M. (1999). The Role of Media Use and Active Learning in Higher Education: The Development of an Instrument to Determine the Dimensions of Teaching, Proceeding of the 20th International Conference on Information Systems, (December, 1999, p.386-399).

Shakarian, D. (1995). Beyond Lecture: Active Learning Strategies that Work. Journal of Education, (Vol. 66, p.21-24).

Shapiro, A., Niederhauser, D. (2004). Learning from hypertext: Research issues and findings. Handbook of research on educational communications and technology (2nd ed, p.605-620). Erlbaum Publishing

Shuell, T.; Lee, C. (1976), Entering Behavior, Learning and Instruction, (p. 102-118). Wadsworth Publishing.

Smith, M. (1999), Learning theory, The Encyclopedia of Informal Education, Last update: January 30, 2005. Retrieved on December 30, 2005 from http://www.infed.org/biblio/b-learn.htm.

Sosin, K., Goffe, W. (2005). Teaching with Technology: May you Live in Interesting Times, Journal of Economic Education, (Vol. 36, No. 3, Summer, 2005, p. 278-291)

Stafford, T., Stafford, M. (2001). Identifying Motivations for the Use of Commercial Web Sties, Information Resources Management Journal (Vol. 14, January 2001, p.22-30).

Stern, L., Markham, S., Hanewald, R. (2005). You can lead a horse to water: how students really use pedagogical software. In Proceedings of the 10th Annual SIGCSE Conference on innovation and Technology in Computer Science Education (Caparica, Portugal, June 27 - 29, 2005). ITiCSE '05. ACM Press, New York, NY, (p. 246-250).

Sugrue, B. (2000). Cognitive Approaches to Web-based Instruction; Computers as Cognitive Tools (Vol. 2, p. 133-162). Lawrence Erlbaum Associates Publishing

Travers, J. (1972). Learning Theories, parts I & II; Learning – Analysis and Application (p. 175-220). McKay Publishing

Trumbull, D., Gay, G., Mazur, J. (1992). Students' actual and perceived use of navigational and guidance tools in a hypermedia program, Journal of Research on Computing in Education, (Vol. 24, No.3, p.315-328)

Wales, C., Stager, R. (1978). The Guided Design Approach. Educational Technology Publishing. Retrieved on January 28, 2006 from http://www.edtech.vt.edu/edtech/id/models/guided.html.

Walker, J. (1996). Relationships, Concepts and Thinking; The Psychology of Learning, (p. 269-307). Prentice Hall Publishing.

Waxman, H., Lin M., Michko, G. (2003). A Meta-Analysis of the Effectiveness of Teaching and Learning with Technology on Student Outcomes. Learning Point Associates. Retrieved January 22, 2006, from http://www.ncrel.org/tech/effects2/.

Wegner, S., Holloway, K., Garton, E. (1999). The effects of Internet-based instruction on student learning, Journal of Asynchronous Learning Networks, (Vol. 3, No. 2)

White, G., Coscarelli, W. (1986). The Guided Design Guidebook: Patterns in Implementation. National Publishing. Retrieved on January 28, 2006 from http://www.edtech.vt.edu/edtech/id/models/guided.html.

Zakon, R. (2005). Hobbes' Internet Timeline 1993-2005. Retrieved March 7, 2006, from www.zakon.org/robert/Internet/timeline

Zimmerman, B. (1989). Models of self-regulated learning and academic achievement, Self-regulated learning and academic achievement: Theory, research, and practice (pp. 1-25). Springer-Verlag Publishing.