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The Relationship of Perceptual Learning Modality Preference and the Use of an On-Line Learning Environment to Achieve Non-Technology Related Course Objectives

Patricia M. Nickel
University of Nebraska at Omaha

THE RELATIONSHIP OF PERCEPTUAL LEARNING MODALITY PREFERENCE AND THE USE OF AN ON-LINE LEARNING ENVIRONMENT TO ACHIEVE NON-TECHNOLOGY RELATED COURSE OBJECTIVES

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Patricia M. Nickel

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ProQuest LLC.
789 East Eisenhower Parkway
P.O. Box 1346
Ann Arbor, MI 48106 - 1346

Thesis Acceptance

Acceptance for the faculty of the Graduate College, University of Nebraska, in partial fulfillment of the requirements of the degree Master of Arts, University of Nebraska at Omaha.

Committee

Teacher Education

Dr. Neal Grandgenett (Chair)

Special Education

Dr. James Akers (Member)

Teacher Education

Dr. Melodee Landis

Teacher Education

Dr. Neal Topp (Member)

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ABSTRACT

THE RELATIONSHIP OF PERCEPTUAL LEARNING MODALITY PREFERENCE AND THE USE OF AN ON-LINE LEARNING ENVIRONMENT TO ACHIEVE NON-TECHNOLOGY RELATED COURSE OBJECTIVES

The purpose of this thesis study was to explore the possibility of a relationship between perceptual learning modality preference and efficacy in the use of an on-line learning environment to achieve non-technology related course objectives. Subjects were 30 adult students enrolled in the CaseNET course administered by the University of Virginia. Two research questions were explored: 1.) Is there a difference in feelings of student efficacy, in a course which uses Internet technology to achieve non-technology related course objectives, for auditory, visual, and tactile learners? 2.) Is there a difference in the use of student adaptation techniques for tactile, visual, and auditory learners in their use of Internet course materials to achieve course objectives? The students' learning modality preferences were determined using a 25 item sensory modality preference inventory completed by the student on-line, which simultaneously returned their preference on the screen and recorded it in a data base. Levels of efficacy and adaptation were measured according to the students' answers on an exit survey, also taken on-line, which were submitted by the student to the data base. Findings imply that no perceptual modality preference group had a particularly low sense of efficacy in the use of an on-line environment to achieve non-technology related course objectives. For those questions on the exit survey indicating high efficacy, with a range of 13-56 and a mean of 42.66, auditory learners averaged a score of 49.60, visual learners scored an average of 41.00, and tactile learners scored an average of 41.58. A high score indicates high efficacy. Adaptation scores were calculated based on the students' response to exit survey

questions inquiring as to their attempts to manipulate the on-line environment. Auditory learners had an average adaptation score of 1.48, visual learners had an average adaptation score of 1.66, and tactile learners had an average adaptation score of 1.63, with a range of 1-2 and a mean of 1.62. A high score indicates low adaptation. Tables reporting significant findings are included. It is contended that perceptual modality preference is a necessary criteria for the evaluation of on-line environments as an instructional tool. The author provides recommendations for further study.

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CHAPTER I

Introduction

The recent increase of technology use in educational settings has instigated inquiry as to its ability to affect the learning of students. Concurrently, as educators are discovering that each student has a unique style of learning, computer technology may emerge as a means of accommodating individual perceptual learning modalities. In order to determine the utility of emerging technology in education, the relationship between learning modality and the use of computers must first be established. This investigation seeks to explore the ability of an on-line learning medium, partnered with a traditional classroom setting, to effectively accommodate the perceptual learning styles of adult learners.

An understanding of the relationship between perceptual learning modality preference and student perception of achievement, when using the Internet to achieve non-technology related course objectives, may serve to help educators determine how to best serve their students.

Learning style research seeks to explain individual learning differences. Research in this area has produced several models of learning style. One model, developed by Dunn and Dunn, identifies five dimensions in which styles differ: (1) environmental, (2) emotional, (3) sociological, and (4) personal/physical elements and (5) psychological. The physical dimension of learning style includes perceptual

modality preference, or visual, auditory, and kinesthetic (tactile) ways of processing (Carbo, Dunn, and Dunn, 1986). This study will focus on perceptual, or input, modalities. Other models will be discussed in Chapter Two.

If students learn according to different learning styles, then teaching methods that accommodate only one style may be ineffective for those students whose styles are not consistent with the method of instruction. Dunn (1990) stated that, "Students are not failing because of the curriculum. Students can learn almost any subject when they are taught with methods and approaches responsive to their learning style strengths" (p. 15). Estimates of the perceptual learning style demographics of the classroom vary. Approximately 20 to 30% of the school-aged population are auditory learners; 40% are visual; and the remaining 30-40% are tactile/kinesthetic (Carbo, Dunn, and Dunn, 1986). However, classroom instruction remains focused on the auditory and visual learners. Withers (1997) explained, "We all seem to have a learning style preference based on our sensory intake of information. Most schooling has hierarchized these three information intake modes such that the visual is hypostasized, next is the auditory and last is the tactile/kinesthetic. Nevertheless, the modern university focus on theoretical learning places a definite bias on the visual."

The ability to reach students of varying learning styles may be realized through the use of technology in education. Learning style theorists have explored the idea that tactile learners will have a positive response to the use of the computer in the learning process (Wallace, 1995) and that the computer may offer the opportunity to provide a variety of ways of learning a concept (Guild and Garger, 1985). Withers

(1997) suggests that the computer has the potential to accommodate all three learning modalities:

> Inherent to both modality-based learning and technology use is the concept that learners progress at their own pace, and understanding and application are emphasized together. For the educator, this allows for unwavering focus on the learner's needs. NetLearn's Modality-Based Course Template is a cursory attempt at integrating three modality "channels" on a single Internet/Web site. As video technologies and bandwidth continue to grow, the video frame holds promise for the more "visual learner." It also "humanizes" an often-criticized element of the medium by putting teacher and learner face-to-face. Auditory Learners benefit from the audio elements in the course site. Perhaps inherent to all three learning styles is the hypermedia elements possible in the site's main frame. The very nature of the desktop computer, complete with keyboard, mouse, and ancillary peripherals, make it a "tactile" experience for the learner. Further, failure to accommodate all three modalities into a multimedia learning environment, when it continues to lend itself to this architecture, may handicap not only the learner but the facilitator.

This study seeks to examine if, in fact, the nature of the computer is conducive to all three learning modalities.

Statement of the Problem

Is there a relationship between a student's perceptual learning modality preference and their level of efficacy in a graduate level education course, which incorporates the Internet as a means of achieving course objectives not related to technology?

Operationally Defined Terms

The following terms are operationally defined within the study:

Learning Modality is defined as visual preference, auditory preference, and tactile

preference (Jonassen & Grabowski, 1993).

Internet shall be defined as the World Wide Web, video-conference, discussion groups, and electronic mail (Herbert & McNergney, 1998).

Visual Preference is defined as: The student prefers to learn through sight; and does well using visual representations of material.

Auditory Preference is defined as: The student prefers to learn through sound; and does well listening to lecture and discussing topics in class.

Tactile Preference is defined as: The student prefers to learn through touch; and does well using resources that are readable, touchable, and movable.

Graduate Level Education Course is defined as TED 8600. This elective course is titled "Advanced Seminar in Educational Technology: Interdisciplinary Studies." Students explore issues related to interdisciplinary teaching through the analysis and discussion of cases representing real life situations. These discussions take place both in the classroom and via the Internet.

Incorporation of Internet Material is defined as the administration of the course in cooperation with CaseNET. CaseNET is a set of courses delivered to college and university students, inservice teachers, teachers' aides, and school administrators via the Internet (World Wide Web, video conference, discussion groups, and electronic mail), videotape, and print materials. Faculty use case methods-- similar to instructional approaches used in business, law and medicine--to bridge educational theory and real-life practice in schools. CaseNET is not "distance education" in the typical sense of the term. Students meet physically at a particular site and given time.

Their work is guided by an instructor on-site (Herbert & McNergney, 1998).

Level of Efficacy is defined as the students' perceived level of confidence in reaching the desired course objectives through the Internet medium, as measured by the exit survey developed for this study.

Adaptation Techniques is defined as the printing, copying in to word processing programs, or other identified manipulations of the Internet course materials by students, to conduct course requirements outside of the existing CaseNET on-line format.

Questions of Exploration

1.) Is there a difference in feelings of student efficacy, in a course which uses Internet technology to achieve non-technology related course objectives, for auditory, visual, and tactile learners?

2.) Is there a difference in the use of student adaptation techniques for tactile, visual, and auditory learners in their use of Internet course materials to achieve course objectives?

Significance of the Problem

This investigation of the relationship between learning modality and the use of the Internet to achieve non-technology related course objectives proceeds from the increased use of computers in education and the current focus on learning style. The significant increase in the use of computers in education over the past decade has

prompted researchers to examine their ability to enrich the educational experience. Concurrently there has been an influx in of research in the area of learning style. However, as Ayersman and von Minden report: "Despite the fact that hypermedia is expected to accommodate individual differences, Litchfield (1993) admits that research specifically addressing multimedia programs and learning styles is almost nonexistent" (p. 71).

Education over the past decade has seen a tremendous influx of technology in the classroom. According to Quality Education Data, between the years of 1990 and 1996, there has been a 208% increase in the use of computers, for instructional purposes, by K-12 schools. An increase of 65% was expected for the 1996-97 school year and 41% is expected for the 1997-98 school year. In 1997, 70% of schools had Internet access (Sivin-Kachala and Bialo, 1997). K-12 schools are joined by higher education. Green (1996) explained:

> Although the technology experience may not be universal, the presence of technology in the learning environment is increasingly common: an e-mail address on a course syllabus; electronic mail as a supplement to office hours; class sessions held in computer labs; desktop computers in faculty offices; commercial software and simulations as part of the resources provided by textbook publishers; and course assignments that send students to World

> Wide Web (WWW) sites in search of information resources (published articles, conference pares, digitized images, and just released data files). These example and others reflect the new significance of information technology in the instructional domain - across almost all disciplines (from art history to zoology) and in virtually all types of campus contexts, from elite research universities to community colleges to distance-education programs (p. 24).

Despite the proven benefits of technology in the curriculum (Fletcher-Flinn and Gravatt, 1995 and Kulik and Kulik, 1991), it has been criticized. In an interview with the ASEE Prism, Clifford Stoll, author of *Silicon Snake Oil*, stated that what students really need is more in-person, face-to-face instruction by committed teachers (Panitz, 1997).

However, learning style research is raising questions concerning the effectiveness of the traditional method of instruction, due to its failure to meet the needs of some students. Sims and Sims (1995) state:

> Higher education administrators responsible for the success of their teaching efforts can no longer afford to assume all students learn through whichever strategy the teacher prefers to use. Why gamble the potential success of the teaching effort? For the student who has been unsuccessful with previous teaching styles, learning is

> miserable and there is little chance that in the next course or class the student will suddenly adjust his or her learning style or even be capable of adjusting. Higher education administrators need to decide whether they want students to adjust or to learn. If learning is the objective, then new mind capturing techniques must be developed and applied for teaching to be successful (p. 8).

What the following study of this thesis seeks to examine is whether the Internet as a learning environment is effective in meeting the needs of students' varying perceptual learning styles.

Boundaries of the Study

This study was exploratory in nature and sought to probe the responses of adult learners, of varying modalities, to the incorporation of an online learning environment. Thus, the following restrictions must be taken into account when considering the results.

Delimitations

- This study is delimited to adult students voluntarily enrolled in the CaseNET course. Only three of the fourteen CaseNET classes are included in the study. The results have not been confirmed for the other classes in a study which employs an experimental design and therefore only limited generalizations can be made about the population.

- There were 30 subjects included in the sample, however only five of these subjects were auditory learners, 13 were visual learners and 12 were tactile learners. While this reflects the population, it is difficult to draw significant conclusions based on the responses of only five auditory learners.

Limitations

- Only perceptual learning style is considered; other factors which contribute to student learning may impact the learning process as well.
- Student responses on the exit survey may be influenced by factors other than their efficacy toward using the online format, such as feelings toward the instructor.
- The experience of the students is not limited to the on-line learning environment. The class met on campus for 150 minutes each week under the direction of experienced instructors.
- It is also important to consider that in this study, where adults have voluntarily enrolled in a course, that the subjects may be familiar enough with their modality preference and the instructional methods used in the course, that they will have chosen the course based on an expected high level of efficacy.
- The Sensory Modality Preference Inventory used in this study does not account for mixed modalities. The occurrence of mixed modalities is important to consider when evaluating efficacy in the classroom. While some students may have a dominate tactile modality, (their tactile score was the highest) if there visual or auditory modality is strong as well, (they had a high visual score, but it was not

the highest) their sense of efficacy may be higher than that of a tactile learner with a weak visual or auditory modality.

Definitions From the Literature

The following definitions are provided in order to give the reader greater insight into what is generally suggested in the literature regarding learning style and efficacy. These definitions are distinguished from the operationally defined definitions provided earlier in the study.

Learning Style: Keefe (1988) proposes that learning style can be viewed as an umbrella term encompassing cognitive, affective, and physiological/environmental dimensions. Therefore, Keefe, et al., defines learning style, as "the composite of characteristic cognitive, affective, and physiological factors that serve as relatively stable indicators of how a learner perceives, interacts with, and responds to the learning environment. It is demonstrated in that pattern of performance by which an individual approaches educational experiences. Its basis lies in the structure of neural organization and personality which both molds and is molded by human development and the learning experiences of home, school and society." (p. 3).

Perceptual Learning Style ought to be distinguished from the broader term, learning style. Perceptual learning style refers to the dimension. This dimension does not take into account other dimensions of an individuals learning style.

Learning Modality is distinguished from learning style. Modalities refer to the sensory channels, a facet of learning style, through which we receive and give

messages (Barbe, et. al, 1985).

Self-Efficacy as defined by Oliver and Shapiro:

> "Self-efficacy refers to perceptions about one's capabilities to organize and implement actions necessary to attain a designated performance of skill for specific tasks. Perceived self-efficacy could further be defined as a person's judgements of their capabilities to organize and execute courses of action required to attain designated types of performances."(p. 81).

Summary:

Instructional technology is often suggested as a means of matching instruction with learning modality preferences. However, there is little understanding of this potential relationship. Through the investigation of the efficacy of tactile, visual, and auditory learners when completing a class using an on-line medium to achieve non-technology related course objectives, a better understanding of this relationship may be achieved. A review of the literature related to this study is provided in Chapter 2.

CHAPTER II

Review of Literature

Introduction:

The current literature addressing learning style theory, as well as computer use in education, provides a base upon which to evaluate the possibility of a relationship between perceptual learning modality and efficacy levels related to computer use. Both topics have received a great deal of attention in educational research circles. In order to form an inclusive understanding of this research, the following topics were investigated: a.) learning style theory; b.) technology in education; and c.) the impact of learning style on the efficacy and achievement of students using computers in the educational process.

Learning Style Theory

At its most basic level, learning style theory is based upon the premise that the act of learning is related to an individual's method of knowing. Learning style is defined by Keefe (1988) as "the composite of characteristic cognitive, affective, and physiological behaviors that serve as relatively stable indicators of how learners perceive, interact, and respond to the learning environment." (p. 3). Since the emergence of learning style theory, several models have developed and the term "learning style" may refer to a number of concepts. However, there are common elements at the core of all learning style theory. Silver, et al., state the following:

"Although learning-style theorists interpret the personality in various ways, nearly all models have two things in common:

- *A focus on process.* Learning-style models tend to concern themselves with the process of learning: how individuals absorb information, think about information,

and evaluate the results.

- *An emphasis on personality.* Learning-style theorists generally believe that learning is the result of a personal, individualized act of thought and feeling." (p. 22).

While these characteristics help to define what learning style theory is, another important common element is what learning style theory seeks to explain. Guild (1997) proposed six areas in which learning style theories overlap in practice:

"Each of the theories is learning and learner centered; The teacher is a reflective practitioner and decision maker; The student is also a reflective practitioner; The whole person is educated; The curriculum has substance, depth, and quality; and Each of these theories promotes diversity." (p. 30).

As discussed in Chapter One, Carbo, Dunn, and Dunn (1986) identify five dimensions in which styles differ: (1) environmental, (2) emotional, (3) sociological, and (4) personal/physical elements and (5) psychological. The physical dimension of learning style includes perceptual modality preference, or visual, auditory, and kinesthetic (tactile) ways of processing. According to Curry (1983), learning style theory is manifest in four primary tiers. Curry conceptualizes these tiers as an onion in which the core of the onion represents personality and the following layers represent social interaction, information processing, and finally instructional preference. Keefe (1988), and a national Task Force working with the National Association of Secondary School Principals, conceptualized the theory differently. Keefe, et. al. (1988), depict the area of learning style having three dimensions: cognitive; affective; and physiological; each with its own variables. This study focuses on Dunn and Dunn's perceptual, or input, modalities, Curry's final tier, instructional preference, or Keefe, et. al.'s physiological dimension.

Learning modalities, or perceptual modalities, are "the sensory channels through which individuals give, receive, and store information." (Reiff, 1992, p. 17). Three modality types dominate the learning modality literature: Auditory, Visual, and Tactile, or Kinesthetic. Auditory learners are those who learn best by hearing or discussing. Visual learners are those who learn best by seeing. Tactile learners are those who learn best by touching, or manipulating an object. Kinesthetic learners, often grouped with tactile learners, learn best when movement is involved(Reiff, 1992). The accepted demographic breakdown of these groups in the population varies, Reiff (1992) reported that 25-30 percent of students are visual; 25-30 percent are auditory; 15 percent tactile; and 25-30 percent have mixed modalities. In her discussion of learning modality, O'Brien reported that less than 10 percent of the student population are auditory learners, 40 percent of the population are visual, and 50 percent are haptic, or for the purpose of this study, tactile (O'Brien, 1989). Carbo, Dunn, and Dunn (1986) estimate that 20 to 30 percent of the school-aged population is auditory, 40 percent is visual, and the remaining is tactile. Yet, 80 percent of secondary instruction is typically in the lecture format (O'Brien 1989). The sample used for the study of this thesis reflects these estimations with 17 percent of the sample being auditory, 43 percent visual, and 40 percent tactile, with many students having a strong secondary modality.

It is generally accepted that learning style is individualized and that students can benefit when teachers tailor instruction to encompass differences. In 1995 Dunn, et al. performed a meta-analysis of experimental studies, during 1980-1990, based on

the Dunn and Dunn Learning Style Model. The review of 42 studies concluded that matching students' learning-style preferences with educational interventions compatible with those preferences is beneficial to their academic achievement (Dunn, et. al., 1995). This discovery mandates the exploration of instructional methods and their ability to meet the unique needs of varying modal preferences. Instructional technology may be one means of providing instruction that is matched to the needs of tactile learners who do not learn well in the traditional lecture and text format.

Instructional Technology

Like learning style research, the research regarding instructional technology indicates that, in general, its use is beneficial to students. The term instructional technology, like learning style, has many conceptualizations. For the purpose of this discussion instructional technology will include all those methods of instruction in which the student uses a computer as part of the learning process. Note, however, that the term does not include activities such as word processing. The spirit of the definition refers to computer-aided instruction and hyper-media, as they are broadly defined. While this definition is broad, it allows the exploration of all studies which might provide insight into the direct relationship between learning style and the use of the computer for instruction. This is necessary at this point in time due to the scarcity of research exploring the relationship. While the relationship between instructional technology and student achievement is generally accepted, there is still a need to determine how this relationship unfolds and for whom.

In order to explore this question Skinner conducted a study investigating the effects of computer-based instruction on the achievement of college students as a function of achievement status and the mode of computer-based instruction (Skinner, 1990). The two modes investigated were mandatory and optional. The study reports that low achieving students benefited more from computer-based instruction than did high achievers and that both mandatory and optional modes proved superior to not having computer-based instruction available at all.

In a meta-analysis exploring the effectiveness of computer-based instruction, Kulik and Kulik reviewed the findings of 254 controlled evaluation studies (Kulik and Kulik, 1991). Kulik and Kulik report that computer-based instruction generally produced a positive effect on student achievement, raising student examination scores by 0.30 standard deviations in the average study. Other findings included a reduction in instructional time and a positive effect on student attitudes towards computers.

Fletcher-Flinn and Gravatt (1995) reinforced the above findings in their meta-analysis. The findings of this meta-analysis are similar to those of Kulik and Kulik in terms of student achievement. They are also consistent with Kulik and Kulik's finding that student attitudes toward computers tend to be positive. Results for effective learning were the same for adult learners as for K-12.

The above studies provide a firm basis for the assumption that instructional technology has a positive impact on student achievement. Questions regarding the benefit of using instructional technology seem to not be related as much to the question of whether students benefit from its use, but rather, How much? and At what

cost? These questions are beyond the scope of this study.

Instructional Technology and Learning Modality

While it is accepted that considering learning modality in the classroom and that employing instructional technology both have a positive impact on student achievement, it has not been established what technology benefits what perceptual modal preference. This is a key point of investigation. The utility of instructional technology ought to consider its ability to provide successful learning experiences to a broad range of students.

Relatively few studies have explored the relationship between perceptual modality and the use of instructional technology. Ayersman and Minden (1995) reported that: "A recent trend in education has been to generally accept that hypermedia can accommodate learning style differences because of the multi-modal attributes that are involved. There is very little research, however, to support this claim."(p. 71). The research to date regarding learning style in relationship to the use of instructional technology includes five useful tools for defining learning style: the Dunn, Dunn, and Price questionnaire; the Group Embedded Figures Test (GEFT); Kolb's Learning Style Inventory; Gregorc Style Delineator and the learning modality inventory developed by Barbe and Milone.

Dunn, Dunn, and Price

Billings and Cobb (1992) report that computer assisted interactive videodisc instruction appeals to a variety of learning styles. Billings and Cobb studied the effects of learning style preferences, attitude, and GPA on learner achievement when

using computer assisted interactive videodisc instruction with juniors in a baccalaureate nursing program. This study identified learning style using the Dunn, Dunn, and Price questionnaire. Learning styles were defined as persistence, mobility, evening-morning, late-morning, afternoon, motivation, and responsibility. The treatment was a lesson executed on a level III interactive videodisc with a touch screen monitor as an input device. The instructional design included visual, auditory, and tactile cues. No significant difference was reported between learning style preference and achievement.

Group Embedded Figures Test

In a study done by Hong, et al, (1995) 171 junior high school students and 38 senior high school students completed the Group Embedded Figures Test (GEFT) via computer. Those whose scores were in the fourth quartile were defined as field independent. Those whose scores fell within the first quartile were defined as field dependent. The students were exposed to three types of discovery learning on the computer. In the type-A learning situation students were not provided with any feedback after answering a question and were asked if they needed any hints after they had made three errors. In the type-B learning situation students were given a choice whether to have incorrect answers highlighted or not and had the option of hints after one error. In the type-C learning situation students were offered feedback after making three errors and were asked if they needed any hints after they had made three errors. In all three situations field dependent subjects used more hints than field independent subjects did. Field independent learners performed better than field

dependent learners did. Type A discovery learning proved to be the most effective.

Kolb's Learning Style Inventory

The following four studies explore the relationship between learning style, as defined by Kolb's Learning Style Inventory, and the use of instructional technology. This inventory classifies learners as Diverger, Converger, Assimilator, and Accomodator.

Park and Gamon (1996) used Kolb's Learning Style Inventory to determine the learning style of university personnel participating in in-service computer training. The study investigated the relationship between learning style and opinions toward computer training and support. Findings report that there is a relationship between learning style and training methodology preference.

Ellsworth (1991) investigated whether adults with certain learning styles are more likely to select electronically mediated learning strategies to assist them in learning. The students' learning styles were defined according to Kolb's Learning Style Inventory. The students had access to a faculty-maintained, computer-based bulletin board system for information and assistance with course assignments. They also participate in an on-line assessment of their own learning. This system seems to be similar to the CaseNET format in it's provision of an on-line forum for learning in addition to the time spent in a classroom and in its provision of student/student, student/faculty, and faculty/faculty interchange. Ellsworth reports that Concrete Experience and Active Participation styles proved to be more likely to select the electronically mediated strategies to assist them in learning. If one assumes that

students chose the on-line environment because they felt confident in their success and the success of the strategy employed, these findings support the idea that efficacy in an on-line environment is related to learning style.

Melara (1996) also used Kolb's Learning Style Inventory. Melara's study investigates the effect of learning styles on different hypertext environments. The two hypertext environments included hierarchical-like and network-like structures. Melara found that for the 40 subjects both structures were equally effective in accommodating students with different learning styles.

Clarina (1997) conducted a study in which computer assisted learning resulted in a shift in learning style preference, as defined by Kolb's Learning Style Inventory. The shift moved towards concrete experience and active experimentation. Higher ability groups experienced the greatest shift. Clarina contends that these results may indicate that computer assisted learning results in more active learning, less reflection, and more risk taking. The results are interesting in that they seem to contradict the idea that an individual's learning style becomes relatively constant by adulthood.(Ayersman and Minden, 1995). If learning styles shift with computer assisted learning, then it would seem that learning style is nothing more than a function of comfort level; as the student becomes more comfortable with computer assisted learning, he or she uses it to a higher degree, resulting in the suggested increase in active learning and risk taking.

Gregorc Style Delineator

Davidson, Savenye, and Orr (1993)employed the Gregorc Style Delineator in

their study investigating the relationship between the learning style of adults and performance in a computer applications course. The study reports that learning style had a significant impact on performance. Those students having high abstract sequential ability demonstrated high scores, while learners with a dominance in abstract random style had lower scores, as measured by grades on class projects and exams.

Perceptual Modality

Overbaugh's (1993) study of the effects of instructional content, brief instructional activities, and learning modality on Teacher Education students' computer anxiety found no significant relationship between learning modality and computer anxiety.

Overbaugh (1995) explored computer assisted instruction and learner differences in another study, of the efficacy of interactive video for teaching basic classroom skills to pre-service teachers. In another study Overbaugh administered the learning modality inventory developed by Barbe and Milone that identifies individuals as auditory, visual, kinesthetic, or a combination. Overbaugh excluded those with dual modalities and, because there were only two, he also excluded kinesthetic learners. The exclusion of kinesthetic learners, while a sound scientific decision, is unfortunate because there is an assumption in the literature that computer aided instruction is a viable means of adjusting to the style of the Kinesthetic learner. Overbaugh also considers class rank, computer anxiety, and grade point average.

These variables are correlated with the dependent variables of achievement and stages of concern. In terms of learning modality, the treatment, a combination of visual and auditory material, did not result in a significant difference between visual and auditory learners.

Summary

Embark upon a search for sound evidence of the relationship between learning modality and efficacy when using instructional technology, and one becomes painfully aware of how little evidence there is. Two axioms seem to exist: 1) There is evidence supporting the premise that there is a relationship between attention to learning style in the classroom and student achievement and 2) The use of computers in the classroom has a positive impact on student achievement. The question regarding the strength of the relationship between these two axioms is only beginning to be explored. The above studies exploring this question suggest that a relationship does exist and that there is sufficient reason to explore it.

CHAPTER III

Methodology

Introduction

The purpose of the study was to explore the relationship between perceptual learning modality and the use of an on-line learning environment to achieve non-technology related course objectives. The following discussion presents the methodology used in the development and execution of the study, including research design, subjects, instrumentation, instruction, data collection, and data analysis.

Research Design: The study was a descriptive exploration of the relationship between perceptual learning modality and efficacy in the use of an on-line learning environment to achieve non-technology related course objectives. The independent study variable was perceptual learning modality. The dependent study variable was efficacy in the use of an on-line learning environment to achieve non-technology related course objectives.

Subjects: Subjects participating in this study voluntarily enrolled in upper level Education classes that were part of CaseNET, Internet-based Courses for Teachers and Other Educators. Three classes, at Dayton University, the University Nebraska at Omaha, and the University of Virginia participated in the study. All subjects were adult students working towards an undergraduate or graduate degree in Education.

Materials: Class materials were available exclusively to CaseNET participants, with a valid user name and password, via the Internet. Internet materials were organized in a frame page, http://casenet.edschool.virginia.edu/. The materials available included, but were not limited to: Introduction, providing a description of CaseNET, and sample curricula; Curricula and Instruction, which included the class syllabus, links to all assigned readings, and tutorials; Talking with Each Other, which included biographies of participants, and were organized in teams of 3-5 students, journals, discussion forums, and videoconferencing; The Virtual Librarian, which provided an opportunity to ask the Virtual Librarian questions via e-mail and a link to the ERIC Database; Keeping in Touch, which provided a communication forum between participating students and between students and instructors, and Help, which provided an opportunity to ask questions of an instructor via e-mail.

Variation in content occurred according to each university's class content area which was either Teaching across the Content Areas, Standards of Learning and Assessment, or Using Technology to Solve Problems in Schools. Students in each content area were assigned to read professional articles specific to their content area, in addition to the cases read by every class. All areas were included in the CaseNET syllabus.

All subjects participated in the reading and discussion of the same cases which demonstrated situations encountered in the field of Education. Discussion took place in local class settings and in an online forum including 14 classes from participating

universities. The discussion was either part of a string, in which participants posted a response, or was done via CU-SeeMe software which allowed for real time discussion between universities, including audio and video elements. Internet discussion forums were limited to CaseNET participants.

Procedures

This study was conducted in accordance with the CaseNET syllabus which encompassed 13 sessions. The syllabus is included as Appendix A. The students were asked to complete the Perceptual Modality Preference Inventory and the Exit Survey on the Internet at the provided URLs. The surveys were designed as forms in Claris Home Page 3.0. A database to collect the student responses was then set up in FileMaker Pro 4.0. Thus, after students had completed the survey, by clicking on their response, they submitted their answers to the FileMaker Pro file. For the Perceptual Modality Preference survey, their perceptual modality preference was immediately calculated based on their answers and their preference was returned on the screen.

Instrumentation:

Subjects completed two surveys. The Sensory Modality Preference Inventory was adapted from existing Learning Style Inventory literature (Wyman 1996) and piloted in a pre-service teacher education class before being used in math manipulative research. (Mooney, 1997). The Sensory Modality Preference Inventory was used to identify subjects as Auditory, Tactile, or Visual Learners. The Sensory Modality Preference Inventory is a 24 item test. For each question, subjects were

asked to choose one of three answers: OFTEN = 5 points, SOMETIMES = 3 points, and SELDOM = 1 point. Select demographic information was collected at this time also, including: GPA, gender, computer ownership, level of Internet experience, and level of computer experience.

The Exit Survey was developed specifically for this study in order to measure students' level of efficacy in relation to the CaseNET class format. The survey consisted of 31 questions. The first ten questions asked students to rate ten statements on a lickert scale, indicating positive or negative reactions to the CaseNET class, with 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree. Next, subjects were asked to rate how important six reasons for enrolling in the CaseNET class were for them, using a lickert scale, with 1 = not at all important, 2 = somewhat important, 3 = important, 4 = very important, and 5 = extremely important. Subjects were then asked to compare CaseNET to their traditional classes (lecture and text based) on a lickert scale, with 1 = less (interesting) (potential to increase knowledge) (potential to impact thought process), 2 = about the same (in interest), (potential to increase knowledge) (potential to impact thought process), and 3 = more (interesting) (potential to increase knowledge) (potential to impact thought process). The final six questions asked subjects how they completed their assignments. The final three questions addressed GPA and computer accessibility.

Data Collection

Both surveys were made available via the Internet. Subjects completed the Sensory Modality Preference Inventory, as a form online, by clicking on their answers. Their

answers were immediately recorded in a database as a record identified by their e-mail address. The database then calculated their scores and returned their sensory modality preference on the screen. The exit survey was taken at the end of the course. For each question, students were asked to rate their agreement with a series of statements. This survey was placed online in the same method as the Sensory Modality Preference Inventory. Students indicated their answers by clicking on their choice. Records were recorded in a database and matched according to the subjects' e-mail address, as it was recorded for the Sensory Modality Preference Inventory.

Data Analysis

Because this study used a convenience sample and was exploratory in nature, only a limited attempt was made to make inferences to the general population. The results of the exit survey were analyzed using descriptive statistics produced in SPSS-X 7.75. A cross tabulation, with a chi square, was done, for each exit survey question, by perceptual modality preference. Only significant findings were examined further. The mean and standard deviation were also calculated for each question and then sorted by sensory modality preference, as determined by the Sensory Modality Preference Inventory.

An efficacy score was calculated for each respondent. For those questions in which a high number indicated a high sense of efficacy, questions 1,2,6-9,17,19-22, the original codes were used. For those questions which indicated a low sense of efficacy; questions 4-5, and 10, the codes were inverted so that a high number indicated a high sense of efficacy (1=5, 2=4, 4=2, 5=1). A sum of questions 1, 2, 4-

10, and 19-22 was calculated for each respondent, resulting in the efficacy score. On a range of 13-57, a high score indicates a high sense of efficacy. A mean score was then determined for auditory, visual, and tactile learners. In order to calculate a score for adaptation, answers to questions number 23-24 and 26-28 on the Exit Survey were used. The codes for questions number 23 and 28, 1 and 2, were inverted so that a meaningful comparison could be made with other questions determining adaptation, where a higher score represented a lower occurrence of adaptation. Question number 25 was eliminated due to suspected vagueness in it's wording. For each question, the responses of auditory, visual, and tactile learners were averaged, resulting in three averages, auditory, visual, and tactile, for each question. Next a mean was calculated for the sum of the questions indicating adaptation, based on the group's average response to questions 23-24 and 26-28, resulting in the adaptation score for each perceptual modality group (auditory score = mean {Q23 + Q24 +Q26 +Q27 + Q28}/5). A mean for the sample was then calculated using all responses for Q23-Q24 and Q26-Q28.

CHAPTER IV

Data Analysis

Introduction:

The purpose of this study was to investigate a possible relationship between perceptual learning modality and level of efficacy in a graduate level education course, which incorporated the Internet as a means of achieving course objectives not related to technology. Two questions were explored:

1.) Is there a difference in feelings of efficacy, in a course which uses Internet technology to achieve non-technology related course objectives, for auditory, visual, and tactile learners?

2.) Is there a difference in the use of adaptation techniques for tactile, visual, and auditory learners in their use of Internet course materials to achieve course objectives?

The data were transferred from the FileMaker Pro file, where it was submitted from the Internet, to Excel '97 and then to SPSS-X 7.75. Data analysis included a cross tabulation, with chi-square analysis, of each Exit Survey question by perceptual modality preference. Only significant findings are discussed. Further, a report was produced which identified the mean and standard deviation for each Exit Survey question by perceptual modality preference groups.

Results:

Scores

1. Subjects with an auditory learning modality preference scored an average of 49.60

on the Exit Survey questions indicating high efficacy, with a range of 13-56 and a mean of 42.66. A high score indicates high efficacy, thus the score of 49.50 represents relatively high efficacy.

2. Subjects with a visual learning modality preference scored an average of 41.00 on the Exit Survey questions indicating high efficacy, with a range of 13-57 and a mean of 42.66. A high score indicates high efficacy, and thus the score of 41.00 represents below average efficacy, relative to the other modalities in the sample.
3. Subjects with a tactile learning modality preference scored an average of 41.58 on the Exit Survey questions indicating high efficacy, with a range of 13-57 and a mean of 42.66. A high score indicates high efficacy, and thus the score of 41.58 represents a level of efficacy that is only slightly below average for the sample.
4. Subjects with an auditory learning modality preference had an adaptation score of 1.48, with a range of 1-2 and a mean of 1.62. A high score indicates low adaptation, thus the score of 1.48 represents a relatively high level of adaptation.
5. Subjects with a visual learning modality preference had an adaptation score of 1.66, with a range of 1-2 and a mean of 1.62. A high score indicates low adaptation, thus the score of 1.66 represents relatively a relatively low level of adaptation.
6. Subjects with a tactile learning modality preference had an adaptation score of 1.63, with a range of 1-2 and a mean of 1.62. A high score indicates low adaptation, thus the score of 1.63 represents a relatively average level of adaptation.

Significant Findings

1. Question 6 on the Exit Survey, where students were asked to rate their level of agreement with the statement: This class was more enjoyable than my traditional classes (lecture based), the relationship, a chi square of 16.268 with 8 degrees of freedom, between perceptual modality preference and the results was significant at the .05 level, based on the chi square.
2. Question 10 on the Exit Survey, where students were asked to rate their agreement with the statement: Having to complete assignments on the Internet interfered with my ability to complete them, the relationship, a chi square of 15.763 with 8 degrees of freedom, between perceptual modality preference and the findings were significant at the .05 level, based on the chi square.
3. Question 21 on the Exit Survey, where students were asked to rate the potential of the CaseNET course to impact thought process, in relation to their traditional courses the relationship, a chi square of 8.704 with 4 degrees of freedom, between perceptual modality preference and the findings are significant at the .10 level, based on the chi square.

Table I

Table I demonstrates the frequency of Auditory, Visual, and Tactile learners, as well as the percentage of each group in the total sample.

Perceptual Modality Preference	Frequency	Percent
Auditory	5	16.7%
Visual	13	43.3%
Tactile	12	40.00%
Total	30	100%

Table II

Table II provides descriptive statistics for the responses of Auditory, Visual, and Tactile learners to each Exit Survey question. The table indicates how each group responded to the elements of the CaseNET course.

Codes for the Exit Survey

Questions 1 - 10

1=Strongly disagree
2=Disagree
3=Neutral
4=Agree
5=Strongly agree

Questions 1 - 16

1=Not at all important
2=Somewhat important
3=Important
4=Very important
5=Extremely important

Questions 17 - 19

1=Less enjoyable
2=About the same in enjoyment
3=More enjoyable

Questions 20 - 22

1=Lower potential to increase knowledge
2=The same potential to increase knowledge
3=Higher potential to increase knowledge

Questions 23 - 28

1=Yes
2=No

Questions 29 - 30

4.0=4.0
3.5=3.5
3.0=3.0
2.5=2.5
2.0=2.0

Question 31

1=Yes 2=No

Case Summaries

Perceptual Modality Preference		Q1 - I've enjoyed the CaseNET class	Q2 - I would recommend CaseNET to other college students	Q3 - I would take a class in another subject area if it was offered in a format similar to the CaseNET format	Q4 - I felt the CaseNET format interfered with my communication with the class instructor	Q5 - I was frustrated by having to complete course assignments on the Internet	Q6 - This class was more enjoyable than my "traditional" classes (lecture based)	Q7 - I felt I had a greater ability to interact with my fellow students in the CaseNET format than in my traditional courses (lecture based)	Q8- I felt I was capable of completing the requirements of this class
Auditory	N	5	5	5	5	5	5	5	5
	Mean	4.4000	4.8000	4.8000	1.4000	1.2000	4.8000	4.6000	5.0000
	Std. Deviation	.8944	.4472	.4472	.8944	.4472	.4472	.5477	.0000
Visual	N	13	13	13	13	13	13	13	13
	Mean	3.9231	3.8462	3.9231	2.1538	2.4615	3.3846	3.3846	4.2308
	Std. Deviation	1.1152	1.2142	1.1875	1.2142	1.5607	1.1929	1.3868	1.1658
Tactile	N	12	12	12	12	12	12	12	12
	Mean	3.6667	4.0000	3.6667	2.4167	2.6667	3.5833	3.5833	3.6667
	Std. Deviation	1.1547	.9535	1.0731	1.3790	1.3707	1.0836	1.2401	1.4975
Total	N	30	30	30	30	30	30	30	30
	Mean	3.9000	4.0667	3.9667	2.1333	2.3333	3.7000	3.6667	4.1333
	Std. Deviation	1.0939	1.0483	1.0981	1.2521	1.4223	1.1492	1.2685	1.2794

Case Summaries

Perceptual Modality Preference		Q9 - I felt I had adequate communication with the course instructor	Q10 - Having to complete assignments on the Internet interfered with my ability to complete them	Q11 - Reason for enrolling in CaseNET class: To become more successful	Q12 - Reason for enrolling in CaseNET class: It was required for my program	Q13 - Reason for enrolling in the CaseNET class: Interest in case based study	Q14 - Reason for enrolling in the CaseNET class: Interest in interdisciplinary studies	Q15 - Reason for enrolling in the CaseNET class: to get a better job	Q16 - Reason for enrolling in the CaseNET class: Interest in computers
Auditory	N	5	5	5	5	5	5	5	5
	Mean	5.0000	1.8000	3.4000	3.4000	4.2000	4.0000	2.8000	4.2000
	Std. Deviation	.0000	1.0954	1.8166	2.1909	1.0954	1.0000	2.0494	.8367
Visual	N	12	13	13	13	13	13	13	13
	Mean	4.2500	2.6923	3.1538	3.6154	3.3846	3.4615	2.6154	3.9231
	Std. Deviation	1.1382	1.6525	1.2142	1.5566	1.2609	1.0500	1.2609	1.0377
Tactile	N	12	12	12	12	12	12	12	12
	Mean	4.0833	2.2500	3.5000	3.6667	3.3333	3.5833	2.0000	4.0833
	Std. Deviation	.9962	1.4222	1.0871	1.3707	1.3707	1.3790	.9535	.7930
Total	N	29	30	30	30	30	30	30	30
	Mean	4.3103	2.3667	3.3333	3.6000	3.5000	3.6000	2.4000	4.0333
	Std. Deviation	1.0037	1.4735	1.2411	1.5447	1.2798	1.1626	1.3025	.8899

Case Summaries

Perceptual Modality Preference		Q24 - When completing reading assignments in CaseNET did you read them on the computer screen and take notes on paper	Q25 - When completing reading assignments in CaseNET did you read them on the computer screen and take notes in a word processing program	Q26 - When completing reading assignments in CaseNET did you print them before reading	Q27 - When particiapting in online discussions did you compose on paper and then type answers	Q28 - When participating in online discussions did you compose on the computer without doing so on paper first	Q29 - Has your GPA in graduate school been about:
Auditory	N	5	5	5	5	5	4
	Mean	1.8000	2.0000	1.2000	1.4000	1.6000	3.3750
	Std. Deviation	.4472	.0000	.4472	.5477	.5477	.4787
Visual	N	13	13	13	13	13	13
	Mean	1.6923	1.9231	1.3077	1.9231	1.0000	3.3846
	Std. Deviation	.4804	.2774	.4804	.2774	.0000	.5064
Tactile	N	12	12	12	12	12	12
	Mean	1.7500	1.9167	1.2500	1.8333	1.1667	3.5417
	Std. Deviation	.4523	.2887	.4523	.3892	.3892	.3965
Total	N	30	30	30	30	30	29
	Mean	1.7333	1.9333	1.2667	1.8000	1.1667	3.4483
	Std. Deviation	.4498	.2537	.4498	.4068	.3790	.4501

Case Summaries

Perceptual Modality Preference		Q30 - Has your GPA in undergraduate school been about:	Q31- Do you have a computer at home
Auditory	N	5	5
	Mean	3.8000	1.4000
	Std. Deviation	.4472	.5477
Visual	N	13	13
	Mean	3.9231	1.2308
	Std. Deviation	.1878	.4385
Tactile	N	12	12
	Mean	3.9167	1.1667
	Std. Deviation	.1946	.3892
Total	N	30	30
	Mean	3.9000	1.2333
	Std. Deviation	.2421	.4302

Table III

Table III reports the mean adaptation scores for auditory, visual, and tactile learners. The adaptation score was calculated in order to provide a measure of how each modality manipulated their environment. Adaptation techniques are those techniques that attempt to manipulate the environment in order to imitate the conditions in which a student may have greater efficacy. For example, if a tactile learner were to have a low sense of efficacy in the use of an on-line environment to achieve non-technology related course objectives he or she may print the assigned readings, in order to simulate a text book. Therefore, it is assumed that students with a low sense of efficacy would manipulate the environment in order to adapt the tools to their perceptual modality preference. If high adaptation occurs, it is suspected that a technology environment is inappropriate.

	Auditory	Visual	Tactile	Mean for Sample
Mean Adaptation Score Range = 1-2 2 = Low Adaptation	1.48	1.66	1.63	1.62

Table IV

Table IV illustrates the frequency and percentage of computer owners by perceptual modality preference. This is intended to provide further insight into the adaptation score. It is suspected that those students who have a computer at home would find it more convenient to comply with the spirit of the CaseNET format, using technology to achieve non-technology related course objectives, and, therefore, would have a lower rate of adaptation.

Q 31. Do you have a computer at home?	Frequency	Percent of Modality Group	Percent of Computer Owners	Percent of Total Sample
Auditory N=5	3	60%	13.04%	10%
Visual N=13	10	76.92%	43.47%	33.33%
Tactile N=12	10	83.33%	43.47%	33.33%
Total N=30	23	76.66%	100%	76.66%

Table V

Table V reports the mean efficacy score for auditory, visual, and tactile learners, as well as the mean for the sample. The efficacy score is a measurement of the students' perceived level of confidence in achieving desired course outcomes using the Internet as a medium for learning, based on their responses to specified questions on the Exit Survey.

	Auditory	Visual	Tactile	Mean for Sample
Mean Efficacy Score Range = 13-57 57 = High Efficacy	49.60	41.00	41.58	42.66

Table VI

Table VI is a cross tabulation of Question 6 on the Exit Survey by perceptual modality preference, including a chi-square test. The chi-square indicates a potential relationship between the two variables, perceptual modality preference and agreement with the statement: This class was more enjoyable than my traditional classes (lecture based). The significance level was targeted at .05.

Perceptual Modality Preference * I've enjoyed the CaseNET class

Crosstab

			I've enjoyed the CaseNET class			
			Strongly Disagree	Disagree	Neutral	Agree
Perceptual Modality Preference	Auditory	Count			1	1
		% within Perceptual Modality Preference			20.0%	20.0%
		% within I've enjoyed the CaseNET class			14.3%	11.1%
		% of Total			3.3%	3.3%
	Visual	Count	1		2	6
		% within Perceptual Modality Preference	7.7%		15.4%	46.2%
		% within I've enjoyed the CaseNET class	100.0%		28.6%	66.7%
		% of Total	3.3%		6.7%	20.0%
	Tactile	Count		2	4	2
		% within Perceptual Modality Preference		16.7%	33.3%	16.7%
		% within I've enjoyed the CaseNET class		100.0%	57.1%	22.2%
		% of Total		6.7%	13.3%	6.7%
Total		Count	1	2	7	9
		% within Perceptual Modality Preference	3.3%	6.7%	23.3%	30.0%
		% within I've enjoyed the CaseNET class	100.0%	100.0%	100.0%	100.0%
		% of Total	3.3%	6.7%	23.3%	30.0%

Crosstab

			I've enjoyed the CaseNET Strongly Agree	Total
Perceptual Modality Preference	Auditory	Count	3	5
		% within Perceptual Modality Preference	60.0%	100.0%
		% within I've enjoyed the CaseNET class	27.3%	16.7%
		% of Total	10.0%	16.7%
	Visual	Count	4	13
		% within Perceptual Modality Preference	30.8%	100.0%
		% within I've enjoyed the CaseNET class	36.4%	43.3%
		% of Total	13.3%	43.3%
	Tactile	Count	4	12
		% within Perceptual Modality Preference	33.3%	100.0%
		% within I've enjoyed the CaseNET class	36.4%	40.0%
		% of Total	13.3%	40.0%
Total		Count	11	30
		% within Perceptual Modality Preference	36.7%	100.0%
		% within I've enjoyed the CaseNET class	100.0%	100.0%
		% of Total	36.7%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.108[a]	8	.423
Likelihood Ratio	9.014	8	.341
Linear-by-Linear Association	1.528	1	.216
N of Valid Cases	30		

a. 15 cells (100.0%) have expected count less than 5. The minimum expected count is .17.

Table VII

Table VII is a cross tabulation of Question 10 on the Exit Survey by perceptual modality preference, including a chi-square test. The chi-square indicates a possible relationship between the two variables, perceptual modality preference and agreement with the statement: Having to complete assignments on the Internet interfered with my ability to complete them. The significance level targeted was .05.

Perceptual Modality Preference * Having to complete assignments on the Internet interfered with my ability to complete them

Crosstab

			Having to complete assignments on the Internet interfered with my ability to complete them			
			Strongly Disagree	Disagree	Neutral	Agree
Perceptual Modality Preference	Auditory	Count	3		2	
		% within Perceptual Modality Preference	60.0%		40.0%	
		% within Having to complete assignments on the Internet interfered with my ability to complete them	23.1%		66.7%	
		% of Total	10.0%		6.7%	
	Visual	Count	4	4		2
		% within Perceptual Modality Preference	30.8%	30.8%		15.4%
		% within Having to complete assignments on the Internet interfered with my ability to complete them	30.8%	80.0%		33.3%
		% of Total	13.3%	13.3%		6.7%
	Tactile	Count	6	1	1	4
		% within Perceptual Modality Preference	50.0%	8.3%	8.3%	33.3%
		% within Having to complete assignments on the Internet interfered with my ability to complete them	46.2%	20.0%	33.3%	66.7%
		% of Total	20.0%	3.3%	3.3%	13.3%
Total		Count	13	5	3	6
		% within Perceptual Modality Preference	43.3%	16.7%	10.0%	20.0%
		% within Having to complete assignments on the Internet interfered with my ability to complete them	100.0%	100.0%	100.0%	100.0%
		% of Total	43.3%	16.7%	10.0%	20.0%

Crosstab

			Having to complete assignments Strongly Agree	Total
Perceptual Modality Preference	Auditory	Count		5
		% within Perceptual Modality Preference		100.0%
		% within Having to complete assignments on the Internet interfered with my ability to complete them		16.7%
		% of Total		16.7%
	Visual	Count	3	13
		% within Perceptual Modality Preference	23.1%	100.0%
		% within Having to complete assignments on the Internet interfered with my ability to complete them	100.0%	43.3%
		% of Total	10.0%	43.3%
	Tactile	Count		12
		% within Perceptual Modality Preference		100.0%
		% within Having to complete assignments on the Internet interfered with my ability to complete them		40.0%
		% of Total		40.0%
Total		Count	3	30
		% within Perceptual Modality Preference	10.0%	100.0%
		% within Having to complete assignments on the Internet interfered with my ability to complete them	100.0%	100.0%
		% of Total	10.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	15.763[a]	8	.046
Likelihood Ratio	17.684	8	.024
Linear-by-Linear Association	.062	1	.804
N of Valid Cases	30		

a. 13 cells (86.7%) have expected count less than 5. The minimum expected count is .50.

Table VIII

Table VIII is a cross tabulation of Question 21 on the Exit Survey by perceptual modality preference, including a chi-square test. The chi-square indicates a possible relationship between the two variables, perceptual modality preference and level of potential (higher, lower, the same) the students agreed that the class had to impact thought process, with a significance at .01.

Perceptual Modality Preference * Think about what you take away from your traditional lecture based classes in terms of Increased Knowledge, Thought Processes, and Confidence in the Content Area. Would you say this class had:

Crosstab

			Think about what you take away from your traditional lecture based classes in terms of Increased Knowledge, Thought Processes, and Confidence in the Content	
			Lower potential to impact thought process	The same potential to impact thought process
Perceptual Modality Preference	Auditory	Count		
		% within Perceptual Modality Preference		
		% within Think about what you take away from your traditional lecture based classes in terms of Increased Knowledge, Thought Processes, and Confidence in the Content Area. Would you say this class had:		
		% of Total		
	Visual	Count		6
		% within Perceptual Modality Preference		46.2%
		% within Think about what you take away from your traditional lecture based classes in terms of Increased Knowledge, Thought Processes, and Confidence in the Content Area. Would you say this class had:		85.7%
		% of Total		20.7%
	Tactile	Count	2	1
		% within Perceptual Modality Preference	16.7%	8.3%
		% within Think about what you take away from your traditional lecture based classes in terms of Increased Knowledge, Thought Processes, and Confidence in the Content Area. Would you say this class had:	100.0%	14.3%
		% of Total	6.9%	3.4%

Crosstab

		Think about what you take away from your traditional lecture based classes in terms of Increased Knowledge, Thought Processes, and Confidence in the Content	
		Lower potential to impact thought process	The same potential to impact thought process
Total	Count	2	7
	% within Perceptual Modality Preference	6.9%	24.1%
	% within Think about what you take away from your traditional lecture based classes in terms of Increased Knowledge, Thought Processes, and Confidence in the Content Area. Would you say this class had:	100.0%	100.0%
	% of Total	6.9%	24.1%

Crosstab

			Think about what you take away from your traditional lecture based Higher potential to impact thought process	Total
Perceptual Modality Preference	Auditory	Count	4	4
		% within Perceptual Modality Preference	100.0%	100.0%
		% within Think about what you take away from your traditional lecture based classes in terms of Increased Knowledge, Thought Processes, and Confidence in the Content Area. Would you say this class had:	20.0%	13.8%
		% of Total	13.8%	13.8%
	Visual	Count	7	13
		% within Perceptual Modality Preference	53.8%	100.0%
		% within Think about what you take away from your traditional lecture based classes in terms of Increased Knowledge, Thought Processes, and Confidence in the Content Area. Would you say this class had:	35.0%	44.8%
		% of Total	24.1%	44.8%
	Tactile	Count	9	12
		% within Perceptual Modality Preference	75.0%	100.0%
		% within Think about what you take away from your traditional lecture based classes in terms of Increased Knowledge, Thought Processes, and Confidence in the Content Area. Would you say this class had:	45.0%	41.4%
		% of Total	31.0%	41.4%

Crosstab

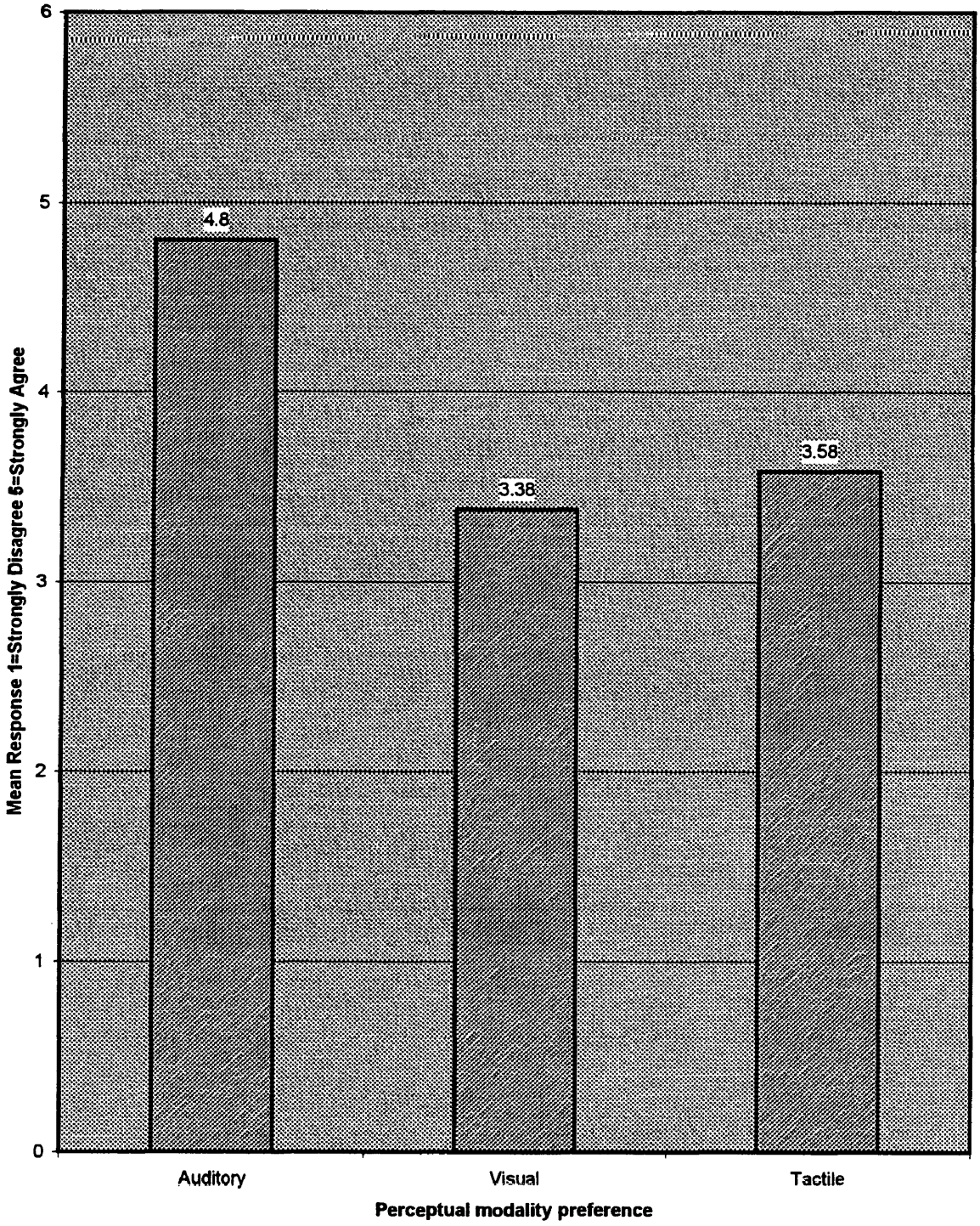
		Think about what you take away from your traditional lecture based: Higher potential to impact thought process	Total
Total	Count	20	29
	% within Perceptual Modality Preference	69.0%	100.0%
	% within Think about what you take away from your traditional lecture based classes in terms of Increased Knowledge, Thought Processes, and Confidence in the Content Area. Would you say this class had:	100.0%	100.0%
	% of Total	69.0%	100.0%

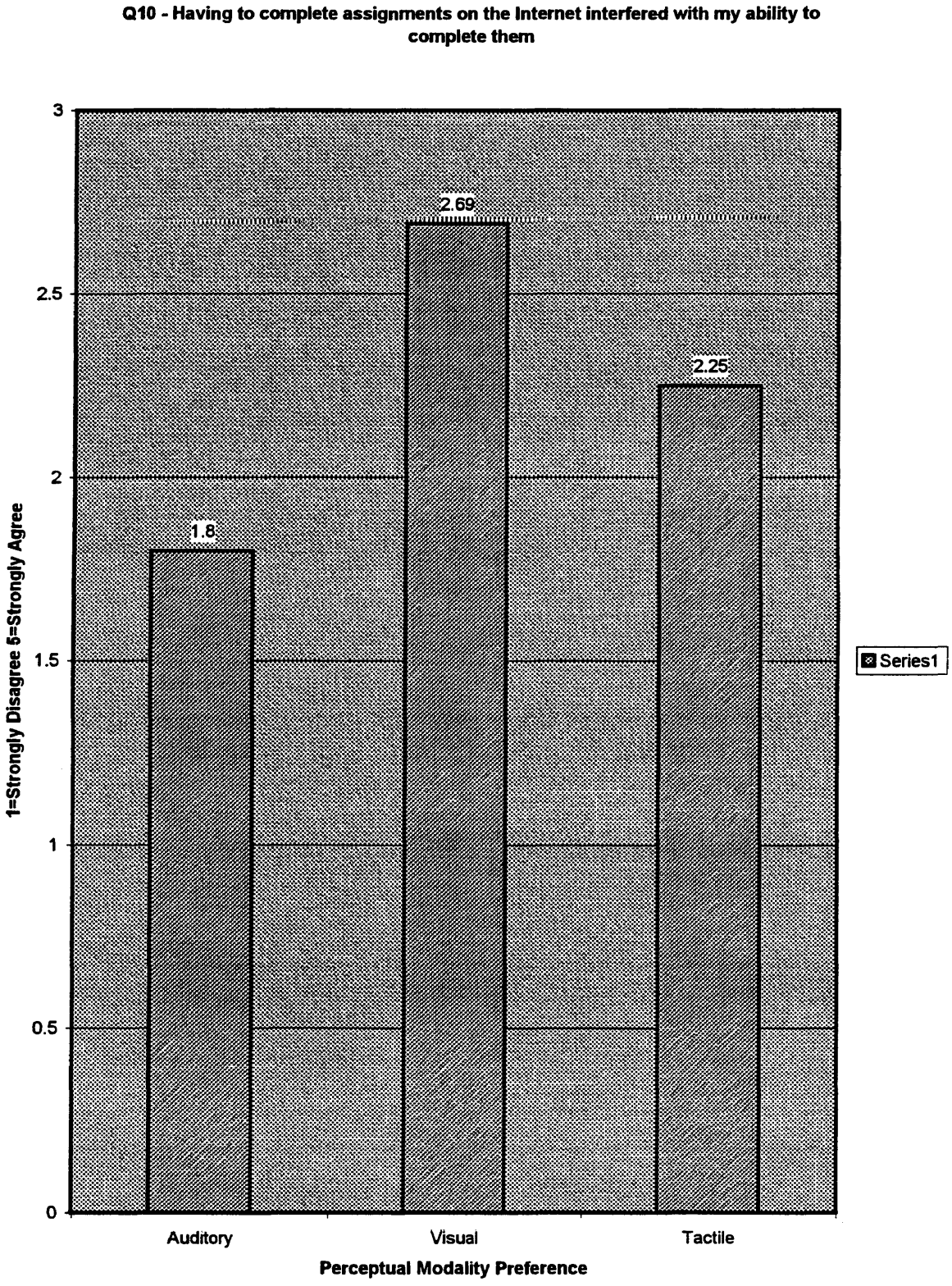
Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.704[a]	4	.069
Likelihood Ratio	10.199	4	.037
Linear-by-Linear Association	.724	1	.395
N of Valid Cases	29		

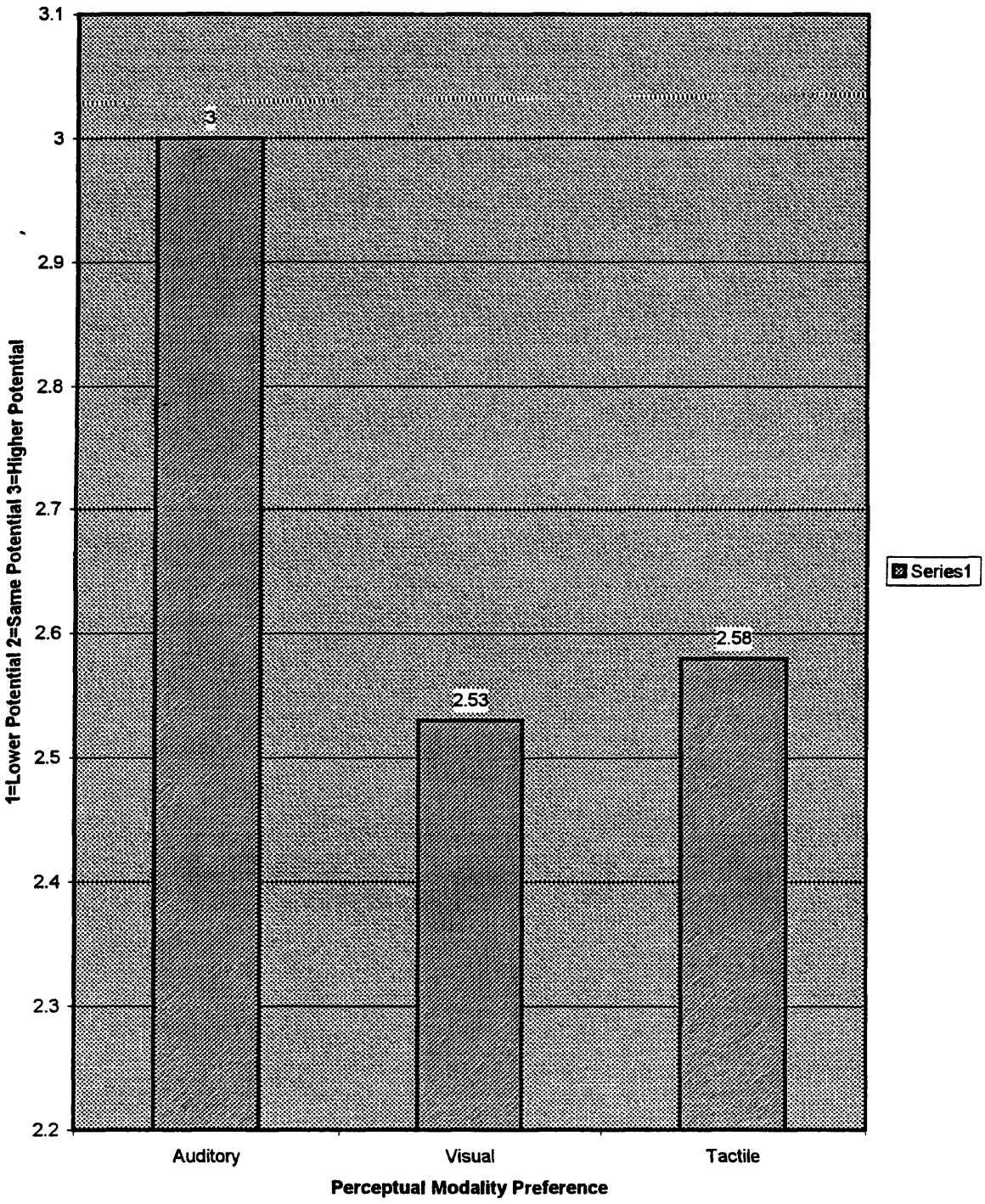
a. 7 cells (77.8%) have expected count less than 5. The minimum expected count is .28.

Question 6 - This class was more enjoyable than my traditional classes (lecture based)




Q10 - Having to complete assignments on the Internet interfered with my ability to complete them
1=Strongly Disagree 5=Strongly Agree
3
2.5
2
1.5
1
0.5
0
1.8
2.69
2.25
Auditory
Visual
Tactile
Perceptual Modality Preference
Series1

Q21 - Think about what you take away from your traditional lecture based classes... would you say this class had Lower potential to impact thought processes, The same potential to impact thought processes, or Higher potential to impact thought processes?



CHAPTER V

Discussion and Recommendations

Introduction:

This chapter discusses the results of an exploration of the relationship between perceptual learning modality and efficacy in the use of an on-line environment to achieve non-technology related course objectives. Included are a review of the study methodology, a discussion of the study results, and a review of limitations. Recommendations for further study are also offered.

Review of the study methodology:

This study investigated the relationship between perceptual learning modality and the use of an on-line environment to achieve non-technology related course objectives in an upper level education course administered through CaseNET. The CaseNET format is unique in that it encompasses education classes at several universities, in the United States and abroad. Universities participating in CaseNET offer a topical course through their campus and these individual classes meet on site in the classroom. Each class participates in the CaseNET forum through a uniform syllabus available on-line, in addition to the on site meetings. Class materials were available exclusively to CaseNET participants, with a valid username and password at http://casenet.edschool.virginia.edu. The course readings were included on-line and therefore could be read on the computer screen. Participants then discussed the readings

with all CaseNET members by posting their response in the appropriate area of discussion. The strings of discussion were available for all participants to read. Other discussions were conducted using CU-SeeMe software which allowed the participants to discuss a topic in real time with both audio and video elements. There was also one common plenary session with a guest speaker. Three of the 14 CaseNET schools participated in the study. Thirty-one subjects completed both the perceptual modality inventory and the exit survey. One subject had an unbreakable tie for perceptual modality preference and was therefore dropped.

The surveys used in this study were placed on the Internet as a form, using Claris Home Page 3.0 and FileMaker Pro 4.0. In the development of the form, choices were coded. Therefore, the codes for the respondents' answers were automatically entered into the data file, depending on their response. The URL, http://ois.unomaha.edu/modality for the Sensory Modality Preference survey, and http://ois.unomaha.edu/exit for the exit survey, was used by the participants, who then completed the survey and submitted it to the server. Their answers were then saved in the software package, FileMaker Pro.

The methodology of the study, specifically the use of an on-line survey, proved to be an extremely effective means of conducting on-line research. Subjects were chosen to participate and provided their e-mail address for verification, therefore avoiding random persons interfering in the research if they happened upon the survey on the Internet and submitted a response. Having the survey responses coded prior to placing the survey on the Internet also eliminated data entry tasks. Also valuable, was the simplicity in having a multiple university sample. All of the subjects could complete the surveys on the Internet,

eliminating the task of distributing the materials via mail. If there was a problem with the submission of their responses, they could be e-mailed and asked to re-submit their responses in a timely manner.

Discussion of the results:

In order to have an effective discussion of the results of this thesis study, the significance of the problem should be revisited. This investigation, of the relationship between perceptual learning modality and efficacy in the use of an on-line learning environment, was the result of an observation that computers are increasingly used in educational environments, with a positive impact on achievement (Kulik and Kulik, 1991), and that attention to students' learning styles may increase learning (Dunn, et al., 1995). The question then became, is the use of the computer as a mode of instruction an efficacious means of considering students' learning style? Answering this question will require a deeper inquiry than the present thesis study. However, considering that the range of possible scores for efficacy is 13-57 and that the mean efficacy score for the sample was 42.66, it appears that no perceptual modality group had a dramatically low sense of efficacy in the use of the on-line learning environment to achieve non-technology related course objectives. These findings support the idea that the use of instructional technology in the classroom may be a means of providing a mode of instruction that is efficacious to students of varying learning styles.

However, returning to the question of whether there is a relationship between perceptual learning modality and efficacy in the use of an on-line learning environment to achieve non-technology related course objectives, the findings of this study do merit a

further inquiry into the efficacy of auditory, visual, and tactile learners in such an environment. This is not to say that the on-line learning environment is adverse to any perceptual modality group, but rather that the assumption that it is a multi-sensory experience, and therefore compliments all perceptual modalities, ought to be further explored before investing in instructional technology primarily on this basis.

Auditory Learners

While initially surprising, the auditory learners' high level of efficacy in the use of the computer to achieve non-technology related course objectives is somewhat logical. The auditory learner learns well through interaction with others and the Internet expands the opportunity for such discussion. The CU-SeeME sessions, which allowed for real-time discussions with students in the CaseNET class at other universities, may have contributed to the auditory learners' high efficacy as well. These discussions allow the auditory learner to hear other opinions on the subject matter as well as the opportunity to voice their own thoughts. Additionally, auditory learners had a relatively high rate of adaptation. This may account for their high level of efficacy, due to their ability to change the environment to meet their needs.

Visual Learners

It was predicted that adaptation would have a strong impact on efficacy due to the greater effort it added to the intake process. Thus, it is interesting to note that visual learners had the lowest rate of adaptation, but that as a group they also had the lowest sense of efficacy; while the auditory learners had the highest occurrence of adaptation, and also the highest efficacy score.

Tactile Learners

The idea that using the computer is a tactile experience, discussed in the literature, suggests that tactile learners would have a particularly high level of efficacy in the use of on-line materials to achieve non-technology related course objectives, which they did not. A possible explanation may be that the use of the computer is not necessarily a tactile experience. The tactile learner, in the on-line environment of this study, is using his or her hands, but in fact is not manipulating the object of study he or she is attempting to understand. Using the computer to retrieve information, to read, or to participate in discussion does not necessarily aid the tactile learner in understanding subject matter which is not computer-related. The computer may be a vehicle for retrieving and viewing the information, and for delivering one's thoughts, but the tactile learner is not physically experiencing the information.

If the use of the computer were in fact a tactile experience one would expect to see a very low level of adaptation among tactile learners. In fact, the adaptation level is average.

Limitations of the study:

As discussed in Chapter I, this study had several limitations. Most imperative is the relatively non-experimental design and small percentage of auditory learners. Also, only perceptual learning style is considered. It may be that other learning style factors have a stronger influence on efficacy in the use of the computer.

Recommendations for Further Study:

The results of this investigation clearly mandate a further consideration of the relationship between perceptual learning modality preference and the use of the computer as a learning tool. The study is indeed limited by its non-experimental design, yet there is an apparent difference in the responses of auditory, visual, and tactile learners. The assumption that the computer offers a multi-sensory learning environment needs to be re-examined in further investigations. The following are suggestions for further study:

- It is often assumed that auditory learners prefer in-class experiences with an instructor, and therefore would possibly not do well in exclusively on-line courses or distance learning. Considering the high sense of efficacy among the auditory learners in this study, additional research regarding the opportunities the Internet offers for discussion and the impact those opportunities have on the efficacy of auditory learners would be valuable in the development of exclusively on-line or correspondence courses.
- As educators consider computer-based instruction, a further exploration of the specific elements of instructional technology - the use of the keyboard and mouse, the visual stimuli, and the opportunity for expanded discussion - as they are perceived by auditory, visual, and tactile learners may provide a better understanding of their efficacy. It would be valuable to determine what it is about these elements that makes efficacious for varying perceptual modalities.
- Future research on the topic of instructional technology ought to pay special attention to the adaptation techniques students use, in order to determine if they are having to

alter their environment in order to achieve the desired outcome and whether the benefits of the technology outweigh these efforts.

- The Sensory Modality Preference Inventory, used to determine perceptual modality preference in this study, does not determine a secondary preference. A strong secondary preference may have an impact on learners' efficacy in the use of an on-line environment. More accurate instrumentation for determining learning modality, including secondary preferences, may help to further probe the efficacy of auditory, visual, and tactile learners in the use of instructional technology.
- Ann M. Quade (1996) completed a study assessing retention and depth processing associated with note-taking, using either pencil and paper, or an on-line notepad, in computer-delivered instruction. As she noted in her study, there is very little research exploring the act of taking notes using the computer. Quade reports that there was a difference between the control group, which took no notes, and the treatment group, which took notes in an on-line computer notepad. Quade contends that this difference supports on-line note-taking. In this thesis study, there was no attempt to study the impact of how participants took notes in the on-line learning environment. However, participants were asked if they took notes in a word processing program on the computer. Keeping in mind that subjects had the option of reading the articles and other assignments on-line, and could copy and paste from the reading to a word processing program, 6.7 percent of the total sample reported that yes, they took notes using the a word processing program on the computer. Participants were also asked if they took notes on paper. 26.7 percent of the total sample reported yes, they took

notes on paper. It would be interesting to further explore the note-taking habits of students in an on-line environment, particularly a further exploration of Quade's question of the relationship between note-taking using an on-line notepad and retention and depth processing. Further research along this line ought to focus on the relationship between the act of copying and pasting on-line, as a means of note-taking, and retention.

Call to Action

The use of instructional technology is increasing at a rapid rate. As with any innovation, educators and researchers need to determine criteria by which to evaluate its use. The results of this study suggest that one such criteria ought to be learning style.

If learning is better achieved by varying modes of instruction in order to accommodate learning style, then clearly, it ought to be a criteria for introducing innovative instructional strategies. The results of this study further suggest that there may be a difference in the efficacy of auditory, visual, and tactile learners when using instructional technology, and, that they may be adapting to accommodate the use of technology. Thus, educators must exercise due diligence in considering what they know about learning style when using instructional technology as a mode of instruction.

Given that varying instruction to accommodate learning style has a positive impact on student learning, and that efficacy in the use of instructional technology is possibly related to learning style, it is incumbent upon researchers to further explore the relationship between learning style and the use of instructional technology in order to determine those environments which maximize student learning.

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Appendix A

CascNET Syllabus

Contemporary Issues: Interdisciplinary Teaching and Learning
TED 8600 -- Spring 1997

Instructor:
Neal W. Topp, UNO; Joanne M. Herbert,UVA; Robert F. McNergney, UVA; and faculty from institutions of higher education across the United States and Canada).

Course Description:

Students will concentrate on multi- or interdisciplinary teaching and learning in elementary, middle, and secondary schools across the land.

Course contents will be delivered in a case-based format via the Internet (World-Wide Web, video conference, discussion groups, and electronic mail), videotape, and written materials. The purpose of the course will be to prepare teachers to cooperate and compete across disciplines to address educational problems as they occur in interdisciplinary studies, and as they reveal themselves in our rapidly changing, culturally diverse world.

To function effectively in this course, individuals and teams of teachers must be able to navigate the Internet. Although this will not be a course about the Internet per se, we shall offer some instruction in rudimentary technological skills. By using the Internet to teach high-interest cases, we shall help teachers sharpen those skills naturally within the context of the course.

The course is dedicated to guided practice that will help students: (1) recognize issues and problems in cases, (2) consider situations from multiple points of view, (3) examine personal, theoretical, and empirical knowledge relevant to a particular case, (4) forecast possible actions that might be taken in a case and in similar situations, and (5) speculate about the consequences of such actions, or consider how results of teaching and learning might be appraised.

Instructors will also coach students to work in teams and will guide students in matters of written and verbal presentation of case analyses. During the last part of the course students will work in teams to analyze the same case across sites and will submit their analyses to a panel of judges noted for their expertise in educational practice and professional problem solving. Judges will compare teams' performances to a set of performance standards and award scores.

In addition, students will write their own cases and prepare those cases for on-line publication. Finally, students will evaluate both the worth and merit of the course and will offer suggestions for improvement.

Course Requirements:

Completion of weekly assignments, team case analyses, and an individually written case.

Course Schedule

THERE IS ONE COMMON SESSION ON **April 8, 1996 Plenary Session On-line: Special Guest, 7:00-8:00 EST**

Session 1. (Monday, January 20, 1997, 4:15 p.m.).
"Introduction to Course and Technology Requirements"

TECH TIP:
(a) Prior to this session be sure NETSCAPE is installed on your computers and that helper applications are installed and configured on each machine.

(b) Arrange to have e-mail accounts assigned to each student, if they do not already have them. (c) Set up mailing list for your class.

Introductions of class members.
Divide class into teams of 4-5 for entire semester.

Course overview--goals & objectives, schedule, materials, grades.

Web tutorial, introduction to e-mail (You may need local technical assistance.)

Explore Casecourse Web site.

Have students visit the Virtual librarian's page and, as a class, post a question about interdisciplinary teaching and learning. They might, for example, ask for tip on finding information about planning for instruction, evaluating the results of instruction, or where to find information on interdisciplinary studies.

Teams write group bios and take team photo.

Each team member will contribute to the team bio by providing an autobiographical statement in no more than 25 words.

Be sure to pick a team name.

One member of each team e-mails group bio to the course e-mail address (casecomp@virginia.edu).

Instructor mails team photos (with names and e-mail addresses) to Joanne Herbert at 298 Ruffner, 405 Emmet St. , Charlottesville, VA 22903)

Instructor also e-mails brief bio to the course e-mail address (casecomp@virginia.edu) and sends color photo via U.S Mail.

HOMEWORK ASSIGNMENT (to be completed before the next session): Kain, D.L. (1993, March).

Helping teams succeed:
An essay review of groups that work and those that don't: Creating conditions for effective teamwork. Middle School Journal, 24 (4), 25-31.

Session 2. (January 27, 1997). "The Importance of Teamwork in Case Analysis"

TECH TIP:

(a) Make sure you are familiar with Hyper News before this session.
(b) After you and your students view and discuss the Columbus video, place the Columbus video on reserve in the library, so students can revisit the videotape at their convenience.

Revisit home page of the course.

Questions / comments.

Introduce students to the five-step reflection process found on the Homepage.

View Columbus case.

Role play perspectives (or step #2 from the 5-step process) of Dennis, Lynda, and Paula (The woman with short brown hair who says she felt "cheated" by going to U.S. schools and missing out on the knowledge of Mexican culture).

As a class, discuss the remaining 4 steps of the reflection process (issues, knowledge, actions, consequences).

Introduce the concept of "critical perspective."

Help students locate Hyper News.

Explain how to read a critical perspective on the case of Columbus.

Introduce Hyper News.

Have students read at least one of the critical perspectives on Columbus posted on Hyper News.

Make sure that about one-half of the group reads the Haberman perspective and the other half reads the Casanova perspective.

These must be read before session 3.

HOMEWORK ASSIGNMENT (to be completed before the next session): Read a critical perspective on Columbus video and the multimedia case "All the News That's Fit to Teach."

Students complete HyperNews Tutorial.

Session 3. (February 3, 1997). "The Importance of Leadership and Multiple Perspectives"

TECH TIP:

In this session students must be able to post comments to Hyper News.

These postings will be done as individuals and then as teams.

Make sure your students understand the difference between posting an article and posting a response to an article.

Questions/comments?

Discuss critical perspectives for Columbus.

Have each student log into Hyper News and post one comment about the Columbus video that he or she read in a perspective or one comment made by a colleague that she or he found especially important.

Divide into teams to analyze the multimedia case (All the News That's Fit to Teach).

Instructor uses nominal group technique to debrief teams about issues and perspectives in the case.

Identify team captains.

Teams seek additional knowledge relevant to the resolution of the multimedia case (e.g., interview individuals in local educational community, contact Virtual Librarian, go to the library). Work in teams to craft a team analysis (addressing ONLY knowledge, actions, consequences). Captain posts analysis on Hyper News (by September 14) so other teams at home and at other instructional sites can read it.

HOMEWORK ASSIGNMENT (to be completed before the next session): Fogarty, R. (1991, October). Ten ways to integrate the curriculum. Educational Leadership, 49 (2), 61-65.

Session 4. (February 10, 1997). Dealing With Competing Points of View.

TECH TIP:

In this session you will introduce CU-SeeMe technology. Each site will hook up with UVA at a time convenient for both parties. Remember to have a telephone and speaker phone nearby as a back-up in case there is some difficulty with the computer technology.

Discussion of reading.

Examine case responses to "All the News That's Fit to Teach" from several teams other than your own.

Discuss their reactions to this multimedia case.

View videotaped perspectives on "All the News..." done by Rudy Ford and Eric Wee. Have students get into their teams and list 3-4 comments they remember hearing Eric and/or Rudy make about the case.

These will form the basis of the on-line discussion with an expert from UVA.

Have students begin thinking of problem(s)/issue(s) they have encountered either as a student or as a teacher for eventual development of your own case.

HOMEWORK ASSIGNMENT (to be completed before the next session): Each team selects a particular multimedia case and individuals read it before the next session.

Instructors select time from those provided on the schedule (forthcoming) to connect as a class with UVA during the next week (September 16-20).

Topics for on-line discussion will include questions, problems, issues identified by students--for example, why is it important to seek multiple points of view in case analysis?

What role should knowledge play in case analysis?

Have you been surprised by other people's analyses or perspectives?

Session 5. (February 17, 1997).

Stretching to Consider Other Cases of Interdisciplinary Studies.

TECH TIP:

(a) Instructor reviews procedures for posting to HyperNews, making certain that captains understand their responsibilities. HyperNews will contain headings under which analyses for particular sites will be posted.

(b) Remind students that they may want to consult the Virtual Librarian for relevant information.

Each team uses class time to prepare a partial analysis of the multimedia case they have read for homework. Teams address EITHER (1) issues/problems and perspectives/values of players, OR

(2) relevant knowledge, possible actions, likely consequences. LIMIT RESPONSES TO NO MORE THAN 250 WORDS OR ONE MANUSCRIPT PAGE PER ITEM.

Instructor draws attention to the on-line teaching notes for the cases.

The notes should help guide students' thinking as they approach their first team analysis.

Team captains post analyses to Hyper News no later than Sunday, September 29th.

HOMEWORK ASSIGNMENT (to be completed before the next session): Students access Hyper News and read others' perceptions of the case they analyzed.

Read the John McCullum case for discussion in the next session.

Session 6.

(February 24, 1997) Evaluating Others' Responses to Interdisciplinary Cases.

TECH TIP:

Prepare for Cu-SeeMe teleconference. Sites need to exchange the IP addresses of the machines they will be using. Point-to-point connections will yield better audio than use of reflectors. This might be a good time to connect with one other site using CU-SeeMe for the purpose of discussing students' reactions to the analyses of the John McCullum case.

The easiest way to schedule such a session will be from one instructor to another.

Also, e-mail addresses of individual students can be found in the bio section.

Teams discuss others' responses to the case they analyzed the previous week.

Students read two sample analyses of the John McCullum case. Students use forms provided by the instructor to evaluate both sample analyses.

The whole group discusses their ratings of the analyses of John McCullum case.

(This is an excellent opportunity to distinguish between more and less acceptable analyses of cases.)

OPTION:

Two sites might like to connect using CU-SeeMe to discuss their perceptions of the McCullum case and the analyses of that case.

HOMEWORK ASSIGNMENT (to be completed before the next session): Read McNergney, R.F., (1994, December). Videocases: A way to foster a global perspective on multicultural education. Phi Delta Kappan, 76 (4), 296-298.

Session 7.

(March 3, 1997) Learning About Others and About Ourselves from an International Case.

Discuss readings.

Students work through Project Cape Town, either individually or in teams (http://curry.edschool.Virginia.EDU/go/capetown/)

HOMEWORK ASSIGNMENT (to be completed before the next session): Read McNergney, R.F., Herbert, J.M., & Ford, R.E. (1994, November-December).

Cooperation and competition in case-based teacher education. Journal of Teacher Education, 45 (5), 339-345.

This article will be available on line from the Virtual Librarian.
March 10, 1997 - NO CLASS - SPRING BREAK

Session 8.

(March 17, 1997) How to Compete Professionally.

Discuss readings.

Questions/problems?

View video on past competitions and discuss process, noting norm-referenced vs. criterion-referenced assessment.

Lay out local schedules for e-mail communications among team members for new competition case.

Meet the judges whose profiles will be available on line.

Read and discuss the rules for the competition, available on line.

Let the contest begin!

(Teams begin to analyze the competition case.)

HOMEWORK ASSIGNMENT (to be completed before the next session):

No formal assignment.

Teams work on the competition case.

Session 9.

(March 24, 1997)

Teamwork for a Purpose.

Teams work on competition case.

They may spend no more than 6 hours developing an analysis that focuses on the five areas listed on the evaluation form.

Documents may be no longer than 5 single-spaced pages or 2500 words.

HOMEWORK ASSIGNMENT (to be completed before the next session): Teams continue to work on competition case.

This offers an opportunity to seek professional knowledge in its many forms--practical, theoretical, empirical--to buttress the argument a team will present in its analysis. Remember the Virtual Librarian.

Remember also that "knowledge" is not always codified; that is, students might want to interview knowledgeable people in the community about issues reflected in the case.

Read: Brophy, J., & Alleman, J. (1991). A caveat: Curriculum integration isn't always a good idea. Educational Leadership, 49 (2), 66; Palmer, J.M. (1991). Planning wheels turn curriculum around. Educational Leadership, 49 (2), 57-60.

Session 10.

(March 31, 1997)

Making Public Statements About Professional Practice.

Discuss readings.

Teams meet to compare notes and to prepare and post final analysis of competition case.

Captain posts analysis to Hyper News.

Direct instruction on how to write a case.

REMEMBER:

Students' cases should be fictionalized.

HOMEWORK ASSIGNMENT (to be completed before the next session): Each student is to begin outlining the highlights of the case he or she will write.

Read the posting for the upcoming plenary session.

Every student should write one question that might be asked at the plenary session.

Read: (to be determined).

Session 11.

**April 8, 1997

On-line Plenary Session:

Special Guest, 7:00-8:00 EST**

TECH TIP:

Prepare for CU-SeeMe Teleconference

The first half of class is devoted to participation in the CU-SeeMe plenary session.

Details will be forthcoming.

During the last part of class, instructors hold small-group sessions where individuals discuss briefly their ideas for cases, and the group makes suggestions. (Be sure to consult the guidelines for writing cases posted on the home page.)

HOMEWORK ASSIGNMENT (to be completed before the next session): Individuals begin writing their cases.

Each person should come to the next session with (a) a brief description of his or her case and (b) a list of what she or he thinks will be the main issues in the case.

Both items should be submitted to the instructor.

Session 12.

(April 14, 1997)

Refining Cases and Examining Teams' Results.

TECH TIP:

Visit Strunk and White on line
(http://www.columbia.edu/acis/bartleby/strunk/)

Individuals share the brief descriptions of their cases with colleagues.

Students refine their cases based on feedback.

The session is devoted to individual writing with feedback and suggestions from the instructor as needed.

You might want to remind students that they must protect the anonymity of characters in the case.

For commonly acceptable writing standards, refer students to Strunk & White on-line. They should also have their final draft proofread by the instructor before posting it. The final date to post a case is November 29th.

HOMEWORK ASSIGNMENT (to be completed before the next session): Consult suggestions for good writing provided on line and continue writing individual cases.

Session 13.

(April 21, 1997) More and Less Acceptable Case Analyses.

TECH TIP:

Remind students that they will be posting their cases to Hyper News no later than November 29th and that they must have them approved by the instructor before doing so.

Assign teams to read particular analyses of the competition case. (For example, they might read one analysis from each of five sites.

Or they might read all the analyses from a particular site.)

Have each team share their perceptions of the analyses they read and discuss the judges' evaluations of those analyses.

Do students agree or disagree with the judges?

Why or why not?

Instructors encourage students to revisit particular analyses and judges' comments, drawing attention to dissenting points of view about the judges' ratings. Discussion might revolve around these kinds of questions: What makes a good analysis?

What is the difference between a "fair" and a "biased" judgment? Should judgments of student performance be translated into grades? If so, how?

If not, why?

HOMEWORK ASSIGNMENT (to be completed before the next session): Students finish writing their cases, have them approved by the instructor, and post them to Hyper News.

Session 14.

(April 28, 1997) - Multidisciplinary Studies:

Past and Future.

Instructor does whatever he or she deems appropriate.

Students evaluate the course using the on-line evaluation form and any other forms instructors wish to use.

Concluding Assignment: Have students read two cases of their choice and write a one-page (250 words) reaction paper.

Appendix B

Sensory Modality Preference Inventory and scoring procedure

SENSORY MODALITY PREFERENCE INVENTORY

Directions:

Sensory modality preferences are of three types visual, auditory and tactile. To identify your modality preference answer each question by selecting the best answer as it pertains to you. This will allow you to evaluate the way you prefer to learn or process information. You will then be able to develop strategies which will enhance your learning potential.

This survey is not timed. Read each question carefully and decide which of the three responses agrees with how you feel about the statement.

I'm ready - take me to the survey!

Email Address (for validation only): _____

1) I prefer to learn about a subject through the lecture method with an opportunity for explanations and class discussions.	O Often	O Sometimes	O Seldom
2) I prefer to have information presented through writing on the chalkboard or with the use of visual aids.	O Often	O Sometimes	O Seldom
3) I do well in classes where most of the information has to be read.	O Often	O Sometimes	O Seldom
4) When I make things for my classes, I remember what I have learned better.	O Often	O Sometimes	O Seldom
5) I prefer a verbal explanation of materials to graphs ordiagrams.	O Often	O Sometimes	O Seldom
6) I enjoy working with my hands and/or making things.	O Often	O Sometimes	O Seldom
7) I enjoy making graphs and charts and I am good at it.	O Often	O Sometimes	O Seldom
8) I find it easier to remember what I have heard than what I have read.	O Often	O Sometimes	O Seldom
9) Writing spelling words down several times helps me to remember them.	O Often	O Sometimes	O Seldom
10) I can understand and follow directions on maps.	O Often	O Sometimes	O Seldom
11) I do better in subjects that allow for tapes and listening to lectures.	O Often	O Sometimes	O Seldom
12) I tend to play with keys, coins and similar objects.	O Often	O Sometimes	O Seldom
13) Saying the multiplication tables aloud helped me to remember them better than writing them down.	O Often	O Sometimes	O Seldom
14) I prefer reading newspapers rather than listening to the news on the radio.	O Often	O Sometimes	O Seldom
15) While I am studying I chew gum, smoke or snack.	O Often	O Sometimes	O Seldom
16) I feel the best way to remember something is to picture it in your head.	O Often	O Sometimes	O Seldom
17) I remember phone numbers by writing them out in the air (finger spelling)	O Often	O Sometimes	O Seldom
18) I prefer learning by having information read aloud to me rather than quietly reading it by myself.	O Often	O Sometimes	O Seldom
19) I am good at working and solving puzzles.	O Often	O Sometimes	O Seldom
20) I grip objects in my hands during the learning period. (notebooks, pencil)	O Often	O Sometimes	O Seldom

21) I prefer listening to the news on the radio rather than reading about it in the newspaper. O Often O Sometimes O Seldom

22) I gather information on subjects I am interested in by reading relevant materials. O Often O Sometimes O Seldom

23) When I sign up for a class I always hope that most of the learning will come from lab experiments or field study. O Often O Sometimes O Seldom

24) I find it easier to follow oral directions than written ones. O Often O Sometimes O Seldom

25) What response best describes your current position?

O Teacher O Administrator O Technology Coordinator (no teaching)

O Media Specialist O Support Staff

26) If you are a teacher, what area are you assigned?

O Elementary or Self-contained O Language Arts O Math

O Foreign Language O Social Studies O Science

O Family and Consumer Science O Industrial Technology

O Business O Physical Education O Music O Art

27) What grade level are you assigned?

O PreK-3 O 4-6 O 7-8 O 9-12 O K-6 O K-12

28) What is your degree status at this time?

O BA/BS O BA/BS+15 O Masters O Masters+15 O Doctorate

29) What is your age?

O Under 30 O 30-39 O 40-49 O 50-59 O 60 or over

30) What is your gender?

O Female O Male

31) I would rate my level of computer experience as:

O Below Avg O Average O Above Avg

32) I would rate my level of internet experience as:

O Below Avg O Average O Above Avg

Reset Values | Submit My Responses to OIS Server

SCORING PROCEDURES:

Place the point value on the line next to the corresponding item. Add the points in each column to obtain the preference scores under each heading

OFTEN = 5 pts.
SOMETIMES = 3 pts.
SELDOM = 1 pts.

VISUAL NO.	PTS.	AUDITORY NO.	PTS.	TACTILE NO.	PTS.
2	_____	1	_____	4	_____
3	_____	5	_____	6	_____
7	_____	8	_____	9	_____
10	_____	11	_____	12	_____
14	_____	13	_____	15	_____
16	_____	18	_____	17	_____
19	_____	21	_____	20	_____
22	_____	24	_____	23	_____

VPS = APS = TPS =

VPS = Visual Preference

APS = Auditory Preference

TPS = Tactile Preference

If you are a **VISUAL** learner, be sure that you look at all study materials. Use charts, maps, videos and notes. Practice viualizing words/concepts in your head.

If you are an **AUDITORY** learner, sit in the classroom where you can hear well. Use tapes, videos, lectures, and discussions. After you have read something, summarize it and recite it outloud.

If you are a **TACTILE** learner use manipulatives and three dimensional materials. Use study sheets and resources that are touchable, moveable and readable.

Appendix C

Exit Survey

Exit Survey for CaseNET Participants

Directions:

Thank you for taking the time to participate in this study. This survey is not timed. It is designed to measure how comfortable you are, as an auditory, visual, or tactile learner, with classes like CaseNET. Read each question carefully. Your answers are confidential.

Your E-mail Address _____ (Manditory)

Please rate the following on a scale ranging from 1 to 5. (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree).

1. I've enjoyed the CaseNET Class	1	2	3	4	5
2. I would recommend CaseNET to other college students	1	2	3	4	5
3. I would take a class in another subject area if it was offered in a format similar to the CaseNET format	1	2	3	4	5
4. I felt the CaseNET format interfered with my communication with the class instructor	1	2	3	4	5
5. I was frustrated by having to complete course assignments on the Internet	1	2	3	4	5
6. This class was more enjoyable than my "traditional" classes. (lecture based)	1	2	3	4	5
7. I felt I had a greater ability to interact with my fellow students in the CaseNET format than in my traditional courses. (lecture based)	1	2	3	4	5
8. I felt I was capable of completing the requirements of this class	1	2	3	4	5
9. I felt I had adequate communication with the course instructor	1	2	3	4	5
10. Having class assignments on the Internet interfered with my ability to complete them	1	2	3	4	5

The following are some possible reasons for enrolling in CaseNET. Please rate how important each of them was for you (1 = Not at all important, 2 = Somewhat important. 3 = Important. 4 = Very important. 5 = Extremely important)

11. To become more successful	1	2	3	4	5
12. It was required for my program	1	2	3	4	5
13. Interest in case based study	1	2	3	4	5
14. Interest in interdisciplinary studies	1	2	3	4	5
15. To get a better job	1	2	3	4	5
16. Interest in computers	1	2	3	4	5
17. Think about your traditional classes, where you are required to read a text and discussions take place in class. Did you find this class:	More enjoyable			Less enjoyable	
	About the same in enjoyment				

Exit

18. Think about your traditional classes, where you are required to read a text and discussions take place in class. Did you find this class:	More difficult Less difficult About the same in difficulty
19. Think about your traditional classes, where you are required to read a text and discussions take place in class. Did you find this class:	More interesting Less interestin About the same level of interest

Think about what you take away from your traditional lecture based classes in terms of **increased knowledge, thought processes, and confidence in the content area.** Would you say this class has a *higher* potential to help you achieve these objectives, the *same* potential, or a *lower* potential to:

20. increase knowledge?	Higher potential to increase k Lower potential to increase kn The same potential to increase knowledge
21. to impact thought process?	Higher potential to impact tho processes Lower potential to impact tho processes The same potential to impact t processes
22. to increase confidence in content area?	Higher potential to increase c in content area Lower potential to increase co in content area The same potential to increase confidence in content area.
23. When completing reading assignments in CaseNET did you read them on the computer screen and take no notes?	Yes No
24. When completing reading assignments in CaseNET did you read them on the computer screen and take notes on paper ?	Yes No
25. When completing reading assignments in CaseNET did you read them on the computer screen and take notes in a word processing program	Yes No
26. When completing reading assignments in CaseNET did you print them before reading?	Yes No
27. When participating in online discussions did you compose on paper and then type answers?	Yes No
28. When participating in online discussions did you compose on the computer without doing so on paper first?	Yes No

29. Has your GPA in graduate school been about:	4.0	3.5	3.0	2.5	2.0
30. Has your GPA in graduate school been about:	4.0	3.5	3.0	2.5	2.0

Thank You

Submit Reset

Appendix D

IRB Approval Forms

University of Nebraska at Omaha
College of Education

Office of the Dean
Omaha, Nebraska 68182-0161
(402) 554-2719
FAX (402) 554-2879

January 6, 1998

Dr. Ernest Prentice
Institutional Review Board
Eppley Science Hall 3018
University of Nebraska Medical Center
Omaha, Nebraska 68198-6810

Dear Dr. Prentice,

I am a graduate student in the Department of Teacher Education at the University of Nebraska at Omaha pursuing a Master's Degree in Secondary Education. As part of my thesis research I will be working in collaboration with the CaseNet project as it is incorporated in TED 8600 Contemporary Issues: Interdisciplinary Teaching and Learning at UNO. CaseNet is a partnership among universities which provides course contents via the Internet. I will be evaluating the relationship between students' learning modality and their perception of achievement in a course which incorporates online technology as a means of achieving course objective not related to technology as it occurs in this course during the Spring semester, 1998. The class will begin on January 19, 1998. Data collection will begin upon approval.

Please refer to the enclosed IRB Request for Exemption Form which provides an extended explaination of my study. I believe the study qualifies as exempt within the IRB guidelines. Also enclosed is a copy of the student informed consent letter and a letter granting of approval from the Department of Education at the University of Nebraska at Omaha.

If you have any questions, please do not hesitate to contact me at UNO, 554-4911, or at home, 334-6815. Dr. Neal Grandgenett, an associate professor at the University of Nebraska at Omaha, is acting as my advisor. If needed, you may also contact Dr. Grandgenett at 554-2690.

Thank you for considering my request. I look forward to hearing from you.

Sincerely,

Patricia Michelle Nickel

University of Nebraska
Institutional Review Board
For the Protection of
Human Subjects

University of Nebraska Medical Center
Eppley Science Hall 3018
600 South 42nd Street
Omaha, NE 68198-6810
(402) 559-6463
Fax (402) 559-7845

EXEMPTION FORM

SECTION I: APPLICATION DATA

TITLE OF RESEARCH PROPOSAL: The Relationship Between Learning Modality and the Use of Online Technology in Universiy Level Education Courses

STARTING DATE: January 19, 1998

PRINCIPAL INVESTIGATOR: Patricia Nickel

SECONDARY INVESTIGATOR(S): Dr. Neal Topp, Dr. Neal Grandgenett

DEPARTMENT/COLLEGE: Department of Teacher Education/College of Education

ADDRESS: 3018 S. 126th Plaza #79, Omaha, Nebraska ZIP CODE: 68144

TELEPHONE: Home: 334-6815 Work: 554-4911

SECTION 2: CERTIFICATION

CERTIFICATION OF PRINCIPAL INVESTIGATOR: Signature certifies that the research project as described will be conducted in full compliance with University of Nebraska Regulations governing human subject research as stated in the IRB Guidelines for the Protection of Human Subjects. It is understood that the IRB will be notified of any proposed changes which may affect the exempt status of the research.

Signature of Principal Investigator

1-5-98
Date

Graduate Assistant
Position

ADVISOR APPROVAL: Student investigators are required to obtain approval from their advisor. Signature of approval certifies the research proposal has been approved and recommended for submission to the IRB.

Signature of Advisor

1-5-98
Date

Neal Grandgenett
Printed Name of Advisor

The IRB requires submission of an original and one (1) copy of the Exemption Form.

SECTION 3: REVIEW INFORMATION

In order to determine whether your proposal qualifies for exempt status under 45 CFR 46:101(b), the IRB requests submission of the following information. Each subpart must be titled as described below and addressed in the listed sequence.

I. **PURPOSE OF THE STUDY.** State concisely and realistically what the research in this proposal is intended to accomplish.

II. **CHARACTERISTICS OF THE SUBJECT POPULATION.** Address the following questions in sequence using the listed subheadings.
   a. **AGE RANGE.** What is the age range of the subjects?
   b. **SEX.** What is the sex of the subjects?
   c. **NUMBER.** What is the anticipated number of subjects?
   d. **SELECTION CRITERIA.** What are the subject selection criteria?

III. **METHOD OF SUBJECT SELECTION.** Describe the method(s) to be employed in the identification/recruitment of prospective subjects.

IV. **STUDY SITE.** State the location(s) where the study will be conducted. Attach letters of approval from any non-University of Nebraska study site.

V. **DESCRIPTION OF PROCEDURES.** Describe all procedures to be applied to subjects. Attach one copy of all surveys, questionnaires, and educational tests.

VI. **CONFIDENTIALITY.** Describe how and the extent to which confidentiality of data will be maintained.

VII. **INFORMED CONSENT.** Some technically exempt research projects ethically require informed consent (written or oral). If, in the investigator's opinion, the study requires informed consent, the method used to obtain informed consent should be described and any written consent forms submitted. If the study does not require consent, it should be so stated and justified.

VIII. **JUSTIFICATION OF EXEMPTION.** The exempt category (1-6) under which the proposal is submitted should be stated and justified.

SECTION 4: CATEGORIES OF RESEARCH THAT QUALIFY FOR EXEMPT STATUS

Research activities in which the only involvement of human subjects will be in one or more of the categories specified by Federal Regulations 45 CFR 46:101(b) are exempt from the requirements of 45 CFR 46. Only an Exemption Form must be submitted and approved by the IRB. The exempt categories do not, however, apply to research involving deception of subjects (the researcher deceives the subject with regard to the purpose of the research and/or the results of the subject's actions in the study), sensitive behavioral research, or to research involving pregnant women, prisoners, mentally incompetent people and other subject populations determined to be vulnerable.

Exempt Categories:

1. Research conducted in established or commonly accepted educational settings, involving normal educational practices, such as: (i) research on regular or special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

   Educational research protocols are exempt providing all of the following conditions are met:

   a. All of the research is conducted in a commonly accepted educational setting (e.g., public school).

   b. The research involves normal educational practices (e.g., comparison of instructional techniques).

   c. The study procedures do not represent a significant deviation in time or effort requirements from those educational practices already existent at the study site.

   d. The study procedures involve no increase in the level of risk or discomfort attendant normal, routine educational practices.

   e. The study procedures do not involve sensitive subjects (e.g., sex education).

   f. Provisions are made to ensure the existence of a non-coercive environment for those students who choose not to participate.

   g. The school or other institution grants written approval for the research to be conducted.

   NOTE: When an educational research project meets all of the above-listed conditions the IRB does not require parental consent. The investigator and/or the school system may, however, decide that parental consent should be obtained. Verbal child assent should be obtained. Educational projects that do not meet the above-listed conditions are not exempt and must be reviewed by either the expedited or full Board method.

2. Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.

NOTE: Sensitive survey research is not exempt. A sensitive survey is one that deals with sensitive or highly personal aspects of the subject's behavior, life experiences or attitudes. Examples include chemical substance abuse, sexual activity or attitudes, sexual abuse, criminal behavior, sensitive demographic data, detailed health history, etc. The principal determination of sensitivity is whether or not the survey research presents a potential risk to the subject in terms of possible precipitation of a negative emotional reaction. An additional risk consideration is, of course, whether or not there is risk associated with a breach of confidentiality should one occur. With respect to potential psychological risk associated with a survey, the presence or absence of subject identifiers is not necessarily a consideration since the risk may be primarily associated with the sensitive nature of the survey as opposed to being dependent upon confidentiality. Subject identifiers do, however, become a factor when confidentiality is an issue.

NOTE: When children are involved as subjects in research using survey or interview procedures, the research is not exempt.

NOTE: When children are involved as subjects in research using observation techniques, the research is not exempt if the investigator participates in the activities being observed.

NOTE: Observation research involving sensitive aspects of a subject's behavior is not exempt.

3. Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph 2 of this section, if: (i) the human subjects are elected or appointed public officials or candidates for public office; or (ii) federal statute(s) require(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.

4. Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.

5. Research and demonstration projects which are conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine: (i) public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.

6. Taste and food quality evaluation and consumer acceptance studies: (i) if wholesome foods without additives are consumed or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the Food and Drug Administration or approved by the Environmental Protection Agency or the Food Safety and Inspection Service of the U.S. Department of Agriculture.

I. Purpose of the Study

The purpose of this study is to determine the relationship between learning modality and achievement in college level courses that incorporate online technology as a means of achieving course objectives not related to technology.

II. Characteristics of the Subject Population

a. Age Range: All of the participants will be enrolled in university courses and therefore will be at least 17 years of age.

b. Sex: Both male and female students will be included in the study.

c. Number: Approximately 17 - 35 students will participate in the study.

d. Selection Criteria: Those students who are enrolled in courses affiliated with CaseNet will be eligible for the study.

III. Method of Subject Selection

Students will be selected based on their enrollment in CaseNet courses.

IV. Study Site

The study will be based out of the College of Education at the University of Nebraska at Omaha. Students who do not attend UNO will complete surveys online.

V. Description of Procedures

A learning style inventory test will be administered at the beginning of the course. During the semester students at UNO will be observed and interviewed in order to determine their method of using the CaseNet materials. At the end of the course students will complete an exit survey asking them to rate their feelings of achievement as they relate to the course methods.

VI. Confidentiality

Findings will be reported as grouped data. Students will be

assigned an identification number in order to determine their learning modality in relation to their exit survey. Individuals names will not be used to report results. The the learning modality and exit survey data will be reported in an aggregate format. Observations will be tallyed without identification of the student. Interview verbatims will be reported without names and with the permision of the interviewee.

VII. Informed Consent

A document describing the study and requesting consent will be given to all eligible students. They will be informed that they are under no obligation to particıpate and that their decision will not affect their grade.

VIII. Justification of Exemption

1. Research is conducted in an estabished or commonly accepted educational setting with research on regular or special education instructional strategies and research on the effectiveness and comparison among instructional techniques.

a. The research is conducted in a commonly accepted educational setting, in particular at the University of Nebraska at Omaha.

b. The research involves normal educational practices as they exist in TED 8600 at UNO.

c. The study procedures do not represent a significant deviation from the time and effort requirements that already exist at the study site. Students will spend no more that thirty minutes on each the learning inventory and the exit survey.

d. The study procedures involve no increase in the level of risk or discomfort. The educational practices will not deviate from those already in place.

e. The study procedures do not involve sensitive subjects. Students are asked to assess their learning style and achievement.

f. Students who choose not to participate will still be actively involved in the class. They will not complete the learning inventory or exit survey.

g. The school grants written permission for the research to be conducted. A letter is attatched.

2. Information obtained is recorded in such a manner that human subjects cannot be identified directly or through identifiers linked to the subjects. Findings will be reported as group data.

University of Nebraska at Omaha
College of Education

Office of the Dean
Omaha, Nebraska 68182-0161
(402) 554-2719
FAX (402) 554-2879

December 19, 1997

Dr. Ernest Prentice
University of Nebraska Medical Center
600 S. 42 St.
Omaha, NE 68198

Dear Dr. Prentice:

This letter is in support of Ms. Patricia Nickel's proposed thesis. Ms. Nickel proposes to study the relationship between student's learning modality and their perception of achievement in an education course that incorporates on-line technology as a means of achieving course objectives not related to technology. Ms. Nickel has worked closely with her thesis advisor in the design of this study. I believe that the results of her study will greatly assist us in the advancement of computer assisted instruction.

It is my understanding that Ms. Nickel has submitted an application to the Institutional Review Board for approval. I strongly urge the Board's approval of this study.

Thank you for your attention to this matter. Should you have any questions concerning this letter, please do not hesitate to contact me.

Sincerely,

Robert A. Mortenson
Associate Dean

sp

bc: Patricia Nickel

University of Nebraska at Omaha
College of Education

Office of the Dean
Omaha, Nebraska 68182-0161
(402) 554-2719
FAX (402) 554-2879

Dear Student,

I have chosen your class, TED 8600 Contemporary Issues: Interdisciplinary Teaching and Learning, to participate in my thesis research study. I will be studying the relationship between Learning Modality and students' perceptions of achievement in a coure which incorporates online technology as a means of achieving course objectives not related to technology. You are under no obligation to participate. Your decision will not affect your grade.

If you choose to participate, your involvement will be straight forward. I will post a learning style inventory test, online, which will take about 15-20 minutes of class time. (Dr, Topp, can I use class time, or should I take that out?) During the semester I may ask your permision to observe how you use the computer to do your class work. I may also ask for a 15-20 minute interview. At the end of the course I will ask you to complete an exit survey, online, measuring your perception of achievement as it relates to the use of the online course materials. The exit survey will also take about 15-20 minutes of class time.(Dr. Topp?)

Your identity will be kept confidential. Your survey results will be coded according to a number you are assigned. No names will be used in the reporting of results.

I am very excited about this study. It will provide valuable insight into the incorporation of technology in education.

Thank you for your participation.

Sincerely,

Patricia Nickel

University
of Nebraska
Nebraska's Health Science Center

Institutional Review Board
For the Protection of
Human Subjects

University of Nebraska Medical Center
Eppley Science Hall 3018
600 South 42nd Street
Box 986810
Omaha, NE 68198-6810
(402) 559-6463
Fax (402) 559-7845

January 23, 1998

Patricia Nickel
3018 South 126th Plaza, #79
Omaha, NE 68144

IRB#: 009-98-EX

TITLE OF APPLICATION/PROTOCOL: The Relationship Between Learning Modality and the Use of Online Technology in University Level Education Courses

Dear Ms. Nickel:

The IRB has reviewed your Exemption Form for the above-titled research project. According to the information provided, this project is exempt under 45 CFR 46:101b, category 1. You are therefore authorized to begin the research.

It is understood this project will be conducted in full accordance with all applicable sections of the IRB Guidelines. It is also understood that the IRB will be immediately notified of any proposed changes that may affect the exempt status of your research project.

Please be advised that the IRB has a maximum protocol approval period of five years from the original date of approval and release. If this study continues beyond the five year approval period, the project must be resubmitted in order to maintain an active approval status.

Sincerely,

Ernest D. Prentice, PhD
Vice Chair, IRB

EDP:jlg

Appendix E

Annotated Table of Referenced Works

Annotated Table of Referenced Works

The following table was used by the author as a tool to classify the results of the literature search used in this study. As such, the writing and citation format are informal and are related to this study in particular.

Author, Citation study (s) background or editorial in nature (a)	**modality (m) technology(t) both(b) adult learning(a)**	**Significant Findings**
Dunn, Rita *Rita Dunn Answers Questions on Learning Styles* Educational Leadership, V 48 n2, October 1990 p. 15 **a**	m	Explains why different models exist and what the common thread is. & "Students are not failing because of the curriculum. Students can learn almost any subject matter when they are taught with methods and approaches responsive to their (style)"
Callan, Roger John *Learning Styles in the High School: A Novel Approach* NASSP Bulletin, February 1996 p.66 **a**	m	Used perceptual modality in his high school class room and had positive results - no data though - qualitative, briefly mentions efficacy.
O'Brien, Lynn *Learning Styles: Making the Student Aware* NASSP Bulletin, February 1996 p. 85 **a**	m	Good description of auditory, visual and "haptic" (kinesthetic)
Dunn, et al. *A Meta-Analytic Validation of the Dunn and Dunn Model of Learning Style Preferences* The Journal of Educational Research July/August 1995 Vol. 88 No. 6 p. 353 **s**	m	This analysis looked at 42 studies and determined that matching students learning style preferences with educational interventions compatible with those preferences is beneficial to their academic achievement. Also has definition of learning style and examines criticisms.
Billings, Diane M. and Cobb, Karen L. *Effects of Learning Style Preferences, Attitude and GPA on Learner Achievement Using Computer Assisted Interactive Videodisc Instruction* Journal of Computer - Based Instruction Winter 1992, Vol. 19, No. 1, p. 12 **s**	b	Convenience sample, adult students, "Computer assisted instruction appeals to a variety of learning styles" (but perceptual not mentioned)
Wallace, James *Accommodating*	m	Tactile learners love the computer, Auditory thrive

Elementary Students' Learning Styles Reading Improvement Spring 1995 Vol. 32, No. 1 p. 38. **a**		talking to others, percentages of each modality in population.
O'Neil, John *Making Sense of Style* Educational Leadership October 1990, p. 4 **a**	m	Keefe's definition of learning style, that's about it.
Quade, Ann M. *An Assessment of Retention and Depth of Processing Associated with Notetaking Using Traditional Pencil and Paper and On-line Notepad during Computer-Delivered Instruction.* Proceedings of Selected Research and Development at the 1996 National Convention of the Association for Educational Communications and Technology (18th, Indianapolis, IN, 1996) ED 397 825 **s**	b	Should be helpful in interpreting note taking/adaptation techniques
Davidson, Gayle V., et al. *How do Learning Styles Relate to Performance in a Computer Applications Course?* Journal of Research on Computing in Education V24 n3 p348-58, Spring 1992. **s**	b	Looks at performance in an undergraduate course in computer applications in education and finds that some learning styles performed better, but is not a perceptual modality test.
Anderson, Daniel K. *Theoretical Backgrounds: Internet for Training Teachers annd the Development of the HyperCard Internet Premier* Computers in the Schools v12 n1-2 p.73, 1996 **a**	b	Good theoretical background in both ed-tech and learning style, succinct.
Ellsworth, Jill H. *Electronically Mediated Learning Among Adults* Paper presented at the National Conference on the Adult Learner (Columbia, SC, May 1991) ED 337 704 **s**	b/a	Good on whether/what modalities will choose a course with computers, or choose electronically mediated learning strategies, which should be explained - but not perceptual style. College students.

Overbaugh, Richard C. *The Instructional Content, Brief Instructional Activities, and Learning Modality on Teacher Education Students' Computer Anxiety,* Paper Presented at the Annual Meeting of the Eastern Educational Research Association (16th, Clearwater Beach, FL, February 17-21, 1993) ED 354 876 **s**	b	No significant difference was found between learning modality and computer anxiety, unsurprising since the simulation was expected to be equally effective for visual and auditory learners - but, had two kinesthetic learners and dropped them.
Eastmond, Daniel V. *Learning Approaches of Adults Taking Computer Confrencing Courses*, Paper presented at the Annual Conference of the Northeastern Education Research Association (Ellensville, NY, October 28-30, 1992) ED 352 938 **s**	b/a	This study explores the learning-to-learn strategies of adults taking computer conferencing courses. Looks at how these students define effective learning and how they adapt to the medium. On-line strategies, processing on-line information.
Fletcher-Flynn, Claire M and Gravatt, Breon *The Efficacy of Computer Assisted Instruction (CAI): A Meat-Analysis,* Journal of Computing Education Research, Vol. 12 No. 3 1995, p. 219. **s**	t	Is better quality instruction provided by CAI materials? Means *effect* size. "The efficacy of CAI has been the subject of an ongoing debate for over a decade. Proponents tend to draw support from..."mentions Kulik and Kulik. Results for effective learning were the same for adult learners as for K-12 p.227
Kulik, Chen-Lin C. and Kulik, James A. *Effectiveness of Computer-Based Instruction: An Updated Analysis*, Computers in Human Behavior Vol. 7, 1991, p. 75. **s**	t	A meta-analysis of findings from 254 controlled evaluation K-12 and adults, positive effect. found that longer duration actually had less effect - reverse of what one would expect.
Skinner, Micheal E. *The Effect of Computer-Based Instruction on the Achievement of College Students as a Function of Achievement Status and Mode of Presentation* Computers in Human Behavior, Vol. 6, 1990, p. 351. **s**	t/a	Acknowledges that the efficacy of computer-based instruction is well documented, but looks at effect of specific setting, instructional design. Low achieving students benefit more than high achieving students. Adult students.

Clarina, Roy *Considering Learning Style in Computer-Assisted Learning* British Journal of Educational Technology Vol. 28 No. 1 1997, p. 66 **s**	b	Keefe's Definition of learning style. Proposes there is a shift in learning style - Kolb's, not perceptual - when CAI is used. Interesting idea.
Overbaugh, Richard *The Efficacy of Interactive Video for Teaching Basic Classroom Management Skils to Pre-Service Teachers* Computers in Human Behavior Vol. 11, No. 3-4, 1995, p. 511 **s**	b	Adult education students, computers interactive, and efficacy. Looks at only visual and auditory no significant difference for learning modality - but threw out kinesthetic.
Latta, Gail F. *The Virtual University: Creating an Emergent Reality* ED 399 970 May 17, 1996 **a**	t	Not much relevance - principals of a good virtual university. Does look at increase of technology in all areas of society, which could be good for discussion of need for research - if we're going to use it, should know how it impacts learners
Panitz, Beth *A Cyberskeptics View* ASEE Prism, May-June 1997, p. 18 **a**	t	Good discussion of disadvantages of technology in education. Interview with Clifford Stoll, author of "Silicon Snake Oil" who is a computer pioneer who thinks that education isn't fun, or easy, it's hard and the computer is not a quick fix solution for hard work. Also, "I think it will decrease the number of teachers needed... it will vastly lower teaching quality." Stoll does an excellent job of making an intelligent analysis of the impact of technology, whether one agrees with him or not.
Green, Kenneth *The Coming Ubiquity of Information Technology*, Change, March/April, 1996 p. 24 **a**	t	Discusses the increase - and permeation - of computers in the university.
Sherron, Gene T. *Distance Education: What's Up?* New Opportunities for Partnering, Proceedings of the 1994 CAUSE Annual Conference (November 29-December 2, 1994, Walt Disney World Dolphin, Orlando FL) ED 401 856 p. 108. **a**	t	Discussion of distance learning options and using the Internet. Mentions study in which results indicate the instructor was more in tune with the problems of each student and could respond and that students felt personal interest was given to them. P. 111, might be useful when considering exit survey question - "interfered with my communication with the instructor."

Educational Leadership Vol. 55 No. 1, September, 1997. Silver, Harvey, Strong, Richard, and Perini, Matthew. *Integrating Learning Styles an Multiple Intelligences* p. 22 **a**	m	Learning styles focus on content and process of learning. All learning style models have two things in common. Quotes demographics, but not perceptual modality.
Guild, Pat Burke *Where Do the Learning Theories Overlap?* Educational Leadership Vol. 55 No. 1, September, 1997 p. 30 **a**	m	Discusses commonalities among learning styles.
Software Publishers Association *Report on the Effectiveness of Technology in Schools, 1990-97* **s**	t	Pseudo-meta-analysis - section 1, effects of technology on student achievement; section 2, effects of technology on student self-concept and attitudes about learning; section 3, effects of technology on interactions involving educators and students in the learning environment. Don't know how objective this could be, considering it's published by the Software Publishers Association.
Carbo, Marie, Dunn, Rita, and Dunn, Kenneth *Teaching Students to Read Through Their Individual Learning Styles*, 1986 Prentice-Hall, Englewood Cliffs, New Jersey 07632 **a/s**	m	Good description of each type of learning style and each type of perceptual modality, p. 2 & 13, Demographics p. 13.
Reiff, Judith C. *Learning Styles What Research Says to the Teacher*, National Education Association of the United States, 1992 **a/s**	m	Demographics p. 17
Claxton, Charles S. and Murrell, Patricia H. *Learning Styles Implications for Improving Educational Practices*,ASHE-ERIC Higher Education Report No. 4, 1987 **a**	m	Learning Style Onion - good representation of theories. Importance of learning style..
Keefe, James W. *Profiling and Utilizing Learning Style* National Association of Secondary School Principals, Reston, Virginia,1988	m	Good discussion of learning style and definitions. Keefe is the editor.

a/s		
Guild, Pat Burke and Garger, Stephen *Marching to Different Drummers*, Association for Supervision and Curriculum Development, Alexandria, Virginia, 1985 check **a/s**	b	Elements of Dunn and Dunn's learning modalities. Mentions use of the computer as it relates to learning style.
Learning Modalities, Styles and Strategies http://www.fln.vcu.edu/Intensive/LearningStrategies.html **a**	m	Very good site. Discusses learning styles. "We all seem to have a learning style preference based on our sensory intake of information" Interesting quotation on hypostasized - university places a definite bias on the visual.
Jaspers, Fons *Target Group Characteristics: Are Perceptual Modality Preferences Relevant for Instructional Materials Design?* Educational and Training Technology International, Vol. 31 No. 1, February, 1994, p.11. **a/s**	b	Perceptual and learning style research literature offers no clear evidence for modality preference for either video or audio. Very good on what modality prefers "what" in their instruction.
Ayersman, David J. and Minden, Avril von, *Individual Differences, Computers and Instruction*, Computers in Human Behavior, Vol. 11, No. 2-4, p. 71. 1995 **a/s**	b	"A recent trend in education literature has been to generally accept that hypermedia can accommodate learning style differences because of the multi-modal attributes that are involved." "It is hoped and anticipated that hypermedia will bridge the gaps between individual differences and instruction." Addresses lack of research - great bibliography.
Houle, Philip A., *Toward understanding Student Differences in a Computer Skills Course*, Journal of Educational Computing Research, Vol. 14 No. 1, p. 25-48, 1996. **s**	b	Looks at demographics, including learning style, of students taking a computer skills course. Not perceptual.
Jonassen, David H. *Computers as Cognitive Tools: Learning With Technology, Not From Technolgy*, Journal of Computing in Higher Education, Spring 1995, Vol. 6(2), p. 40-73. **a/s**	t	"Applications such as databases, spreadsheets, semantic networks, expert systems, multimedia/hypermedia construction, can function as intellectual partners with learners to expand and even amplify their thinking, thereby changing the role of learners in college classrooms to knowledge

		constructors, rather than information reproducers."
Melara, Gloria E. *Investigating Learning Styles on Different Hypertext Environments: Hierarchial-Like and Network-Like Structures*, Journal of Educational Computing Research, Vol. 14(4), p. 313-328, 1996 **s**	b	Examines the effect of learning style on learner performance within two different hypertext structures. Uses Kolb's learning styles. Experimental - 40 students.
Hong, Jon-Chao, et al. *A Study of the Effects of Learning Style On Computer-Assisted Discovery Learning*, Scientia Pedagogica Experimentalis, XXXII, 1, 1995, p. 137-154. **s**	b	A study looking at junior and high school students. Students given field independent and dependent test. Study done in Taiwan. Learning style had an significant impact.
Sung-Youl, Park and Gamon, Julia *Designing Inservice Education for Extention Personnel: The role of Learning Styles in Computer Training Programs*, Journal of Applied Communications, Vol. 80, No. 4, 1996, p. 15. **s**	b	Investigated the relationship between learning styles and opinions toward computer training and support. Used Kolb's learning style. Significant difference for preference based on learning style.
VanDoninck, Barbara *Where Are We With Modality?*, Special Education in Canada, Vol 57 #2, p. 18.	m	Good discussion of the limitations of learning style measurement. Some review of the literature.
Curry, L. 1983 An Organization of Learning Styles Theory and Constructs Paper presented at the annual meeting of the American Educational Research Association, Montreal, Quebec, 11-15 April. ED 830 554. **a/s**	m	Excellent review of learning modality theory.
T.A. Oliver and F. Shapiro, Self-Efficacy and Computers, *Journal of Computer-Based Instruction*, 20:3, p. 81-85, 1993. **s/a**	b	Good discussion of efficacy and the computer. Definitions.

Brandt, Ron *On Learning Styles: A Conversation With Pat Guild* Educational Leadership, V 48 n2, October 1990 p. 10 **a**	m	An interview with Pat Guild, some anecdotal stuff, but very little concrete information.
Jonassen, D.H. & Grabowski, B.L. (1993) Handbook of Individual Differences, Learning, and Instruction. Hillsdale, New Jersey: Lawrence Erlbaum Associates. **s/a**	m	Good definitions of learning style, particularly perceptual modality preference.