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Comparative Student Perception and Interactional Event Analysis in an Urban Computer-Based Distance Education Environment

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COMPARATIVE STUDENT PERCEPTION AND INTERACTIONAL EVENT ANALYSIS IN AN URBAN COMPUTER-BASED DISTANCE EDUCATION ENVIRONMENT

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ABSTRACT

COMPARATIVE STUDENT PERCEPTION AND INTERACTIONAL EVENT ANALYSIS IN AN URBAN COMPUTER-BASED DISTANCE EDUCATION ENVIRONMENT

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This two-part study used quasi-experimental research methodologies to analyze and assess students' perceptions of the level of their personal interaction, overall interaction, observed interaction, attitude, satisfaction and direct participation in synchronous computer-based interactive remote instruction (IRI) and two-way audio/one-way video (TELETECHNET) intra-urban distance learning environments. For the first part of this study 101 subjects were measured during a semester of instruction in three 4-week interval observations. Intact groups assigned to two different treatment environments, computer-based upper division and graduate level computer science distance learning courses, and two-way audio/one-way video upper division computer science distance learning courses were observed at an urban university's main campus site location and an adjacent intra-urban remote site location.

Subjects in the two learning environments differed significantly in the three trial mean of their perceptions of individual interaction. Computer-based distance learning environment subjects had a more positive mean score on perceptions of individual interaction than did their two-way audio/one-way video counterparts. Perception of individual interaction for computer-based subjects was significantly higher than two-way audio/one way video environment subjects perceptions of individual interaction and

relatively flat across trials one and two with a large linear increase at trial three. Scores for observed interaction were significantly higher for two-way audio/one-way video subjects both as an overall mean and as a function of each trial. Direct participation was significantly higher for computer-based students both as a function of overall score across and as a function of trial. Perceptions of overall interaction did not vary significantly between the environments. Subject attitude stayed nominally, but not significantly, higher in the two-way audio/one-way video environment both overall and by trial. Measured levels of student satisfaction did not differ significantly by overall mean, by trial or by trend between each environment. There were no significant differences in the dependent variables between the main or remote intra-urban sites for either environment.

A multiple regression analysis revealed that 63% of the variance in satisfaction in the computer-based environment and 52% for the two-way audio/one-way video environment could be explained by the combined influence of the criterion variables of student attitude and perceptions of individual interaction measured in this study.

In the second part of the study, the researcher defined and categorized IRI classroom events. A modified interactional analysis methodology was presented to provide a framework for future quantitative analysis that can capture the component elements of student perceptions of interaction measured in the first part of the study.

Implications of the findings for educators, policy makers and student populations within the urban milieu were discussed. Recommendations for increasing student perceptions of each environment's less prevalent forms of interactivity and directions for future research were offered.

Dedicated to my darling, beautiful daughter Ashley Cansu and the best friend and wife in the world, Tijen.

Sizleri kelimelerile anlatamayacagim kadar cok seviyorum.

To the Urban Services Doctoral Program at Old Dominion University: The finest people in the world often go unnoticed and unrecognized while doing the good things that matter most. I am profoundly grateful that my child will someday inherit an urban educational system shaped in some part by the people, teaching and research accomplished at Old Dominion University.

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INTRODUCTION

Introduction

Educators, policy makers and administrators in institutions of higher learning are facing an unprecedented level of concern with the quality, efficiency and access of the educational services they provide to their constituents (Means, 1993, Conte, 1999). Initial reforms following the publishing of "A Nation at Risk..." by the United States National Commission on Excellence in Education (1983) consisted primarily of quantitative efforts aimed at raising course requirements and achievement scores on standardized tests. The result was an increase in courses with greater academic rigor but with the nature of instruction remaining relatively unchanged. An increased willingness to consider a qualitative change through the use of innovative approaches that include both distance learning and recently developed advanced computer technology has become apparent. The current wave of reform efforts now involves governors, educational policy makers in the state legislatures as well as educators (Means, 1993, Bivens, 1996).

Educators and policy makers see embracing technology as an important aspect of change and a fundamental consequence of the technological revolution in educational research from which teaching and learning arise (Chodorow, 1995). Aware of the ways that technology has changed information access and marketing via gateway media such as the Internet and by new and powerful computing capabilities in the business community, administrators and policy makers are now exerting pressure for comparable computer-based technological changes within their own institutions of higher learning.

Reform Through Technology in the Urban Educational Environment

Educational reform through technology in institutions of higher learning has focused a great deal on using distance learning technologies to meet challenges of structural change in terms of student population, learning access, teaching methodology paradigms, and curricula (Means, 1993). These changes are especially noticeable in urban settings where shifts in immigration, demographics and family structure are changing the urban landscape and widening the range of university student body composition. The urban population served by higher education distance learning is a growing and maturing element with a wide spectrum of urban socialization experiences, socioeconomic backgrounds, adult and peer role models and an increasing clientele of adult learners (Dede, 1990). These learners are often poorly equipped socioeconomically or simply disinterested in fulfilling the conventional full-time, on-campus role of the more traditional college student (Duderstadt, 1997).

This higher education distance learning population includes learners in minority enclaves who do not have the physical or cultural access to the on-campus resources of a large university. Others do not have the commuting time or ability. Many others recognize the powerful interactivity made possible by their own home computer use and want to incorporate the pursuit of education in a manner similar to the methods they now use to gain other information, make investments, shop and conduct their finances (Wilkes and Byron, 1991).

To satisfy the needs of these learners, academia is shifting from a teacher-centered paradigm to an interactive, student-centered process (Maly, Overstreet, Abdel-Wahab and Gupta, 1996). This shift includes bringing the classroom to the student, increased educational program marketing, the use of innovative technologies and the lending of more significance to student satisfaction as a measure of program success. The shift to an increasingly engaged and student-centered policy by universities is becoming more dependent upon the use of synchronous computer-based technologies. In this new paradigm, the student becomes an active participant of the class and peer collaboration becomes an important component in the learning process (Maly et al., 1996). Universities that make policy choices to offer distance learning within a synchronous, interactive, computer-based, student-centered paradigm can group students with unusual learning needs (e.g. immigrants to urban city centers with English as a second language) into a class of sufficient size to fund the cost of specialized instruction. Courses in atypical subjects or university-sponsored community collaborations (for example, specialized computing languages, urban spousal abuse support groups or regional urban planning committees) can be offered by linking interested parties via computer networks from dispersed areas of the urban landscape. Learners with unusual emotional problems or persons incarcerated in urban detention facilities can form support, counseling or instructional groups in which computer-based interactive technology allows greater exposure without the risks or commitments of inter-personal contact (Dede, 1990). Urban distance learners, represented by a growing pluralism of backgrounds and characteristics, can be reached by the technology of computer-based distance learning in their homes, city community centers or local area colleges and universities without the students having to risk loss of salary or child care arrangements due to relocation or travel (Ludlow, 1994).

Proponents of all forms of distance learning believe that the efficacy of the medium and the satisfaction with the educational experience to large blocks of non-traditional urban workers who are students in these courses is a crucial benchmark to distance learning's future (Means, 1993). The increasing enrollment of individuals part-time and after work is helping to change distance learning systems from an inter-urban (or urban to rural) link to an intra-urban medium. Distance learners enabled to attend classes through this real-time, synchronous, interactive and collaborative medium can be exposed to better education through the expertise pooling of the most qualified faculty and the use of computer-based technology, interfaces and tools. Disenfranchised or minority participants enrolled in interactive computer-based courses may benefit from the heightened individual attentiveness proponents of interactive remote instruction believe to exist in this media. Ogbu (1991) in a study of minority status and schooling noted that minority populations felt apart from the mainstream classroom culture and were less participatory in the activities of the classroom. Interactive computer-based instruction may have the potential to either solve or exacerbate the problem of minority classroom inclusion and engagement at the personal level.

Hawkridge and Robinson (1992)(cited in Wang, Johnson & Pisapia, 1994) list four other rationales for educators to consider in the implementation and study of synchronous computer-based technology in distance learning systems:

1) The Social Rationale. Higher education policy-makers want students to be prepared to understand technology, especially computer-based technology, and be aware of their role in society because computers are especially pervasive in urbanized, industrialized environments.

2) The Vocational Rationale. Computer and technology familiarity are important competencies for employment in the urban landscape.

3) The Pedagogic Rationale. Students can learn via technology. There are advantages over traditional methods in using computers and distance learning to learn.

4) The Catalytic Response. Computers and technology are catalysts to change schools for the better. They are symbols of progress. They encourage learning.

Advances in computer networking and digital media technology, together with the growth of the Internet, may make synchronous computer-based distance learning an effective framework for supporting interactive learning among the eclectic urban groups served by distance education. By relying on advanced interactive technology to create connections between disparate groups, distance learning approaches can aid America's shift from pluralism to assimilation. Interactive technology's potential for engendering diversity through participant access and overcoming student segregation into homogenous enclaves may have the potential to create a more equitable, tolerant, adaptable and ultimately successful urban environment.

<u>Background</u>

The use of technology to reform education in terms of student satisfaction, pedagogical effectiveness and access has involved a history of media that has culminated presently into a focus on synchronous two-way audio/one-way video television delivery systems (Sherry, 1996, US Department of Education, 1997). Two-way audio/one-way video television delivery systems are however now increasingly giving way to synchronous computer-based interactive remote instruction technology (Giardina, 1991).

Distance Learning Methodologies Employed in Urban Universities

In a 1997 survey of higher education institutions by the US Department of Education, fourteen percent of educational institutions surveyed that offered distance learning courses in fall 1995 reported they utilized two-way on-line interactions during instruction, predominantly through two-way satellite television. Significantly however, three-quarters of institutions that offered distance education courses in the fall of1995 and 64 percent of institutions that planned to offer distance education courses in the next three years intended to start or increase their use of two-way on-line interactions during instruction. A very important belief generally held by urban educators is that an increase in distance learning system interactivity is typically accomplished by increasing the interactive capabilities of the mediating technology employed (Nishinosono, 1991). In fact, twenty-two percent of institutions that offered distance education courses in fall 1995 currently used computer-based technologies rather than two-way audio/one-way video systems. Eighty-four percent of institutions that offered distance education courses in fall 1995 and 74 percent of institutions that planned to offer distance education courses in the next three years actually planned to start or increase their use of technologies other than two-way audio/one-way video. All of the emerging technologies considered by the institutions surveyed generally employ increased automation or computerized technologies to meet a higher expectation of interactivity (U.S. Department of Education, 1997).

Distance Learning System Interactivity

According to Dede (1990), the move from two-way television to purportedly more interactive computer-based technology follows a clear and growing trend towards increasing technology and interactive efforts in all of distance learning. The lack of instructor to learner proximity and the influence of the mediating technology on the instructional process encourage concern for the level and quality of interactivity in distance learning systems. "Interactivity" and "Interaction" however have varied meanings to researchers. Moore (1992) in an editorial of the American Journal of Distance Education 4, (2). 1-6, provides a generally agreed upon and often quoted definition of interaction. He defined three types of interaction in distance learning. The first is learner to content interaction; the interaction between the learner and the content that is the subject of study. This is the process of intellectually interacting with the subject content that results in changes in the learners' understanding. The second type of interaction is learner to instructor interaction. This type of interaction, regarded as essential by educators, is the interaction that guides, shapes and molds learner understanding. Moore believes that the frequency and intensity of this interaction is crucial to the ability of the instructor to influence the student. The third type of interaction is learner to learner interaction. This type of interaction Moore believes is an extremely valuable, even essential, resource for learning and takes place between learners individually or as part of a group setting.

Wagner (1994) further defined interaction as reciprocal events that require two objects, two actions and which mutually influence one another. An instructional interaction is an event that takes place between a learner and the learners' environment, is an attribute of instruction, and may be viewed as an outcome of using interactive delivery systems. Wagner defined interactivity as an attribute of modern telecommunications technologies and one that may eventually be viewed as a machine attribute.

Both Wagner and Moore underscore the importance of the distance learning systems impact on interactions and interactivity. It is Moore's learner to instructor and learner to learner interaction as a function of the distance learning environment's system interactivity as defined by Wagner that is the focus of this study.

While intuitively researchers believe that interaction is important in the instructional process, according to a study of distance learning outcomes by Haynes and Dillon (1992), the complex interplay of interaction itself in distance learning is not well-understood. This lack of understanding is true despite the fact that interaction is thought so important to distance learning as to make it a primary consideration in the design and development of distance learning courses (Threlkeld and Brzoska, 1994, Egan, Sebastian and Welch, 1991, Coldeway, Marcury and Spencer, 1980, Burge and Howard, 1990 and Goldstein, 1991). Comparative interactive analysis studies with computer-based distance learning are lacking despite evidence that suggests different components of interaction are the most significant predictor of two-way television student satisfaction (Fulford and Zhang, 1993).

Recent examinations of various distance learning media in terms of system features designed to engage students by educational technologists reveals a possible bias in the favor of a computer-based learning technology (Moore, Thompson, Quigley, Clark and Goff, 1990). This new computer-based distance learning medium may suggest a quantum leap in interactive possibilities by utilizing a wide variety of processing capabilities, software tools and parallel transmission media such as the Internet and inter-classroom station-to-station conferencing (Dede, 1990, Maly et al., 1996, Santoro, 1995). The assemblage of software tools and capabilities in newer computer-based distance learning media encompasses separate or parallel (ongoing) interactions for audio, imported video, electronic presentations, whiteboards, Web page displays, Web co-browsing, and computer-driven simulations. Manipulable screen–in-screen video panels, personal software notepads and individual selection and manipulation of software tools are believed by computer-based technology proponents to make this distance learning medium a fundamentally different interactional environment than its more common two-way television distance learning medium counterpart. Whether a heightened interactivity stemming from the increased capabilities for system interactivity actually exists in the perceptions of the learners these systems are designed to serve is a question of this study.

Two-way audio/one-way video television distance learning courses typically introduce a camera and large screen monitor into an otherwise traditional classroom setting. Two-way audio/one-way video television broadcasting, so universal in today's distance learning systems, routinely consist of multiple sites, including an originating site and multiple receiving sites. Site enrollment typically ranges from one to twenty, while class enrollment typically ranges from ten to a hundred. Symmetry is very low because video is primarily one-way with limited feedback via audio channels. Interactivity and the degree of perception of interaction are low for any textual and graphic material due to limited television display quality (Fox and Kieffer, 1995, Maly et al., 1996). Student interactivity is a collective and shared experience focused on centrally located monitors at the remote sites and on the instructor at the main site.

Most two-way television distance learning systems involve the transmission of a live televised picture of an instructor at a desk, on a stage or at a podium. Audience questions are encouraged but even with formal physical approaches to a podium or a standing presentation by the questioner, the level of individual participation and interactivity in the classroom experience is low. This low level of learner activity implies a limited individual experience for the learner and suggests a predominantly overall or group interaction dynamic in the two-way audio/one-way video television distance learning environment. Interaction in televised courses is focused and centered primarily on the instructor and the immediate classroom. Tool usage and control by participants co-located with the instructor are equivalent to those found in a traditional class.

In contrast, a study of in-class computer-aided instruction over networks by Bradley and Morrison (1991) concluded that the tools of computer-based distance learning represent a confounding increase in the nature of classroom instruction for both the educator and the student. Additionally, the physical layout of computer-based distance learning classrooms changes the fundamental attributes of the communication patterns for the students involved. Traditional and two-way television classrooms mentioned previously are set predominantly in the style of the "sage" with rows of desks facing a teacher podium at the front of a classroom. Attention and interaction are centered on a common focal point in a shared and collective classroom experience (Mckenzie, 1997). These open classroom experiences reflect the dominant majority culture of the classroom. Kozol (1985) and Ogbu (1991) make numerous references to the disinclination by minority students to participate in these kinds of settings.

In synchronous computer-based distance learning students interact individually with personal computing workstations at each desk. The classroom educational experience is transformed into an essentially personal interaction between the student and a mediating, manipuable computer with learner attention focused primarily on the personal desktop device (Maly et al., 1996, Santoro, 1995, Ellsworth, 1995). This effect is heightened if the computer-based distance learning student is home-based or at a remote site, as is so often suggested as an important capability of this medium (Berge and Collins, 1995, Bivens, 1996 and Clark, 1989) and may or may not be an important aspect of minority inclusion.

A heightened sense of individual involvement and keener perceptivity of the environment by the individual learner has been found to have a more pronounced effect in novel, ambiguous or transactional circumstances (Murphy & Davidshofer, 1994). This ambiguous circumstance is precisely the situation realized as educators begin to implement computer-based educational environments into university classrooms. Unfortunately, when a new technology such as synchronous computer-based education appears in the field of education, there is a tendency to use it in the same manner as the technology it is replacing if research regarding its use does not intervene first (Tennyson, 1980, 1984).

The technology in synchronous computer-based education makes it a fundamentally different educational experience for the student requiring distinct, research-based policy decisions regarding its use and role by education professionals. These decisions can be aided by research measurements based on interactivity, the real-time synchronous computer-based distance learning environment's primary claim to efficacy.

Problem Statement

How then do educators evaluate synchronous computer-based distance learning in regard to the critical factor of interactivity? Do synchronous computer-based remote instruction courses deliver on their promise of heightened interactivity as perceived by the students enrolled in those courses? How do computer-based courses compare to two-way television courses in respect to the interactional component? Computer-based courses are thought to offer an increase in control and function to the student. Do the long sought after interactive capabilities of computer-based distance learning result in heightened perceptions of interactivity by the learners utilizing them? Does this heightened individual interaction perceptivity actually lead to more satisfaction? Or is satisfaction more predictable by overall interactivity in these computer-based courses requiring a de-emphasis on their primary differentiating factor, user functionality, and less value to the argument by technologists and manufacturers that this technology differs in an interactional sense from two-way television courses? Once the role of interactivity in the computer-based distance learning and two-way audio/one-way video environments has been defined, how can interactional classroom events, especially in regards to computer-based distance learning, be quantified?

To find these answers, this study addresses the following specific questions:

1. What effects does a computer-based distance learning course have on student perceptions of personal and overall interaction, satisfaction, attitude, student observations of overall classroom interaction and direct participation over three observations in a semester period?

2. What effects does a two-way audio/one-way video course have on student perceptions of personal and overall interaction, satisfaction, attitude, student observations of overall classroom interaction and direct participation over three observations in a semester period?

3. What student perception predicts student satisfaction in a computer-based distance learning environment?

4. What student perception predicts student satisfaction in two-way television distance learning environments?

5. What are the differences between predictors of satisfaction and perceptions of personal and overall interaction, satisfaction, attitude, student observations of overall classroom interaction and direct participation in computer-based and two-way audio/one-way video television distance education environments?

6. What type of automated interactional event analysis tool can be developed to quantify events occurring in a computer-based distance learning environment and frame them to overall and individual perceptions of interaction?

The Need for Interactive Assessment

The literature in higher education delivery system assessment describes an urgent need by educators and individuals making delivery system choices to better understand the implications of an interactionally heightened (and yet more individualized) paradigm of distance learning as found in the computer-based classroom (Clark, 1989, Moore et al., 1991, Egan, Sebastian and Welch 1991, Westbrook, 1997). An assessment that recognizes the distinct elements of computer-based distance learning itself is essential (Moore et al., 1991, Beaudoin, 1991). An assessment technique which offers comparisons of emerging technology to mainstream methodologies of distance education allowing comparisons with the most common systems in place and aiding in relevancy is required (Davis, 1991). The literature reveals that both cross-sectional and longitudinal assessments of student participants and distance education programs are necessary to evaluate the effectiveness of programs and to provide guidance for future development (Westbrook, 1997: Biner, 1993, Eagen, 1991).

The common advice to higher education instructors in a two-way television distance learning situation is to avoid being "a talking head." Beyond these and other generalities common to the precepts of two-way audio/one-way video television distance learning production, little is shared or written about the use of newer computer-based distance instruction teaching tools or the assessment thereof. The preoccupation with the "talking head" assumption results from the fact that the warmth or immediacy of face-to-face encounters is thought to be removed from distance learning. While this is certainly true of computer-based distance learning systems, the wider capabilities and tools available to both student and instructor, the large measure of student control, and the joint manipulation of tools and transmission media may demand that other measures be taken to assure that students continue to remain engaged in the lesson and that the increased individual interactivity sought for actually exists.

Compounding a lack of pedagogical data, university educators, administrators and policy makers have little evidence in what leads to student satisfaction in these evolving computer-based distance learning media or how to use most effectively the features of these computer-based distance learning systems to establish a successful instructional dialogue (Christman, Badgett and Lucking, 1997, Kaganoff, 1998). Education policy makers, administrators and faculty must decide what kinds and types of interactivity relate to satisfaction in the distance learning methodologies available to them, as satisfaction is a primary component of a programs worthiness (Kaganoff, 1998) and is an essential aspect in the marketing of distance learning to students in the urban landscape.

The interactive perceptions and satisfaction of minority students may be a particularly important demographic to the urban institution.

Failure to address learner satisfaction in the keen competitive educational environment of the 21st century imperils the university as a whole, especially in regards to the financial and opportunity costs inherent in the implementation of expensive distance learning technology (Indiana State Commission, 1998).

Emphasis on interactivity in the computer-based distance classroom is crucial because of the disconnected nature of the teacher's physical presence. This disconnectedness may be heightened by the filtering of the transmission medium, the attentive noise of the interactive tools in parallel use, and the attenuation of outside influences due to the solitary nature of the student's personal workstation environment and the paradigm of student-centered interactivity inherent in computer-based distance learning.

Understanding the relationships involved with student's perceptions of interactivity can shed light on computer-based policy issues of learner station disbursement or group co-location practices (Gilbertson and Pointdexter, 1999). Remote site location setup decisions, whether to issue computer equipment to economically disadvantaged students, whether to pursue this medium through less expensive web-based television componentry and whether policy decisions can better be made with consideration of the environment's interactional efficacy. In the realm of pedagogy, such indicators pointing to an increased need for individual or overall interaction in the computer-based distance learning environment carry varied emphases as described in Table 1.

Of the two synchronous distance learning environments that are the subject of this study, computer-based and two-way audio/one-way video televised environments, the distance learning methodology with the appropriate forms of interaction required to keep students' attention (and therefore, motivation) focused on lesson content should weigh heavily in educator's funding and policy recommendations. The evidence obtained in this study therefore serves as an important and unbiased counterbalance to equipment manufacturer's claims and educator assumptions.

An assessment therefore, determining first which type of interaction leads to satisfaction in these two distance learning methodologies, especially contemporary computer-based methodology, is necessary. This study provides evidence suggesting whether learners involved in these two distance learning environments perceive particular types of interactivity to exist by surveying their perceptions of (among other constructs) two of Moore's (1992) types of interaction: 1) learner to learner and 2) learner to instructor interaction and comparing them among each environment.

A comparative study between these two distance learning methodologies is required to add currency and relevancy to university administrator's decision making process when choosing between delivery systems. A follow-on analysis of the events in

Table 1

Pedagogical Emphases

Emphasis On Individual Interaction	Emphasis On Overall Interaction
1. Increased ability for learner workstation disbursement. Lessened requirement for centralized or localized group or classroom emulative settings.	1. Implementation of wide-screen monitors to heighten sense of overall interaction.
2. Increased emphasis on interface capability. Greater complexity and variety of software tools to learner.	2. De-emphasis of work-station disbursement. Centrally locate classrooms.
3. Emphasis on intra classroom student to student interactivity, classroom subgroup activities, disparate student presentation activities.	3. Train central monitoring screen on classroom vice instructor to heighten overall perception of interaction.
4. Lessen or eliminate now common practice of training one of the screen in screen monitors on an individual workstation on the classroom.	4. De-emphasize tool development, strive for design simplicity and ease of use instead of complexity and capability available to the user.
5. Increase instructional handoffs to students. Emphasize participation. Make individual presentations a pedagogical precept.	5. Use group questioning techniques eliciting several responses emphasizing frequency and overall participation.
6. Encourage individual-oriented tool tool use such as E-mail, note pad and Inter-classroom note sharing and mailing.	6. Allow no blank screen in screens. Develop random video polling Software that would scroll through Student cameras displaying random Screen shots to enhance overall Perceptions of interaction.

Note. Based on an interpretation of Wagner (1994) and Berlo (1960).

computer-based methodology that characterize individual or overall interactions will aid in tailoring and developing an instrument that can be utilized for future computer-based curriculum assessment of an interactional nature.

Purpose

This study's purpose was to define and compare synchronous computer-based and two-way audio/one-way video television distance learning interactions in their most important contexts. This study did not measure asynchronous computer-based environments. This study's first part was to determine what student perceptions of interactions, overall interactions or individual interactions (hypothesized to be more denotative of the individualized nature of computer-based instruction) predict satisfaction in a computer-based distance learning environment. This study then offered comparisons using like data to students in a two-way audio/one-way video television distance learning environment. Data on student attitude, satisfaction and levels of observed interactions was also collected for evidence of correlation with student perceptions.

This study assessed synchronous (real-time/simultaneous) two-way audio/one-way video television and computer-based distance learning environments. Asynchronous web-based courses were not assessed as part of this study as they do not offer the same character and frequency of interaction that live classrooms offer.

To harness the technology of this emerging distance medium, the second part of this study developed an assessment tool that considered the events that take place in a computer-based. Computer-based event analysis assists in determining what individual or overall interactions are occurring in the synchronous computer-based distance learning classroom. Correlation can then be made through observations conducted in future studies as to what types of computer-based classroom events occur and contextualize the most significant predictors of satisfaction in a computer-based distance learning classroom. The framework for computer-based event analysis was accomplished through an assessment instrument that grows out of a heritage of interactional analysis methodology and meets a wide variety of distance learning needs in an automated manner. This interaction analysis instrument was developed as a product of this research, is potentially useful for subsequent research, but was not subject to reliability testing as a function of this study.

In summary, to conduct research for educational policy makers, administrators and educators that will leverage pedagogical features and facilitate choices in delivery systems in urban distance education, this study:

Conducted survey research in part one to accomplish the following;

a. Uncover evidence as to what dependent variable measured (perceptions of overall interaction, perceptions of individual interaction, student attitude, observed interaction or direct participation), if any, was more prevalent and which predicted student satisfaction in a computer-based distance education environment.

b. Uncover evidence as to what dependent variable measured (perceptions of overall interaction, perceptions of individual interaction, student attitude, observed interaction or direct participation), if any, was more prevalent and which predicted student satisfaction in a two-way audio/one-way video television distance education environment.

c. Collect data on attitudes toward instruction, satisfaction and level of observed interactions in both distance learning environments.

d. Compare the differences between the findings in a computer-based and two-way television distance education environments.

In part two, this study developed an automated assessment tool to analyze computer-based classroom events that framed the surveyed student perceptions of individual or overall interaction. The researcher software codified the assessment instrument to assist with automated, computerized validation that can meet interaction assessment needs in computer-based and distance learning environments.

A final quantitative analysis based on inferences drawn from data analysis findings and trends was conducted. Qualitative analysis was limited to researcher narrative and was not a study approach.

Rationale

Old Dominion University, an urban, regional university located in Norfolk, Virginia is heavily involved in two distinct forms of technology-rich distance learning and served as an ideal location for urban education research of the type suggested in this study. Old Dominion University offers a program entitled TELETECHNET, which delivers up to 40 courses to 4000 students each semester using satellite-based, two-way audio/one-way video delivery system. Courses are broadcast to 26 community colleges sites across the Commonwealth of Virginia where site directors are responsible for administration of support services for this operation.

Old Dominion University's approach to distance learning using computer-based technology is the Interactive Remote Instruction system. This computer-based distance learning technology has been developed and is in use by the Department of Computer Science at Old Dominion University with partial support by the National Science

Foundation. This system melds high-speed networking, and computer technologies including audio, imported video, electronic presentations, whiteboards, Web page displays, Web co-browsing, screen-in-screen mini monitors and computer-driven simulations to allow for distance learning over the Internet. Since it is based entirely on terrestrial, digital communication, an entirely different range of teaching tools are possible with this system than that found in two-way audio/one-way video television environments.

These two distance learning programs are representative of the target environments for this study: two-way audio/one-way video televised distance learning and computer-based distance learning. They are defined as follows: two-way synchronous electronic audio and one-way video communications exists between two or more groups in dispersed locations for the purposes of instruction. Student groups are either located at the same site as the instructor or at remote sites viewing the instructor or other class members via a television monitor (or monitors) centrally located and jointly used by other members of the class. Standard open seating classroom settings. Students and instructor may electively pan cameras on themselves or other students or may interact via audio. Dispersed site connectivity is terrestrial, via satellite or a combination of both. (Willis, 1998). Computer-based distance learning connotes a distance learning system in which computer processors utilizing operating system software, modem delivery and computer networks act as a real-time synchronous conduit for two-way interaction between two or more separate groups. Each learner individually operates a single computer workstation to receive instruction and to interact with students and instructor. Computers may be co-located or operated independently. Connectivity is terrestrial, via satellite or a combination of both. (Maly et al., 1996, Cravener and Michael, 1998).

These two distance learning approaches represent the full spectrum of currently applied and sought after distance learning technology and fully embody the operational definitions of their respective environments. Satellite, Internet, terrestrial landline, computer and television systems are encompassed in these two systems. In addition, both these different learning environments comprise two areas of policy and investment decision making that are the distance learning technology acquisition focus of urban education decision makers today (US Department of Education, 1997). Both of these approaches to the delivery of distance learning constitute the most likely paths for future technology-rich urban education environments.

Significance of the Study

Most urban education policy makers recognize that interactive distance learning technology has the potential to solve some of the problems facing learners in an urban setting. The primary motivation for the use of the technology itself by educators is the belief that technology will support superior forms of learning (Means, 1993). For this reason, theory and research in distance learning provide an extremely important source of ideas on which to base policy, funding, delivery system and pedagogical decisions. A widespread and mistaken belief however in increased technology use as a panacea may result from a lack of information and research guidance necessary to make intelligent decisions regarding university, planning, institutional use, and evaluation of educational technologies (Goldstein, 1991 (cited in Moore et al., 1990) and Sherry, 1996). Not only must educational policy makers use research to help guide effective utilization of existing and emerging distance learning technologies, but they must also ensure the results of that research are implemented and considered as a part of the technology procurement and policy process. (Goldstein, 1991 (cited in Moore et al., 1990)).

This study is necessitated by the following factors:

(a) the significant increase in computer-based distance leaning technology availability and likelihood of its use in future urban distance education classrooms.

(b) the dependency on the capabilities and constraints inherent in the technology media chosen when making pedagogical, funding, course location, curriculum and policy decisions,

(c) the unmeasured effects computer-based technology has in the realm of interactivity,

(d) the increased expectations of urban students in the capabilities and functionality of technology-based distance learning systems, and

(e) the lack of efficacy measures based on the significant aspect of interactivity in this new instructional paradigm (Clark, 1989).

This study fills the need by educators and individuals making delivery system policy choices to better understand the implications of an interactionally heightened model of distance learning interactivity as found in the computer-based classroom (Clark, 1989, Moore et al., 1990, Eagen, et. al 1992, Westbrook, 1997). This study is also an assessment that is based upon the recognition that the distinct interactivity elements of computer-based distance learning itself are significant (Moore, 1992, Beaudoin, 1991). This study includes techniques that offer comparisons of the emerging computer-based technology to mainstream two-way audio/one-way video television methodologies of distance education to aid in relevancy (Davis, 1991). A longitudinal assessment of student participants and distance education programs necessary to evaluate the effectiveness of programs and to provide guidance for future development was a major purpose of this study.

This study assists in delivery system choices urban educators face for a medium of distance education that differs significantly from seemingly similar choices of media in traditional education (Stubbs and Burnam, 1990). This study suggests that distance education medium evaluation must be conducted with a view of the distance learning environment not only as a delivery system but also as an individualized paradigm through which interaction must pass. The administrators of urban institutions of higher learning face crucial policy decisions regarding the service delivery system choices of a continuing satellite-based distance learning emphases or of a policy change to emerging computer-based distance learning, a choice in which this study hopes to play a role.

The costs involved in implementing new distance delivery system methodologies or replacing existing ones to educators are not insubstantial (Maly et al., 1996). Prolonged funding and implementation commitments are inherent. Funding inequities and technology disparities between well-funded majority culture urban universities and resource-poor minority urban universities make delivery system choices crucial to the financial health, competitiveness and longevity of the latter institutions. This study provides delivery system choice considerations based on the interactive characteristics of the distance learning medium to urban educators in these situations. Pedagogical decisions, curriculum development issues and staff acquisition policies all ride on the nature of the educational medium chosen. Not only can the system selected by policy makers to convey course content have an effect on the methods employed by the instructor, it may even create new methodologies in an of itself that could bear renewed consideration (Stubbs and Burnam, 1990).

The need for a tailored assessment instrument of this type in the distance learning classroom is evident (Clark, 1989, Bates, 1990). Most of the literature in the area of distance learning assessment focuses on the current two-way audio/one-way video televised technology of distance learning and not on computer-based technology as is proposed in this study. A baseline understanding of the type offered in this study of what characteristic of the learning experience is most important to the computer-based distance learner's satisfaction is the first step toward relevant program assessment, comparison, measurement and pedagogical training (Suen, 1993).

Interactional event assessment in the second part of this study allows an integral understanding of classroom events, which in turn enables future quantification and inferential scientific testing. The observed baseline of interactional events can then find use in comparison with the observed students' perceptions of interactions. Correlation with students' satisfaction ratings will provide an understanding of the relevancy and facility of the computer-based instruction interactivity. The findings, when compared with the findings from television based instructional student population paradigms may further serve as a guide in developing and implementing strategies unique to the computer-based distance learning educational environment. Development of a distinctive assessment instrument from the findings can in turn be used to ensure the effectiveness, efficiency and quality of the educational product of all similar distance learning courses.

Use of the distance learning environment's two most popular formats, computer-based (as represented by Interactive Remote Instruction (IRI)) and two-way audio/one-way video television (as represented by TELETECHNET) (Department of Education, 1997) found at Old Dominion University ensures universality and wholeness of the study.

The type of assessment suggested in this study can have far-reaching benefits--lower attrition rates, increased student motivation, increased student generated referrals, and enhanced learning in all areas of education, whether it be distance education, education or all of education in general (Biner, Dean and Mellinger, 1994). This study suggests evidence based on learner perceptions of system interactivity that can help to determine the type of delivery system that should be the funding and policy focus of urban education administrators. educators and policy makers.

Research Questions

The following research questions are addressed in this study:

RQ1 Research Question one sought to answer the question: what are the differences between learner perceptions of their level of individual interaction between computer-based and two-way remote instruction environments?

RQ2 Research Question two sought to answer the question: what are the differences between learner perceptions of their level of overall interaction between computer-based and two-way remote instruction environments?

RQ3 Research Question three sought to answer the question: what are the differences between learner perceptions of their level of satisfaction between computer-based and two-way remote instruction environments?

RQ4 Research Question four sought to answer the question: what are the differences between learner attitudes in computer-based and two-way remote instruction environments?

RQ5 Research Question five sought to answer the question: what are the differences between learner perceptions of their observed interactions in computer-based and two-way remote instruction environments?

RQ6 Research Question six sought to answer the question: what are the differences between learner perceptions of their direct participation in computer-based and two-way remote instruction environments?

RQ7 Research question seven sought to answer the question: what are the significant relationships between the variables of perceptions of individual interaction, overall interaction, satisfaction, attitude, observed interaction and direct participation in a computer-based distance learning environment?

RQ8 Research question eight sought to answer the question: what are the significant relationships between the variables of perceptions of individual interaction, overall interaction, satisfaction, attitude, observed interaction and direct participation in a two-way audio/one-way video distance learning environment?

RQ9 Research question nine sought to answer the question: what variable of student perceptions of individual interaction, perceptions of overall interaction, student attitude, observed interaction and direct participation predicts student satisfaction in a computer-based distance learning environment?

RQ10 Research question ten sought to answer the question: what variable of student perceptions of individual interaction, perceptions of overall interaction, student attitude, observed interaction and direct participation predicts student satisfaction in a two-way audio/one-way video distance learning environment?

RQ11 Research question eleven sought to answer the question: what is the difference between the predictors of satisfaction in computer-based and two-way audio/one-way video distance learning environments?

RQ12 Research question twelve sought to answer the question: do student perceptions of the variables of individual interaction, perceptions of overall interaction, student attitude, observed interaction and direct participation vary over time?

RQ13 Research question thirteen sought to answer the question: do student perceptions of the variables of individual interaction, perceptions of overall interaction, student attitude, observed interaction and direct participation vary over time?

RQ14 Research question fourteen sought to answer the question: what instrument could be developed to aid assessment of interactional events in distance education computer-based remote instruction environments?

A matrix of problem statements and research questions is found in Table 2.

Assumptions

The following assumptions are made for the intent of this study:

1. The results of this study can be generalized to the experimentally accessible population and the target population.

2. Conduct of the study had a non-reactive effect on the subjects' measured perceptions.

3. Subjects responded honestly and without undue external influence to the survey items.

Table 2.

Problem Statement, Research Questions, Hypotheses and Statistical Analysis Table

PROBLEM STATE-MENTS	1. What effects does a computer-based distance learning course have on student perceptions of personal and overall interaction, satisfaction, attitude, direct participation and student observations of overall classroom interaction over three observations in a semester period?	2. What effects does a two-way audio/one-way video course have on student perceptions of personal and overall interaction, satisfaction, attitude, direct participation and student observations of overall classroom interaction over three observations in a semester period?	3. Which variable of student perceptions of interaction, attitude, observed interaction, or direct participation predicts student satisfaction in a computer-based distance learning environmental sample?	4. Which variable of student perceptions of interaction, attitude, observed interaction, or direct participation predicts student satisfaction in a two-way audio/one-way video distance learning environmental sample?	5. What are the differences between predictors of satisfaction and perceptions of personal and overall interaction, satisfaction, attitude and student observations of overall classroom interaction in computer-based and two-way audio/one-way video television distance education environments?	6. What type of automated interactional event analysis tool can be developed to quantify the events occurring in a computer-based distance learning environment and frame them to overall and individual perceptions of interaction?
RESEARCH QUESTIONS	RQ1 – RQ2 – RQ3 RQ4 – RQ5 – RQ6 RQ12 – RQ13	RQ1 – RQ2 – RQ3 RQ4 – RQ5 – RQ6 RQ12 – RQ13	RQ9 – RQ10	RQ9 – RQ10	RQ11	RQ14

4. Sufficient student experience and classroom stimuli were present for perceptual cognition and manifestations of satisfaction by the subjects.

Delimitations and Limitations

The following demarcations and qualifications apply to this study:

1. There was no random selection or random assignment of subjects. The subject pool consisted of intact groups of students enrolled in Old Dominion University synchronous two-way audio/one-way video televised (TELETECHNET) and synchronous computer-based interactive remote instruction courses during a regular academic year.

2. The study confined itself to an examination of synchronous televised and computer-based students at an urban state university.

3. This is a quasi-experimental study. Attribution of causality cannot be inferred from study results. True experimental designs with random assignment of subjects were not utilized.

4. All subjects were volunteers from the subject pool.

5. Only self-report instruments were used to measure perceptions of interaction, observed interaction, attitude and satisfaction. There was no measure of treatment affects across multiple domains.

6. Generalizability of the study is limited to computer science curriculum courses and content. Group matching was limited to upper-division undergraduate and graduate students in Interactive Remote Instruction (IRI) or TELETECHNET computer science courses in the 1999 academic year. Instructors matching were limited to computer science instructors; course content was not matched. The size of the experimentally accessible population and length of study limited sample size.

Definition of Terms

The following definitions are used in this study:

Audio: Synchronous voice communications transmitted over a distance (Willis, 1998).

Asynchronous Distance Learning: Distance learning where a majority of classroom interaction between students, instructor, and other students is not simultaneous (a majority of the interaction does not primarily occur in real-time and within the same time period). An example would be web-based programmed instruction supplemented by chat rooms and E-mail.

Computer-Based Instruction: A distance learning system in which computer processors utilizing modem delivery and computer networks act as a real-time synchronous conduit for two-way interaction between two or more separate groups for the purposes of instruction. Each learner individually operates a personal computer workstation utilizing a monitor and keyboard and embedded software to receive instruction and to interact with other students and instructor. Software is multi-functional with outside Web retrieval, Web co-browsing, Screen-in-screen capability, collaborative whiteboards, and personal notepad screens. Several computers may be co-located in a single room or operated independently at dispersed locations. Dispersed site connectivity is terrestrial, via satellite or a combination of both. (Maly et al., 1996, Cravener and Michael, 1998).

Computer-Driven Simulations: Singly or jointly manipuable and viewable self-running computer programs.

Distance Education: The process of providing instruction when students and instructors are separated by physical distance and technology, often in tandem with face-to

-face communication, is used to bridge the gap (Willis, 1998).

Distance Learning: The desired outcome of distance education (Willis, 1998).

Electronic Presentations: Media demonstrations using common presentation software over a distance. May include collaboration with students and instructors and be jointly manipuable (Maly et al., 1996).

HyperText Markup Language (HTML) The code used to create and access Internet information. (Willis, 1998).

Individual Interaction: Perceived individual involvement of each participant in a two-way audio/one-way video or computer-based course (Fulford and Zhang, 1993).

Interactions: Reciprocal events that require two objects, two actions and which mutually influence one another. An instructional interaction is an event that takes place between a learner and the learners' environment, is an attribute of instruction and may be viewed as an outcome of using interactive delivery systems. (Wagner, 1994).

Interactivity: An attribute of modern telecommunications technologies and may be viewed as a machine attribute. A function and reflection of the mediating technology and the degree and fidelity to which the medium facilitates interaction among learners, instructors and content. (Wagner, 1994).

Learner to Content Interaction: The interaction between the learner and the content that is the subject of study. This is part of the process of intellectually interacting with content that results in changes in the learners' understanding (Moore, 1992).

Learner to Instructor Interaction: This type of interaction is the interaction that guides, shapes and molds learner understanding. The frequency and intensity of this interaction is crucial to the ability of the instructor to influence the student (Moore, 1992).

Learner to Learner Interaction: This type of interaction is an extremely valuable, even essential, resource for learning and takes place between learners individually or as part of a group setting (Moore, 1992).

Overall Interactions: Perceived involvement of other members of the class by an individual in a two-way audio/one-way video televised course or a computer-based course (Fulford and Zhang, 1993).

Satisfaction: Perceived value and quality of instruction by an individual in a two-way audio/one-way video televised course or a computer-based course (Fulford and Zhang,1993).

Screen in Screen Monitors: Smaller video signal presentations located within a larger video presentation allowing the learner to view two or more simultaneous video presentations.

Synchronous Distance Learning: Distance learning where a majority of classroom interaction between students, instructor, and other students is live (occurs in real-time) and is within the same time period.

Two-way Audio/One-way Video Televised Distance learning: Two-way, real-time synchronous electronic audio and one-way video communications between two or more groups in dispersed locations for the purposes of instruction. Student groups are either located at the same site as the instructor or at remote sites viewing the instructor or other class members via a television monitor (or monitors) centrally located and jointly used by other members of the class. Standard open classroom settings. Students and instructor may electively pan cameras on themselves or other students or interact via audio only. Dispersed site connectivity is terrestrial, via satellite or a combination of both. (Willis,1998).

Video: Synchronous visual images transmitted over a distance (Willis, 1998).

Web Page Displays: Display of commercially or privately available Internet pages usually encoded in Hypertext Markup Language.

Web Co-browsing: Joint browsing of Internet sites and pages between learners and instructors on computer-based systems.

Whiteboards: Singly or jointly manipuable computerized screen presentations commonly used for drawings, notes or mathematical computations (Maly et al., 1996).

Summary

This chapter outlined study used two Old Dominion University distance learning program initiatives in capturing student perceptions of interaction of their respective educational environments. Perceptions in two-way audio/one-way video televised instruction were compared to those same perceptions among computer-based distance learning students from the experimentally accessible population.

Further, to help leverage the pedagogical features in computer-based distance learning, this chapter also described the interactional character of classroom events in a computer-based interactive remote instruction distance learning system. The researcher analyzed classroom events that framed the surveyed student perceptions of interaction utilizing interactional analysis methodology. The researcher then developed a computerized assessment instrument that with further validation can meet a wide variety of both computer-based and distance learning needs.

Chapter I provided introductory material of the issues regarding interactional perceptions in computer-based distance learning instruction and the assessment thereof.

The pervasiveness of distance education, the changing nature of the urban university student, distance education's move from two-way television to computer-based methodologies and the role of interactivity in distance education were discussed. The significance of the problem and a rationale for the research described in this study was proffered. Limitations of the study were explained. The remaining chapters address the study basis and results in further detail.

From the understanding gained in this area, pedagogical techniques that are efficacious for the computer-based interactive distance learning environment can be developed and research-based funding and policy decisions by educators can more readily be made.

CHAPTER II

LITERATURE REVIEW

Orientation of the Review

Considerable diversity of method in higher education inquiry is available to the researcher when reviewing the literature. The specific framework followed in this dissertation to orient the literature to the methodology is that offered by Novak and Gowin (1984) known as Gowin's Vee.

Novak and Gowin note that research in education is unproductive due in part to the artificial nature of educational events and objects which are less consistent and predictable than naturally occurring events because of variations in human individuality (p. 149). This dissertation attempts to make the distance learning environment a more productive one by offering measurements of the occurrence and perception of interactive characteristics of educational events in two distance learning environments for use in pedagogical and acquisition decision making. Novak and Gowin propose theory-driven research based within the theoretical and methodological framework of a discipline. The literature review of interactivity in computer-based distance learning that follows is outlined in Novak and Gowin's framework and endeavors to clarify the theoretical and conceptual sources, including this dissertation's author, from which this dissertation's research questions and specific events or objects of study are determined. This dissertation suggests evidence (bounded within Novak and Gowin's model) that can guide researchers in elaborating the necessary methodological devices required to prepare further observations as evidence to support or refute the findings contained herein, to build upon the findings in studies of their own, and to use instruments suggested in this study for future validation.

As shown in Figure 1, the "V" shape of Gowin's Vee model separates the methodological side on the right, from the conceptual side, on the left while focusing research questions centrally downward to the specific events or objects being studied. Two types of findings from the research are made, knowledge claims that relate to the developing theory of the field, and value claims that relate to the use of the new knowledge. Both are supported by warrants which in the quantitative research theme of this dissertation consists of a priori hypothesis, which is connected to a theoretical system. The evidence discovered in this study as presented in Figure 2 will be based on, among others, Moore's Theory of Interaction (1992), Berlo (1960) and Chute's (1987) Models of Communication and Wagner's Interactive Transport Model (1994). The study will employ statistically analyzed and quantified data acquired, formatted and based in the ideological system of the American educational research community and as framed by the American Psychological Association publication manual and guidelines (1997).

Introduction

Urgency for conceptual frameworks of analysis for advanced distance learning technology is not difficult to discern in the literature. While leaders in urban higher education recognize that the technologies of distance learning encompassing two-way audio/one-way video television, computers and telecommunications offer solutions as well as powerful forces for change for the problems confronting higher education, Deloughry (1992) and Douglas (1993) conclude that there are but few evaluative models

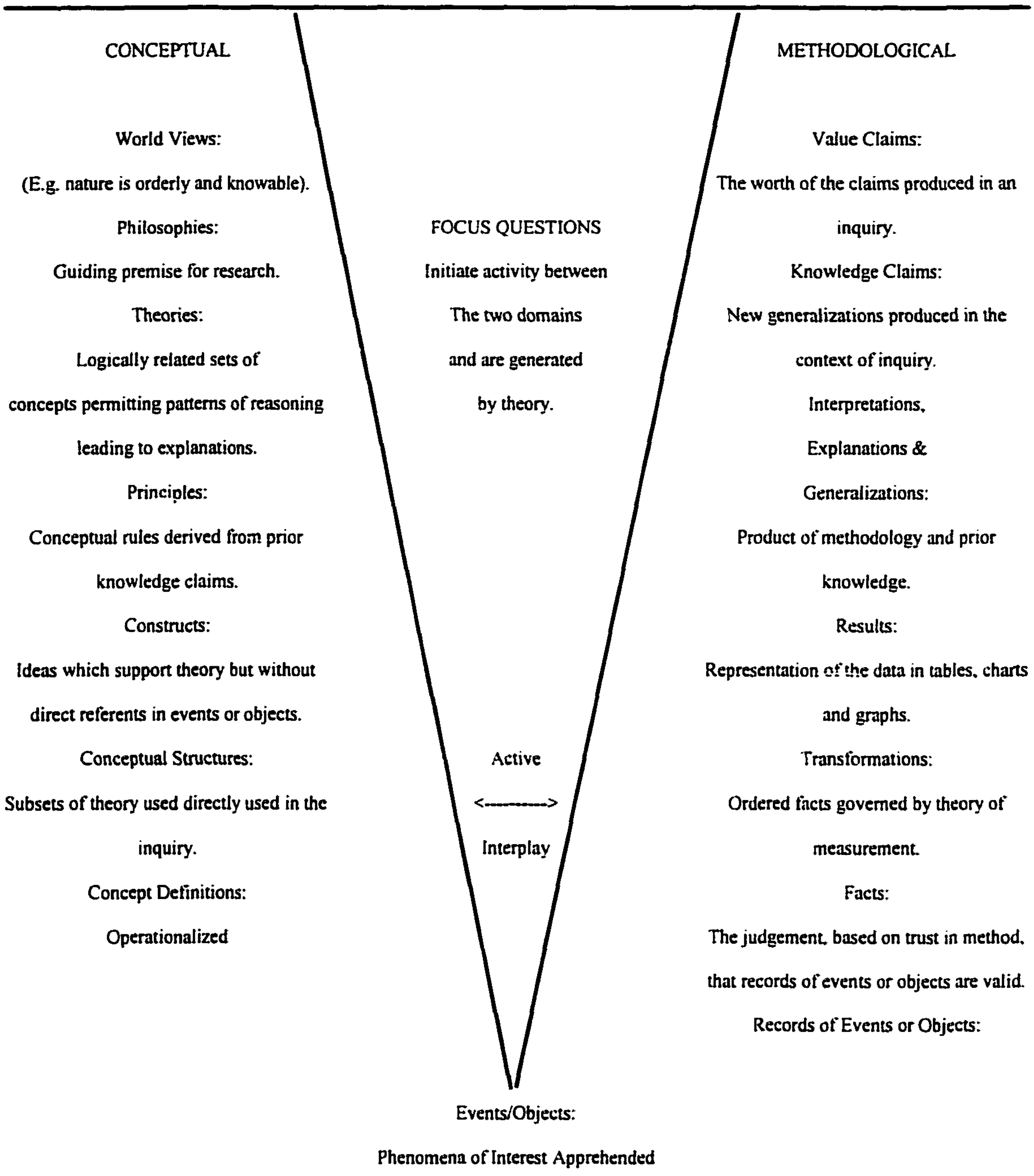


Figure 1. Gowin's Vee. This figure was derived from Novak and Gowin (1984, p. 150).

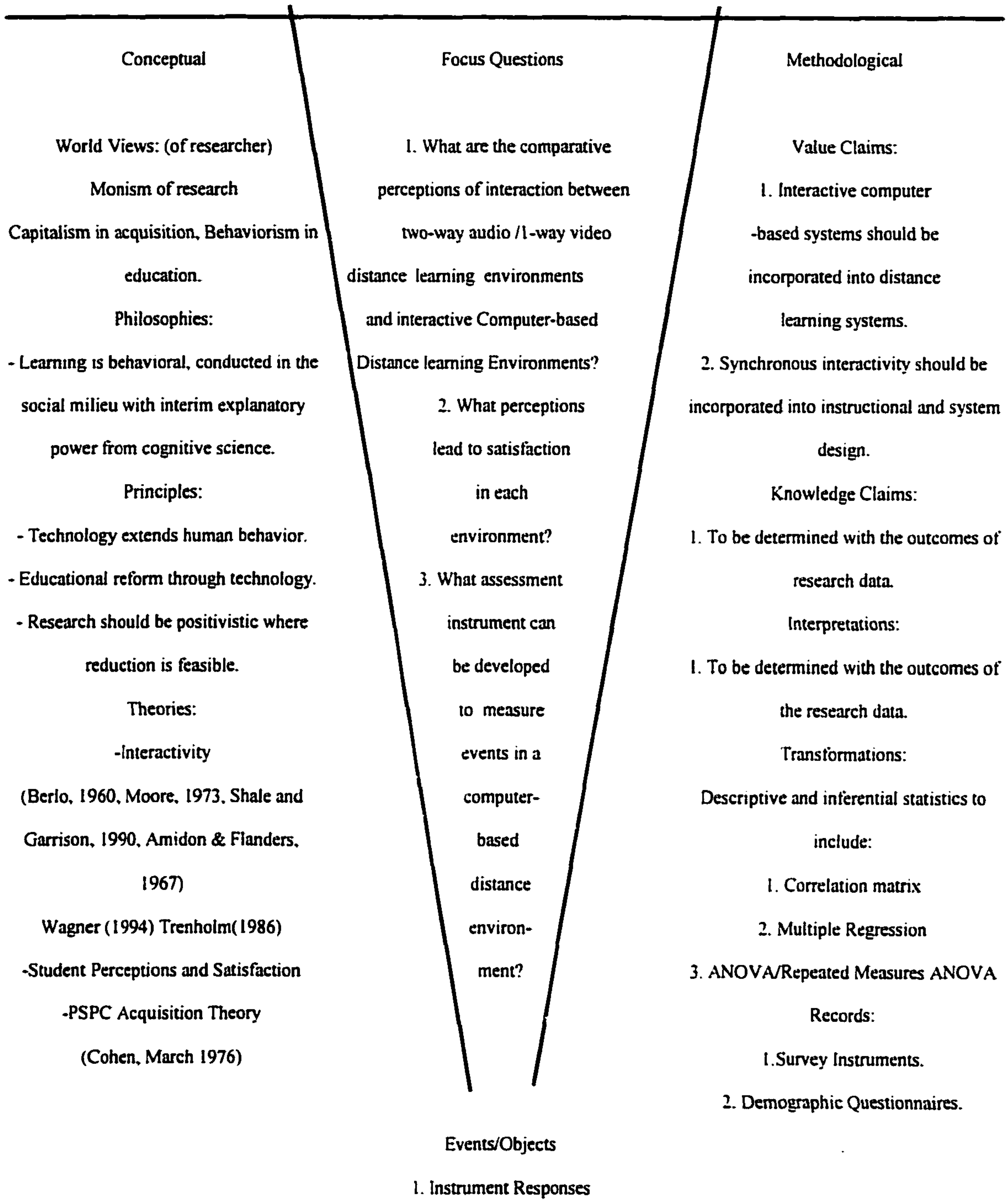


Figure 2. Gowin's Vee Representation of This Research Study. The model for this figure was derived from Novak and Gowin (1984, p. 150).

at educators' disposal for analysis of the technologies. The need is urgent as implementation and use of advanced distance learning technology is thought to be crucial by most urban higher education leaders. The State Council for Higher Education in Virginia (1991) states that "It is not possible to provide an education for the 21st century without the new technology" (p. 2) and recommends the immediate implementation of evaluative systems for its acquisition. In a report provided to the National Science Foundation by Maly, Overstreet, Wahab and Raymond-Savage (1993) the authors suggested:

> A national government movement to expand the utilization of information technologies in the instructional process is underway. This movement is based upon the success of several interactive satellite video networks which have emerged in the past decade, the improvement in digital technology, and a new concept of an electronic highway crossing the country which will provide an individual an incredible access to information. It has been suggested that this electronic highway can provide the bridge for higher education to teach both more effectively and efficiently. As universities are faced with relatively fewer resources to provide quality educational experiences for their students, finding a solution without the utilization of technology is virtually impossible. The advent of digital technology to support virtual classrooms at distant locations is an important step to taking the instructional process one step higher and to solve identified problems with current systems (p. 1).

The authors confirm the belief of other authors including Means (1993) that technology is a viable source of reform in present-day urban education higher education, that important differences exist between the methodologies available (Koch, 1998) and that comparative analysis between present-day and leading edge technologies may lend important considerations in the choices that urban education administrators, educators and policy makers must make in delivery systems (Ludlow, 1994, Kruh and Murphy, 1990, Moore et al., 1990).

Distance Learning in Education

Distance learning represents the forefront of today's technological reform in education and has demonstrated a growing pervasiveness throughout urban institutions of higher learning in America. A 1997 survey by the US Department of Education discovered a third of all higher education institutions in the United States offered distance learning courses. Another quarter of the remaining institutions surveyed planned to offer such courses in the next three years. In the academic year 1994-95 there were approximately 753,640 students formally enrolled in 25,730 distance learning courses (U.S. Department of Education, 1997). Sherry (1996) claims figures such as these represent a substantive investment in funding and focus of policy by university administrators in the adaptation of distance learning as a primary mode of education. This focus by the policy makers, administrators and the faculty of urban universities is occurring as the acclimation to learning by distance among students becomes mainstream and the recognition of the effectiveness of two-way television environments becomes an issue of abundant documentation. Russell (1997), Moore et al., (1990) and Ludlow (1994) have compiled extensive listings of studies equating the equivalencies in achievement of traditional learning environments and two-way audio/one-way video television-based distance learning environments. Yet Orr (1999) compiles an equally compelling list of studies asserting significant differences in achievement and satisfaction between the two educational environments. Neither of these extensive reviews of the literature contains comparisons between present two-way audio/one-way video technologies and the next generation of computer-based distance learning technology that incorporates computerized interactive elements. As Russell (1997) repeatedly points out in his exhaustive study of distance learning methodologies, computer-based distance learning rides a wave of well-documented two-way audio/one-way video television-based distance learning success. The exponential increase in the computer-based environment's interactivity, capabilities and educational environment however, according to a study describing computer-based interactive distance learning by Maly et al. (1996), makes funding and policy choices based on the premises of previous technology's relatively limited capabilities difficult.

Ludlow (1994) in a study of contrasting models of distance education contextualized the differences that exist between the available technologies as especially important in the context of fiscal restraint and in the effective use of taxpayer's funds when public institutions of higher education decide whether or not to acquire or implement distance learning systems. Increasing competitiveness in the student market also make measures of student satisfaction with the available technologies of paramount importance in attracting and retaining students.

Interactivity as a Consideration in Technology Acquisition and Implementation

Studies have identified several factors that seem particularly important in the choice educators' make in delivery systems to facilitate distance learning. One such factor is interactivity (Saettler, 1990, Wagner, 1994). As instructional technologies have become more powerful, pervasive, affordable, user friendly and adaptable, the hopes that these technologies will help to bring about more dramatic improvements in education practice based in part on increased interactivity have become more persistent (Wagner, 1994). Distance learners contend that compared to previous technology mediation of the instructional process, more capable technology such as computer-based distance learning appears to afford greater real-time interactivity, yet debate over this continues without resolve (Clark, 1983; Kozma, 1994) and the results are usually paradoxical (Hillman, Willis and Gunawardena 1994). The fact that technology may affect classroom interaction in important ways is supported by research. Adams and Hamm (1988) show that technology does greatly affect the interaction of its user, and the research of Hillman, Willis and Gunawardena (1994) supports this view.

Although the effectiveness of distance learning may not be completely determined by the mediating technology (Russell, 1992), the technology is certainly not neutral (Norman, 1993). Consideration of the interactive effects of technology in the choice of present or future educational delivery systems is important because as Moore (1973) states, "The very nature of distance learning itself requires any distance learning educational interaction attempted to be mediated, or shaped, by the use of the electronic, mechanical or other device used to transmit the educational interactions via a distance" (p. 662). Saba (1988) claims that this mediation is the single most important differentiating factor in distance educational delivery systems.

In view of this mediation, the selection of technology media for an electronic distance learning system differs greatly from the selection of similar pedagogically enhancing but ancillary media (overhead projectors, white boards, and videos) utilized in traditional education. The technology of distance learning bounds and shapes the educational experience to a greater degree than any other pedagogical tool or type of educational technology considered. Stubbs and Burnham (1990) argue that one critical factor in delivery acquisition choices by urban educators considering the distance learning milieu is their evaluation of the distance learning technology as not only an information delivery system, but also as a flexible methodological conduit of choice through which interaction must pass. Jost (1990) and Haynes & Dillon (1992) argue that educators who choose a distance learning environment with high levels of student interaction and intensive student support measures will often achieve success for learners in distant classrooms. Maxwell, Richter and McCain (1995) in a review of the most proliferate media in graduate distance learning programs define student support to include not only academic services unique to the distance learning environment, but also the identification of students' needs and problems, the ability to maintain motivation, and not coincidentally, the provision of opportunities for interaction with peers and teachers.

Distance learning via two-way television offers urban educators a proven method of instruction but as Boston (1992) states; "In most (overall interactive) classroom settings, students in two-way television distance learning have a tendency to hold back and not participate" (p. 49). Shyness and timidity tend to be less prevalent in computer-based instruction in Boston's experience, although measures must be taken for student weaknesses in technical competence and manipulation skills. Boston's findings imply an individual level of interactivity in the distance classroom commensurate with the interactions at the student level and an overall interactivity at the group level. These findings have important implications for the possibility of building student participation at the individual level in computer-based distance learning through increased individual interactivity and quite possibly implications for overcoming documented minority disenfranchisement from majority culture classrooms.

Proponents of computer-based instruction such as Maly, Overstreet, Abdel-Wahab and Gupta (1994) in a study of melding networking, televisions and computers in interactive remote instruction, Tennyson (1980) in a study of computer-based instructional control strategies and Dede (1990) in a study of the evolution of distance learning technology illustrate the computer-based environment as a different approach to distance learning because of the environment's focus on engagement and individual interactivity and as a method for overcoming interactive reluctance on the part of both students and instructors. Hillman, Willis and Gunawardena (1994) and Bradley and Morrison (1991) support the view that this environmental difference implies a different perceptual level of interactivity required of participants in the computer-based climate if measures of the environment's efficacy based on interaction are to be considered successful.

Intuitively urban educators know that assessment based in the context of interaction is significant. The concepts of one-on-one instruction, tailored pedagogy and small class sizes are based upon the perceived value of their interactional richness. It is axiomatic that this perceived proximity in interpersonal communication enriches interaction. Shale and Garrison (1990) state that "in its most fundamental form education is an interaction among teacher, student, and subject content" (p. 2). Keegan (1990) believes that interaction is key to effective learning and information exchange and Moore (1992) considers interaction a defining characteristic of education. Wetzel (1994) found that increasing the fidelity of interactivity generally increases effectiveness and satisfaction and is essential for the student to remain interested and steered toward success. In traditional classrooms distance educators in general contend that one of the most significant attributes of the technologies used in current and future distance learning systems is their capacity for real time interactivity (Wagner, 1990).

Interactivity Studies

There are few studies that have focused on distance learning interactivity specifically and in terms other than of frequency counts or which have made comparisons between distance technologies involving state of the art computer-based media. Van Haalen and Miller (1994) reported on interactivity as a significant predictor of student success in satellite television systems but interactivity in this study was based on frequency counts of telephone logs recording only the number of calls from students to the teacher both during and after a class during a school year. The interactions were not placed in context with a medium nor were student perceptions equated to the frequency data. A comparative study of several alternative video-teletraining technologies by Simpson (1991) found that the most critical condition for success in an experimental one-way video Tele-training (only) course was the ability for students to see the instructor and have two-way communications. The value of this study is that it compared complete courses but only across one learning environment with essentially limited video exposure. Hennings (1975) in an early study of distance learning methodologies surmised the problem of video teletraining as compared to interactive computer-based media thusly: "There is a need in distance learning research to adopt an expanded view of effective teacher-student communication. It involves integrating a variety of communication forms and channels that include verbal communication, vocal communication and mediated messages." (p. 46). This is precisely the increased capability that technologists twenty years later hope to gain with computer-based technologies.

Researchers have found that students that experience higher levels of "engagement" or interaction have been shown to have more positive attitudes (Garrison 1990; Ritchie and Newby 1989) and higher levels of achievement (Mccroskey and Anderson 1976). Garrison (1990) studied 34 audio-teleconferencing courses and concluded that while distance learning was a viable alternative to traditional classrooms, distance learning systems that increased learner to teacher and learner to learner interaction were necessary for a richer learner to content interaction and student cognitive change. Ritchie and Newby (1989) compared traditional classrooms with 1) TV classrooms with instructors and 2) TV classrooms without instructors using television monitors only. The purpose of the study was to compare the influence of televised distance learning environments on the frequency and type of interactions, attitudes and satisfaction. Twenty-six students were randomly assigned to one of the three environments. The researchers found that environments most closely emulating traditional classrooms had higher student ratings. Distance environments utilizing two-way audio/one-way video were found to have less student involvement, less enjoyment and a lessened student ability to ask questions. The authors felt that future research utilizing systems with greater interactive hardware available was necessary. Computer-based distance learning technology was not studied. Hackman and Walker (1990) in a study of two-way audio/one-way video television systems found that the interactivity of the distance learning system design was a positive influence on learning and satisfaction in a survey of 324 students. Hackman and Walker objected to using grades as an objective measure of student learning and of media differences because student grades are confounded with a number of extraneous variables including communication skills, attitudes and work habits. The researchers felt that mediated learning was most effective when students perceived personal involvement in the educational process. Hackman and Walker concluded that increased interactivity allows learners to engage in a form of personal involvement essential to a technology-mediated environment. Gunawardena, Anderson and Lowe (1996) in a recent study of a world-wide computer conferencing debate held on-line (Internet-based) found that alternative forms of interaction in distance environments must often be found to keep participants' attention (and therefore, motivation) focused on the subject being discussed. Kruh and Murphy (1990) in a video-taped analysis of the technology of teleconferencing found that maintenance of a high level of overall classroom interactivity by instructors truly cognizant of the benefits and limitations of the mediated environment they are teaching in helps to keep individuals involved through both direct and vicarious interaction. Kruh and Murphy suggested that the more engaging a distance learning environment can be, the more satisfactory its potential is. This may suggest that computer-based interactivity has an engagement level edge over its two-way audio/one-way video counterpart.

Hillman, Willis and Gunawardena (1994) found interaction to be crucial to pedagogical effectiveness and to play an important role in student attitudes about the distance learning programs offered. Hillman's study and others show that student attitude toward distance education can be significantly affected by facilitating some degree of interaction among students and teachers, suggesting the study of interaction in the newer forms of distance learning to be appropriate. The researchers studied several intact groups of students over a semester of instruction in various televised distance learning media and noted that transmitted content affects the knowledge acquired by students and that the technology of the medium affects the modes of interaction of its users. Hillman, Willis and Gunawardena concluded that the facility with which the distance learning technology allows participants to interact strongly affects the students' ability to have active involvement (involvement they deemed crucial to learning) in the educational transaction, suggesting system interactivity to be an important consideration in distance learning technologies. Yarkin-Levin (1983) (cited in Fulford and Zhang, 1993) found that students who were told that they would have a subsequent interaction in a class to follow had more positive attitudes and recalled more facts than those who did not anticipate interaction. Student attitudes about being distance learners and their satisfaction with the experience affect their outlook about distance education in general. Older students are typically more enthusiastic and structured in their approach to distance learning according to Nadel (1988). Perhaps this is due to maturity and a more individualized reliability necessary to distance learning course opportunities. Pugliese (1994) in a study of modem delivered courses in community colleges found that learners who are either less socially interactive or capable of participating in the traditional classroom might have a more satisfactory and successful educational experience in modem-based education. With proper levels and types of interactivity, these same conclusions may be drawn on opportunities to engage disenfranchised minority populations in increased distance learning educational environments.

These observations suggest that a satisfactory, individualized computer-based learning approach may be opportune for the distance learner, a significant demographic of the urban higher education population.

The use of a variety of teaching methods with an emphasis on lecture delivery was determined early on by distance learning researchers to be preferred by students (Cohen, 1981). The wider availability of tools and advanced interactivity claims of the computer-based distance learning experience in lecture delivery may lead to a more satisfactory experience based on perceptions of interaction than the two-way audio/one-way video televised experience. Recognizing that the loss of visual immediacy between learners and instructors in distance learning poses actual and perceptual obstacles, researchers and practitioners advocate investigations of interaction specifically in the distance classroom (Hillman, Willis and Gunawardena 1994, Moore 1992). Comparison with perceptions of mainstream distance learning systems in the new computer-based learning system in relation to student satisfaction is apropos (Diir, 1991, Goldstein, 1991(cited in Moore, 1990)).

Interaction and Interactivity

Models of the interactional communication process useful in analyzing the interactive distance learning environment date back at least to Greek antiquity. Aristotle identified the speaker, the speech and the audience as the principal features of communication. Although the interactions within an interactive computer-based distance learning environment may be more complex, these basic elements persist. Berlo (1960) went beyond identifying component elements of communication and advanced the concept of communication as a process. Berlo constructed the quintessential model of communications theory that recognizes the interactive process of communications. The basic elements or concepts of his model are source-encoder, message, channel and receiver-decoder plus feedback as demonstrated in Figure 3.

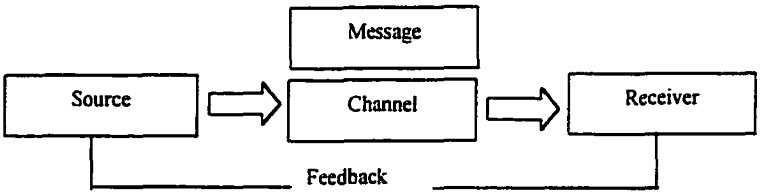


Figure 3. Berlo Interactive Communication Model. Gortner (1989).

The concept of this communications process is one of considerable complexity and subtlety however. When viewed in the context of the distance learning environment the interactions become increasingly enigmatic commensurate with distance and the increasing capabilities of the mediating system.

Chute (1987) (Cited in Wagner, 1994) adapted an earlier model of communication theory by Shannon-Weaver (1949) that expands Berlo's model by adding examples of broadcast media found in computer-based distance learning. Chute suggests these various media could potentially serve as another source in a distance learning environment's interactional communications. Figure 4 represents the researcher's interpretation of Chute's model and demonstrates the learner-interface interaction inherent in the mediating technology and the potential for environmental effects the media offers.

Hillman, Ellis and Gunawardena (1994) also introduced evidence that technology adds a fourth dimension to the definition of interaction, which they deemed learner-interface interaction. The authors argue that this fourth type of interaction is a function of the system design and technology employed.

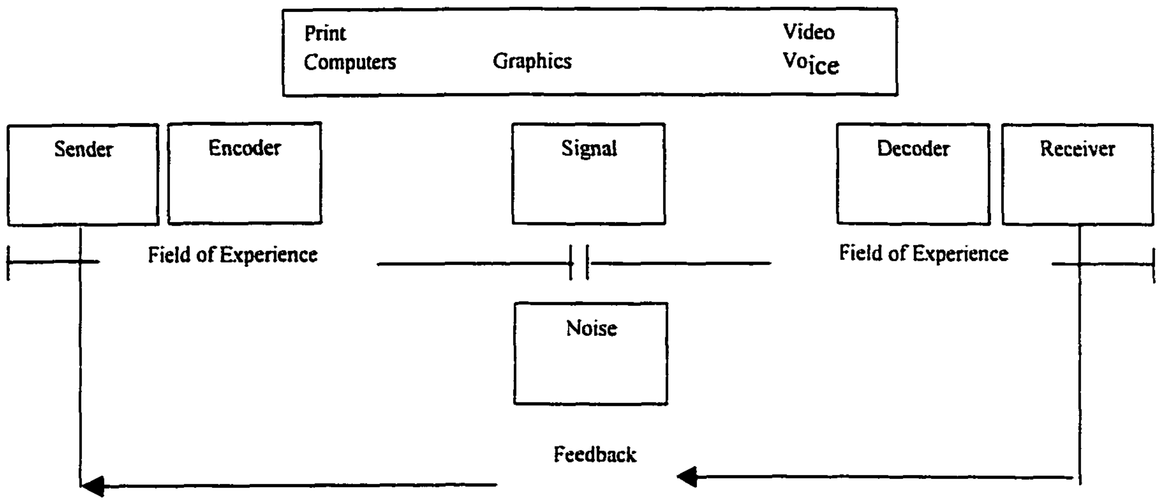


Figure 4. Chute Model. (Wagner, 1994).

Wagner (1994) in a study of distance learning systems recommends the use of an Interactive Information Transport Model outlined in Figure 5 to conceptualize the mechanics of interactive telecommunications.

Wagner (1994) describes interaction as a multifaceted concept requiring delimitation. Wagner suggests interaction is an attribute of the instructional process and interactivity is an attribute of modern telecommunications technologies. Wagner believes that interactivity may eventually be viewed as a machine attribute, while interaction may be viewed as an outcome of using interactive delivery systems, emphasizing delivery system choices in terms of conduits of interactivity.

As stated in chapter one, Moore (1992) defined the other essential components of distance learning interaction: learner-content interaction, learner-instructor interaction

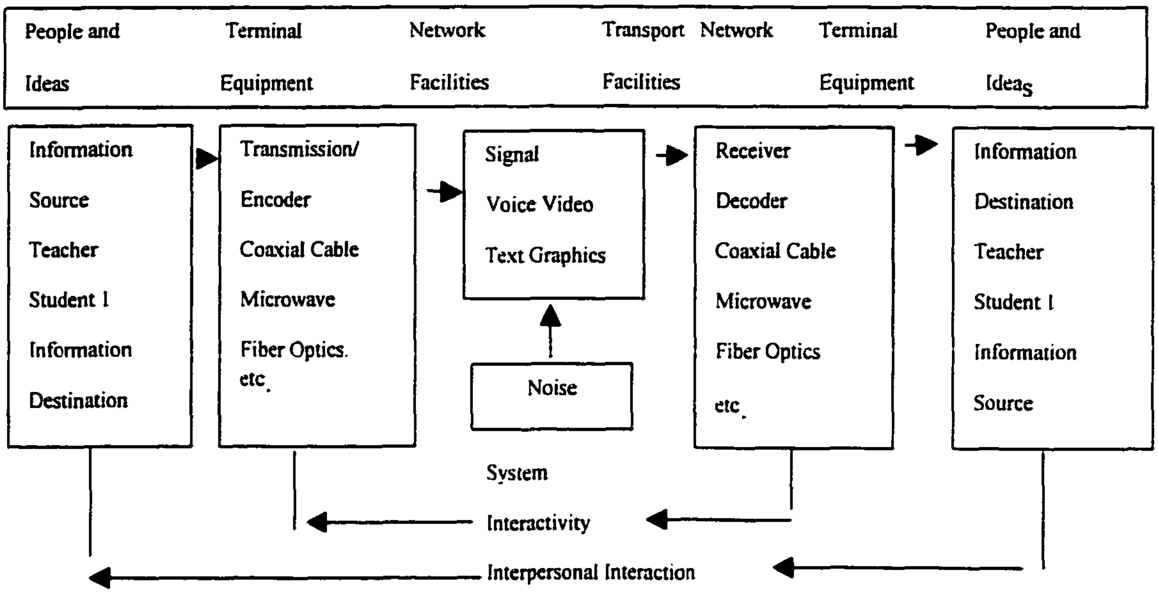


Figure 5. Interactive Transport Model. Wagner (1994).

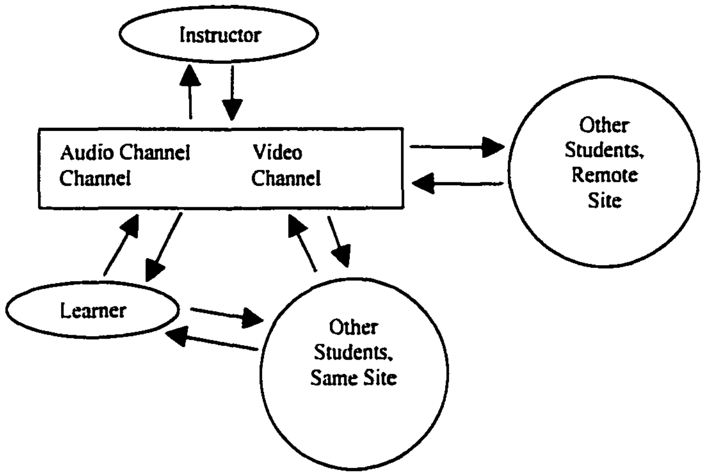
and learner-learner interaction. This study measured distance learning environmental differences in Moore's learner-instructor and learner-learner interaction types as operationalized by learner perceptions and as a function of Wagner's Interactive Transport Model's sub-function of system interactivity.

Neither Wagner (1994), Hillman, Willis and Gunawardena (1994) or Moore (1989) in their often referenced findings describe studies comparing the interactivity attributional differences of distance learning methodologies available to educators today and whether those differences, if they exist, are discernible to the learners involved as suggested in this study.

Individual and Overall Interaction

Sociologist Alex Bavelas (1950) (cited in Gortner, 1989) pioneered network organizational analysis that allows modeling of the interactivity of computer-based and two-way audio/one-way video distance learning systems into an individual or overall orientation. The distance learner in a two-way audio/one-way video distance learning environment may have collective and shared interactions that include the components of Berlo's model in each link as shown in Figure 6. Each link contains the source, channel, message, receiver and feedback components of Berlo's model. Characteristically the interactive channel between each of these components is an "overall" or collectively shared experience within the traditional classroom where Kruh and Murphy's (1990) vicarious interaction abounds. Individual interactivity is perceived by learners as an issue of their personal involvement within an overall classroom experience. In computer-based distance learning, where each learner operates independently from his or her personal computing workstations, elements of the environmental experience are inarguably collective, but a larger share of this interactivity is channeled through the mediating technology. The learner's perceptual acuity is narrowed through the conduit of the mediating technology to a much greater degree than the two-way audio/one-way video environment. It is the interactive nature of this environment, whether it engages the learner on a more individual level as perceived by the learner and whether that perceived individual interaction is more satisfactory than the overall interaction of the two-way audio/one-way video environment that is of prime interest in this study.

Two-way Audio/One-way Video Network Analysis



Computer-Based Interactive Network Analysis

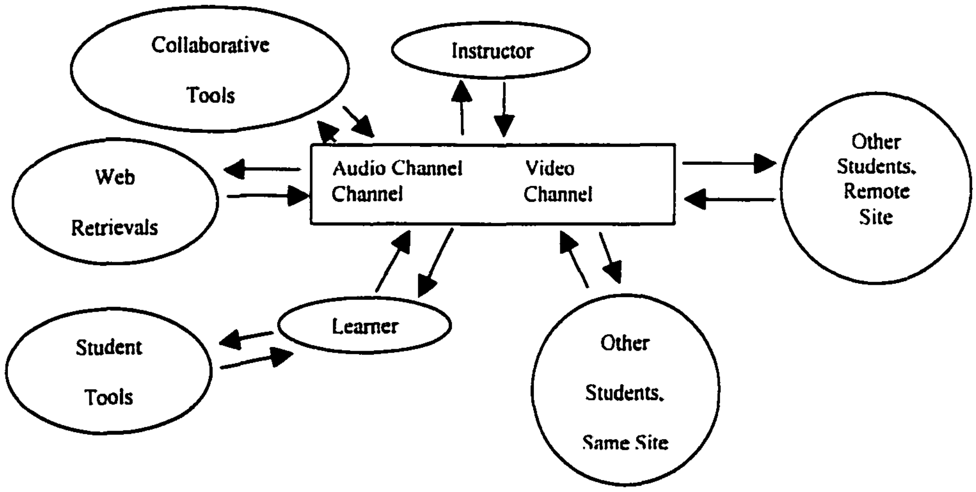


Figure 6. Two-way Audio/ One-way Video Interactive Network Analysis. Adapted from Gortner (1989).

Sewart (1982) proposes that all educational transactions lie somewhere on an interaction continuum, with learner-instructor interaction at one end and learner-content interaction at the other. This continuum is contextual and based on situational characteristics of the medium such as the number of individuals involved, their relative proximity, their interactive and communicative roles and tools, the purpose of the activity engaged in, and delay in feedback times among others.

Illustrating this continuum, Trenholm (1986) establishes a continua of the characteristics and the situational contexts of an educational environment that demonstrate the concept of individual and overall interactional components. Trenholm's contexts range from interpersonal and small group at one end, to public and mass communication at the other. These contexts translate directly to the perceived interactional engagement of a learner within this continuum, referred to in Figures 7 and 8 as "Individual Interaction" or "Overall Interaction." Distance learning environments with a combination of features such as two-way audio/one-way video and computer-based instruction might have characteristics located on a chart of Trenholm's characteristics shown in Figures 7 and 8. In a hypothetical arrangement such as these figures demonstrate, with measures from left as low and right as high, Trenholm's "many persons" refers to the large, open and traditional class sizes and rooms inherent in two-way audio/one-way video environments. According to Maly et al. (1994), and Giardina (1991), computer-based courses close and individualize the perceptual size of the student by the mediation of all interactions through computer workstations with little outside intrusion. Students in open classroom televised two-way audio/one-way video environments on the other hand experience a more collective experience (Mckenzie, 1997). This collective experience is independent of student site location (main/originating or remote) but involves less technology mediation at originating sites.

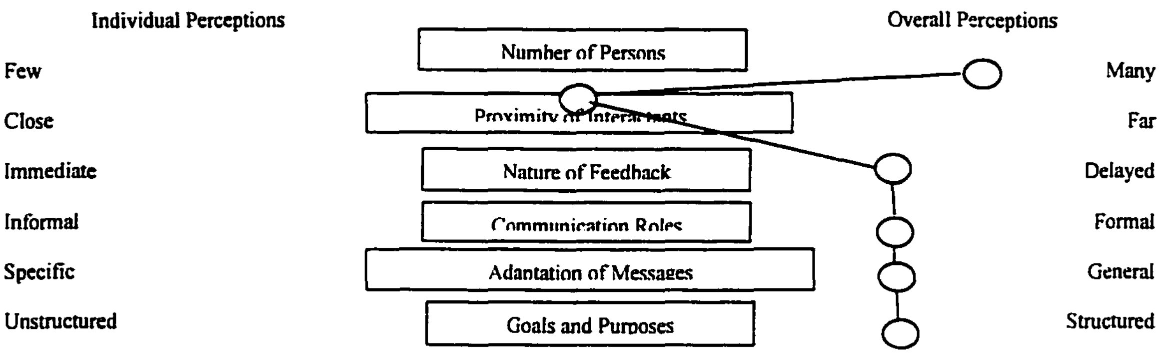


Figure 7. Characteristics of Two-way Audio/One-way Video Interaction. This figure adapted from Trenholm (1986, p.18). The location of two-way audio/one-way video characteristics has been superimposed on the original chart.

Proximity of interactants refers to the physical and perceptual distance of other students and the instructor. Learners in computer-based distance learning environments control their environment through workstations operable only by the individual student. This disconnected approach to learning may decrease the perceived proximity of other interactants by reducing vicarious interaction and mitigating face to face interaction and mediating and confining their perceptivity. The perceptual distance of fellow learners is surmised to be closer with two-way audio/one-way video environments where learners occupy traditional open classrooms with a shared group focus on central monitors or instructor. This individual perceptive experience is possibly greater if the learner is geographically dispersed from other students. Feedback in Trenholm's model is similar in the two environments especially with currently available wider bandwidths and separate

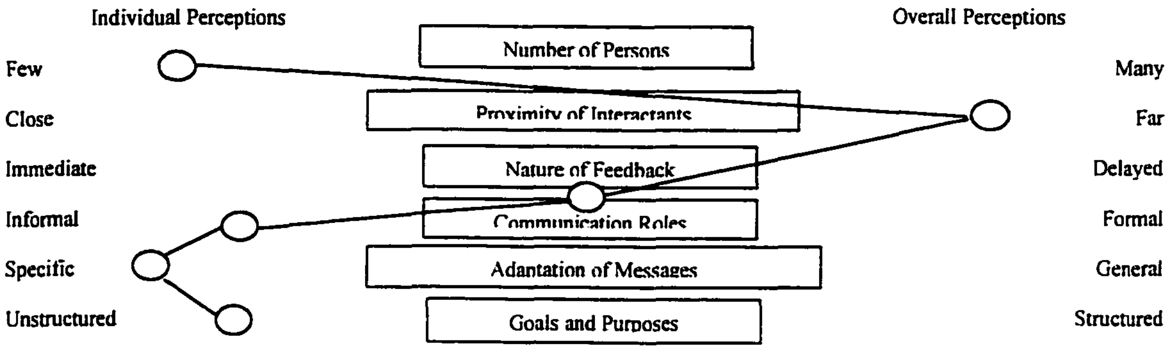


Figure 8. Characteristics of Computer-Based Interaction. This figure adapted from Trenholm (1986, p.18). The location of two-way audio/one-way video characteristics has been superimposed on the original chart.

channel video streaming in the computer-based environment. Communication roles are informal in computer-based distance-learning. The learners can engage in numerous interactive tools at will in their primary interactive venue (the workstation) without knowledge or participation of fellow students or instructors (Maly et al., 1994). Otherwise communication roles are similar to that of the two-way audio/one-way video classroom and the mold of traditional classrooms. Both learner and instructor control of interactive tools and the ability to tailor messages with artwork, animation, pointers and other enhancements may skew inter/intra classroom message adaptability to strong individual perceptivity in computer-based distance learning environments. This capability coupled with a common design purpose and goal of individual interactivity and engagement of the computer-based distance learning system gives this computer-based environment a strong potential for higher levels of individual perceptions of interactivity and commensurate engagement of learners within Trenholm's model.

Moore (1973) presented a two-dimensional theory of distance education that further defined the medium in terms of individual and overall interaction by describing three primary elements of distance learning: learner autonomy (independence); dialogue (interaction between learner and instructor) and structure (extent to which elements of course design are responsive to the needs and objectives of the individual learners). This grounded theory, based on an inductive analysis of 2000 distance education program descriptions, provided a theoretical framework which initially attempted to differentiate the field of distance education from traditional education. Analysis of one program dimension, "distance" was based on the extent to which they were highly individualized or showed "low individualization." Highly individualized programs were categorized as being less distant. The second dimension of independent learning and teaching, learner autonomy, is measured by the extent to which programs allow learners to control or influence their own learning. Both of these two component theories will be measured in this study through learner perceptions.

Environmental Comparisons

Issues in the comparison of distance learning environments based on interactivity can be clarified by using Mcluhan's (1964) classic distinction between "hot" and "cool" media. Mcluhan explained that a hot medium is one that extends students' educational and sensory experiences in "high definition." Mcluhan describes high definition as the state of being well filled with data. A cool medium, by contrast, is one in which little interactivity and "data" is given and much has to be filled in by student intuition and imagination. The technology employed in a distance learning environment with sophisticated interfaces, tools and capabilities, may, be a hotter, more interactive medium than an environment less technologically capable, or for that matter, even a traditional classroom.

Maly et al. (1996) offers a summary table (Table 3) of interactivity in the computer-based and televised distance learning environments that offers further insight into interactive computer-based differences and the coolness or heat of the distance media involved. In Maly's table modern A/V Class refers to a classroom with multimedia capability where all students are co-located with an instructor. Presentation bandwidth refers to the amount of visual information, provided by the instructor that the student has access to during the lecture. Traditional TV (two-way audio/one-way video) distance learning systems are described as having limited bandwidth due to limited resolution. A traditional classroom with multiple blackboards is described a having high bandwidth if the instructor uses all the blackboards. Modern A/V classes are illustrated as having better projection resolution than a televised class with the options of blackboards for increased visual bandwidth. Each IRI student has a high-resolution monitor available for their use at their personal workstation. Student Demo refers to the ability of a student to show their work to other class members. Modern A/V classes have limited student access to the multimedia presentation system but may be able to use the blackboard. Spontaneous access to information refers to the ability for the instructor to refer back to material previously presented or to bring in new material in an order that was not previously planned for. TV and A/V classes do not explicitly support access to this material.

Table 3

Comparisons of Different Teaching Environments

	Live Class	TV Class	Modern A/V Class	IRI (Computer-based) Class
Presentation Bandwidth	Multiple Blackboards	Low	Medium/ High	High
Interactivity: •Verbal •Student Demo	Free flowing discussion Blackboard	Audio only Discussion None	Free flowing discussion Blackboard	Video/audio Discussion X tools
Spontaneous Access to Info.	No	No	No	Yes
In-Class Out-of-band Learning	No	Parallel Learning	No	Parallel Learning on-line
Instructor Feedback	Eye Contact	Audio Questions	Eye Contact	Video class 1 way video Survey
Training	None	Instructor	Instructor	Instructor/ Student
Replay	No	Usually Taped	Instructor Handouts	Remote, with note taking
Engaging Presentation	Teacher as Actor	Limited Motion A/V	Teacher/actor Some animation	Limited motion Animation

Note. Maly (1996). X-Tools are UNIX-based collaborative software tools such as whiteboards, presentations and simulations that are jointly manipuable between learners and instructors. A/V: Audiovisual.

Maly et al. (1996) describe In-class Out-of-band Learning as the ability for the student to enhance the learning experience through a channel different from the instructor's presentation. Maly points out that while the student could read from a textbook during the class, it is discounted for comparative purposes because it is not a function of the mediating system. Parallel Learning refers to the ability for the student to engage in a learning experience with others while the instructor is lecturing. Maly et al. offers asking questions of fellow students or sending e-mail as examples.

Instructor feedback refers to the ability of the instructor to discover if the class is following the material.

Training refers to any additional training required beyond the traditional class as a baseline.

Replay refers to the ability to review a lecture. in the modern A/V class, Maly et al. assumes that the instructor can make a copy available. In the computer-based or IRI class, the student can replay the lecture via computer or review on-line notes.

Engaging presentation refers to the ability to keep the students' attention during the class. Maly et al. believe that in the TV class, and in IRI, the ability of the instructor to use gestures and act out the motion of the class is limited. Much of the interest in these classes comes from the media used for presentation.

As Table 3 clearly demonstrates, there are important interaction related differences in these distance educational environments that can potentially shape and effect the system interactivity component of Wagner's (1994) Interactive Transport Model.

Instructional/Learning Theories and Interaction

Several instructional design and learning theories exist that help define the role of interaction in the environment of distance learning. Learning theories and instructional theories provide frameworks that support a view of interaction as one of the functions of the interactivity of the media. Situational specificity such as that possibly provided by the findings in this study is necessary to develop meaningful implementation strategies by which measures of interactivity may be obtained. Once situational variables are identified, reasonable strategies for improving interaction can be developed.

Gagne (1985) developed a hierarchical task analysis that required a psychoanalysis of the component steps a student needed to learn in order to perform a complex skill. He identifies eight distinct types of learning in order of increasing complexity: (1) signal learning, (2) stimulus-response learning, (3) chaining, (4) verbal association, (5) discrimination learning, (6) concept learning, (7) self-rule learning, and (8) problem solving. The concept learning hierarchy Gagne professes implies that all learning is reducible to a mechanistic process. Whereas Skinnerian behaviorists using operant conditioning stress shaping behavior through development of responses, Gagne stresses an individual's ability to select stimuli at different points in the learning hierarchy. This theory may suggest a special teaching capability to computer-based distance learning that offers a richer, more interactive experience with selectable stimuli and jointly manipuable or collaborative tools and information than the traditional, two-way audio/one-way video distance learning classroom. Cognition of this heightened interactivity would be consistent with findings of increased efficacy of the environment if manifested in the perceptions of the learners involved.

Leslie Briggs joined Gagne (1979) in developing an information-processing model of learning theory that defines instruction as an interactive set of events that takes place in a sequence: (a) gaining attention, (b) informing the learner of the objective, (c) stimulating recall of prerequisites, (d) presenting the stimulus material, (e) providing learner guidance, (f) eliciting performance, (g) providing feedback, (h) assessing the performance and (i) enhancing retention and transfer. As described earlier in the model based on Trenholm's contexts, much of the interactivity of computer-based distance learning is shaped by the mediating technology in an individualized experience with a qualitative difference apart from the vicarious or overall interactivity of the open two-way audio/one-way video television classroom. This computer-based distance learning environment changes the conditions and student perceptions of the interactive "set" of events described in Gagne and Brigg's theory in ways less understood than in the traditional classrooms on which the two-way audio/one-way video television distance learning environment is modeled. The computer-science student may perceive the instructional events in a more or less detached manner dependent upon the effects and mediation of the technology involved. Computer Science courses as suggested in this study make excellent laboratories for analysis of learners' perceptions of Briggs and Gagne's hierarchies of interaction as Briggs and Gagne have found these hierarchies to be most effective in quantitative skills in which the hierarchy contains stratified elements of mathematical-like precepts or rules. Upper division undergraduate and graduate Computer Science courses were chosen in this study to enhance common concept interaction and help to clear the otherwise muddied interactional paradigm.

Scandura (1973) describes a structural learning theory wherein (1) all behavior is generated by rules, and (2) rules can be devised to account for all kinds of human behavior. He describes teaching as using simple rules that build upon more complex rules and then illustrating applications of those rules. His approach is designed for individual instruction and his strategy is for educators to interact on a strong individual level with students to teach those paths of rules the student has not learned. The issue for distance educators is whether the system allows sufficient interactivity at the individual level in the distance learning classroom to be facilitative of this theory. Any distance learning delivery system choices that an urban educator may make based upon levels of interactivity as perceived by the student may be especially appropriate under Scandura's theory.

Cognitive speed theory may provide further understanding of interactivity in distance education. According to Fulford and Zhang (1993), the interactivity inherent in two-way audio/one-way video distance learning (only) is primarily one-way. Learners have the cognitive capacity to process speech at twice the rate that a lecturer speaks (125-150 words per minute). If only half their capacity is needed to listen, the other half can be used to engage in internal conversation. As Fulford states: "Interested learners stimulate their own involvement, but others may begin thought patterns that veer away from the topic. If they are not engaged in a situation in which interaction is required, their renegade thought patterns may dominate their cognitive activity. Understanding this process is especially important in distance education contexts, which can present problems of limited overt interaction" (p. 9).

Learner perceptions of the individual and overall engagement of the distance medium can have important implications as to the medium's efficacy under this theory.

Saettler (1990) believes that as an overall construct, behaviorism and behavioral theory offer some perspective to the interactional process. Saettler describes behavioral theories (such as operant conditioning) as explaining interactive learning as an imitative response from observed behavior which is not complete until the learner's behavior is reinforced. Other behavioral views stress the instrumental nature of the imitation by trial and error. The fidelity with which the interactional medium allows cognition, observation and timely response cues would be indicative of its efficacy under this theory.

Bandura's closely related Social Learning Theory is useful in encompassing most aspects of interactivity in the distance learning environment from a behavioral standpoint. Bandura (1986) believes learning is determined by a three-way interaction among personal factors, the environment and behavior. Bandura believes that the learner's behavior and the environment interact to produce subsequent behavior. Neither of these factors can be considered to be independent of the other but it is essential that a learner have a fully developed and satisfactory interactive experience in and among the learning environment for effective learning to take place. According to Bandura, the level of interactivity and the environmental filtering of the learner's observations and feedback are primary components of learning. This primacy underscores the importance that heightened levels of interaction can have in a learning environment such as distance learning where lack of proximity or the technological mediation of interaction alters the environment and therefore the interactive feedback.

Interactive computer-based instruction environments may have the potential to alter in significant ways the interactional environment of distance learning. Computer-based distance learning may result in more or less interaction by allowing (or encouraging or discouraging) more or less collaboration and engagement. The technology may encourage increased or decreased cognitive levels and involvement. There may be no differences. Analyzing the two environments with equitable groups across a sampling of instructors operating within a specific instructional framework will provide useful evidence as to whether interactional advancements have been made.

Researchers in distance learning have advocated the use of formative and summative course evaluations (Bramble and Martin, 1995), and qualitatively- and quantitatively-based evaluations along with a systematic process for evaluation as proposed in this study (Kember et al., 1994). Few evaluation models such as that suggested in this study appear to have been formally assessed or developed in relation to distance education (Biner, Huffman and Dean, 1995). The student evaluation model suggested in this study however prevails in general within traditional education literature, driven perhaps by the continued and increasing importance placed on teaching by U.S. Colleges and Universities (Abrami, d'Apollonia, and Cohen 1990; Brinko, 1993; Cashin and Downey 1992, Cohen, 1981).

Distance Learner Perceptions and Satisfaction

Student-teacher perceptions play an important role in student attitudes about distance learning and studies have shown that student attitudes toward distance learning can be significantly affected by facilitating some degree of interaction among students and teachers (Garrisson 1990; Ritchie and Newby 1989; Yarkin-Levin 1983). Instructors in two-way television environments have traditionally been able to facilitate interaction through regular individual contact with students via telephone or electronic mail. Newer, computer-based distance learning environments may augment this interactivity and in ways less understood than their televised counterparts. Pascarella, Whitt, Edison, Hadgedorn and Tenzini (1996) in a national study of student learning demonstrated the positive relationship between students' satisfaction with instruction and their academic success. Many studies have attempted or recommend combining the overriding importance interaction has in the educational experience with satisfaction measures within a satisfaction/interaction matrix (Maxwell, Richter, and McCain 1995; Reeves and Reeves 1996). Satisfaction of the learning experience is an especially crucial consideration in respect to the increased competition for students and the widening variety of educational choices of instructional delivery and venues that modern day students have (and within which urban educators must make delivery system choices).

Saettler (1990) argues that educational research considering both technology and the psychology of perception has begun to introduce dramatic changes in the traditional concepts of learning. Research has begun to focus on the perceptions of learners including images, motives, feelings, thoughts, attention and memory: i.e. total perceptions as a direct consequence of environmental stimuli, thus Saettler argues the central focus of educational research has begun to shift to the study of learners' cognitive processes in learning and memory. Hackman and Walker (1990) make a case for using perception data in classroom effectiveness studies. They conclude that effectiveness depends on learner satisfaction, since learners ultimately decide whether the tradeoffs in a distance learning setting are ultimately worthwhile. These researchers felt that judgements regarding learning and satisfaction are best made by distance learning audience members (students). The authors further concluded, "The only reasonable basis for summative evaluation (of distance learning effectiveness) rests with the students' perception of content utility, (and) satisfaction with conveyance... (p. 197). This recognition of student perceptual primacy in the marketing of the technology to students was addressed as fundamental by distance learning planners as early as 1989 (Moore, 1990). In the issue of efficacy, the choice of student perception appears as a particularly appropriate instrument of measurement.

Event Assessment In Computer-Based Distance Learning

As a part of this study the researcher developed hypertext markup language software that allowed the annotation of events that occur in the computer-based environment. By compiling the frequency of events occurring in the computer-based classroom, researchers may be enabled to correlate student perceptions with actual events to lend better understanding of what pedagogical techniques encourage what types of interactivity. The framework for this analysis is the methodology of Interaction Analysis, first introduced by Amidon and Flanders (1967) and modified for use in a computer-based environment.

Codification of the events in computer-based distance learning will define and quantify their role in the interactivity of the environment and allow quantifiable measurements in context of the distance learning medium. When combined with an understanding of the types of interactivity perceived to be important to the learner, a real time, whole and relevant analysis of the student-centered perceptive efficacy of a particular course within the distance learning environment can be made. Studies measuring interactional levels of competing media will aid in evaluating their most promising characteristics. Balancing the findings with student satisfaction will improve understanding of their importance and efficacy.

Interaction Analysis

Amidon and Flanders' (1967) summary of categories for interaction analysis provided the quintessential method for the analysis of interaction in the traditional classroom (Table 4). This method consists of classifying verbal communication into ten categories at an average rate of one classification every three seconds. Observation periods are set to one hour. The categories are divided into teacher statements (7 categories), student statements (2 categories) and no statements/confusion (1 category). This set of ten categories is assumed to be totally inclusive of all statements made in a classroom and are all also mutually exclusive since one, and only one, tally is recorded for any single interaction that is observed.

The seven teacher statement categories are further subdivided into indirect and direct statements. Indirect statements are statements which expand or encourage student participation while direct statements are those that inhibit that same participation.

In interaction analysis, the observer tallies the interactions that occur in the classroom by recording one category number for each event in a sequential manner (as the events occur). The resulting data is a series of columnar numbers that represent observed, sequenced interactions.

In addition to the categorical interaction observations, basic interaction analysis requires the observer to also note five different kinds of class activity that occur

Table 4

Flander's Interaction Analysis

1.	ACCEPTS FEELINGS: accepts and clarifies the feeling tone of the student in a non-threatening manner. Feelings may be positive or negative. Predicting or recalling feelings included.
2.	PRAISES OR ENCOURAGES: praises or encourages student action or behavior. Jokes that release tension, not at the expense of another individual, are
INDIRECT	included. Nods head or says, "Um hm?"
INFLUENCE	or "go on" also included.
3.	ACCEPTS OR USES IDEAS OF STUDENT: Clarifying, building or developing ideas suggested by a student. As teacher brings more of his own ideas into play, shift to category five.
4.	ASKS QUESTIONS: asking a question about content or procedure with the intent
TEACHER	that a student answer.
TALK	
5.	LECTURING: giving facts or opinions about content or procedure; expressing his own ideas.
6.	GIVING DIRECTIONS: directions,
DIRECT	commands, or orders to which a student
INFLUENCE	is expected to comply.
7.	CRITICIZING OR JUSTIFYING AUTHORITY: statements intended to change student behavior from non acceptable to acceptable pattern; bawling someone out; stating why the teacher is doing what he is doing; extreme self-references.
8.	STUDENT TALK–RESPONSE: talking by students in response to teacher. Teacher initiates the contact or

Table 4 (Continued.)

	determines type of student statement. As a student expounds his own ideas, shift to category 9
STUDENT TALK	
9.	STUDENT TALK--INITIATION: talk initiated by students. The ideas expressed are created by students; statement content not easily predicted by previous action of teacher.
SILENCE OR CONFUSION	
10.	NONE OF THE ABOVE: routine administrative comments, silence or confusion; interaction not related to learning activities

Note. Amidon and Flanders (1967).

during a one hour observation period. The interaction analysis data are then tabulated separately for each of the activity types. These activity types are:

1) Routine administration not related to learning actions.

2) Evaluating products of learning such as correcting homework.

3) Introducing new materials, procedures and content to the students.

4) All class discussions not included in the first three-time use categories.

5) The supervision of seatwork or groupwork activities (Flanders, 1965).

Flander's Interaction Analysis, however useful, was developed at a time when distance learning was more of a theoretical construct than a reality. While standard classroom interaction is complex, the folding of standard pedagogy into the distance learning environment utilizing advanced computer-based technology makes this complexity exponential. To analyze this complexity, basic interaction analysis falls short. Boak and Kirby (1989) developed the System for Audio Teleconferencing Analysis

(SATA) instrument for analyzing classroom interaction in an audio teleconferencing distance environment. Their interaction analysis methodology has three categories: who initiates the interaction (student or instructor); the direction of the interaction (an individual student, the class as a whole, or instructor); and the context of the interaction (procedural, content specific, or social).

This schema is useful as it provides observed interactions specific to the distance learning environment and cognizant of its directional, proximity-less environment. The categorization is broad, however, and the complexity of the interaction is deserved of more depth. Main and Riise (1994) developed six multi-leveled compound variable interaction components in their study of distance learning. They are (1) Amount, (2) Type, (3) Timeliness, (4) Method, (5) Spontaneity, and (6) Quality. The amount component surmises frequency and duration of dialog. The frequency of student feedback and mean occurrence per period is the primary data collected. Type refers to instructor-student, student-student, and student-lesson material interactional types. Student-lesson materials interaction is either required or is by choice and is either in class or out of class (Table 5). Timeliness is a measure of the immediacy of the feedback and presumes two-way communications. Method is the method of interaction, voice, text, non-visual verbal gestures, mouse movements, outside web retrievals, etc. The methods differ in the two environments studied, IRI and standard video transmission classes. Spontaneity refers to planned or ad hoc interactions. Quality is the intensity, relevance, depth, formality, and opportunity of the course interactions.

The cardinal study of classroom interactions known as Flander's Interaction Analysis (FIA) done by Amidon and Flanders (1967), suitably modified with portions of

Main and Riise's (1994) distance learning interactional categories, will serve as a theoretical framework for observing unique distance learning interactions. For this research, Flander's Interaction Analysis, as modified, will follow the tradition of modification of Flander's original study observed in the Reciprocal Category System

Table 5

Main and Riise's Interaction Types

	Initiated by	Student-Student	Student-lesson Materials	
	Instructor			Required
	Student			Voluntary
Within Class				
Outside Class				

Note. Main and Riise (1994).

developed by Ober, Bentley and Miller (1971). This system modified FIA to direct more attention to the variety of talk found in the classroom. The study itself is a progression of the Equivalent Talk Categories modification of FIA first developed by Bentley and Miller (1969) (cited in Ober, Bentley and Miller, 1971).

The modifications by Ober, Bentley and Miller (1971) demonstrated a theme of adaptation commensurate with new research findings and understandings of the classroom environment and the students therein. This proposal's research will continue this tradition of adaptation by first codifying IRI events. These events will then be categorized into an FIA assessment instrument further modified with the distance learning taxonomy of Main and Riise (1994). These researchers's multi-leveled interaction components developed specifically for distance learning, when combined with Flander's Interaction Analysis, will provide a clearer picture of the interactional environment of computer-based distance learning. More specifically, it will provide a baseline of interactions occurring in the computer-based distance learning innovation at Old Dominion University.

This study therefore integrated a strong, highly recognized interaction analysis methodology, Flander's Interaction Analysis and incorporate the type of interaction, the timeliness of the interaction, and the method of interaction recognized by Main and Riise (1994) to shed more light in the nature and degree of classroom interactions unique to the computer-based distance learning environment (Table 6). Inclusion in the codification of the key issues of type, timeliness, and method encompasses the interactions that most substantially differentiate the computer-based distance learning environment from the standard classroom environment.

Recordable events within Old Dominion University's Interactive Remote Instruction Environment are delineated in a table form in Appendix F. The events are classified as:

Student –Instructor

Instructor-Student

Student-Interface

Table 6

Revised Flander's Interaction Analysis Model

1.	ACCEPTS FEELINGS: accepts and clarifies the feeling tone of the student in a non-threatening manner. Feelings may be positive or negative. Predicting or recalling feelings included.
2.	PRAISES OR ENCOURAGES: praises or encourages student action or behavior. Jokes that release tension, not at the expense of another individual, are
INDIRECT	included. Nods head or says, "Um hm?"
INFLUENCE	or "go on" also included.
3.	ACCEPTS OR USES IDEAS OF STUDENT: Clarifying, building or developing ideas suggested by a student. As teacher brings more of his own ideas into play, shift to category five.
4.	ASKS QUESTIONS: asking a question about
TEACHER	content or procedure with the intent that a student answer.
TALK	
5.	LECTURING: giving facts or opinions about content or procedure; expressing his own ideas.
6.	GIVING DIRECTIONS: directions,
DIRECT	commands, or orders to which a student
INFLUENCE	is expected to comply.
7.	CRITICIZING OR JUSTIFYING AUTHORITY: statements intended to change student behavior from nonacceptable to acceptable pattern; bawling someone out; stating why the teacher is doing what he is doing; extreme self-references.
8.	STUDENT TALK--RESPONSE: talking by students

Table 6 (Continued)

	in response to teacher. Teacher initiates the contact or determines type of student statement. As a student expounds his own ideas,
STUDENT TALK	shift to category 9.
9.	STUDENT TALK--INITIATION: talk initiated by students. The ideas expressed are created by students; statement content not easily predicted by previous action of teacher.
SILENCE OR CONFUSION	
10.	NONE OF THE ABOVE: routine administrative comments, silence or confusion; interaction not related to learning activities.
TYPE	
11.	Instructor-Student Student-Siudent Student Lesson Material (Interface) This category refers specifically to the distance medium and the student's interface with it.
TIMELINESS	
12.	Immediacy of the feedback Instantaneous Less than 30 seconds Greater than 30 seconds Greater than one minute
METHOD OF INTERACTION	
13.	Voice Text Mouse Amplifying Visual Outside Resource

Note. Amidon and Flanders (1967) and Main and Riise (1994).

Instructor-Interface

The events will be timed by an observer in accordance with Table 5's timeliness category (12). Type classification occurs with assignment to the recordable event list. An observer utilizes the automated hypertext markup language code design of Appendix F to record and provide summary printouts of the interactional character of the computer-based distance learning environment (refer to Appendix F).

Although other systematic analyses for studying communications patterns between students and instructors, peers and subject matter exist, developing them for use in an interactive computer-based environment can be time consuming and faulty in light of the environmental concerns. Follow-on validation and research incorporating the computer-based distance learning instrument as described in Appendix F may offer a unique, and useful perspective towards this end.

Policy Implications

According to Goldstein (1991) urban educators, administrators and policy makers lag in their ability to make timely technology acquisition decisions with consistent guiding philosophies or principles. Heppel (1993) in an article aptly titled "Eyes on the Horizon, Feet on the Ground" surmises the problem (described in Figure 9) of one where rapid changes in technology require rapid changes in pedagogy and an even more rapid understanding of the technology's place and impact in the educational realm. Heppel's argument is that educators, delivery system decision makers and policy makers must have real-time and current information on which to base decisions. The technology available at

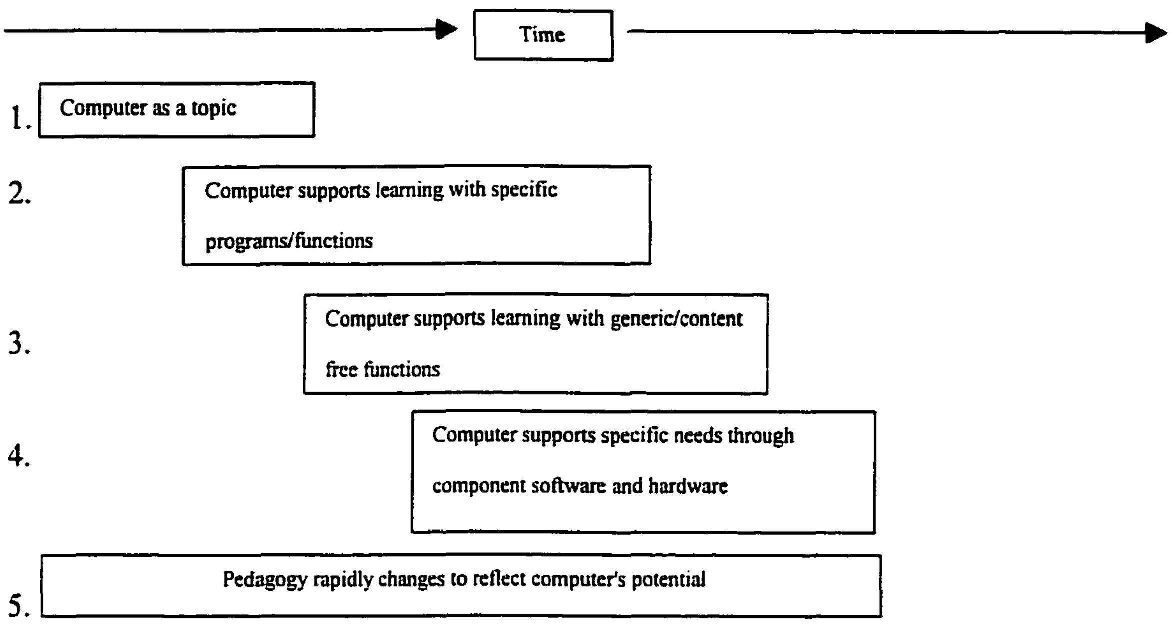


Figure 9. Technology Development Stages. Heppel (1993).

any given point has evolved from what is available, commensurate with the manufacturer or developer's needs, flows to an availability that is generic to all user's needs, and then becomes a technology that is tailored to a specific user's needs. Educators and policy makers in urban institutions need assessments independent of all but specific institutional needs and efficacy of the system on a variety of instructional considerations.

Measurements of interactivity (as suggested in this study) of emerging technologies may provide part of the independent assessment required. Ravitch (1993) (cited in Sherry, 1996) noted that higher education management and administration has been traditionally hierarchical and bureaucratic, whereas implementation of new technologies without recognized and accepted benefits challenge this management model.

Hodas (1993) paints an even darker view that institutions of higher education are immersed in a culture of technology refusal, that technology implementation is an issue which challenges teacher self-definition and revolves around the anxiety generated by their unfamiliarity and incompetence with the new machines. Hodas explains that technologists often try to have things both ways:

"On the one hand, the revolutionary potential of the innovation is emphasized, while at the same time current practitioners are reassured (implicitly or explicitly) that their roles, positions and relationships will remain by and large as they were before. The introduction of computers, for example, is hailed in one discourse (directed towards the public and policy makers) as a process which will radically change the process of what goes on in the classroom, give students entirely new sets of skills, and permanently shift the terrain of learning and schools. In other discourse (directed towards administrators and teachers) computers are sold as straightforward tools to assist them in carrying out pre-existing tasks and fulfilling pre-existing roles, not as Trojan Horses whose acceptance will ultimately require the acquisition of an entirely new set of skills and outlook" (p.8).

Hodas clearly defines the jaundiced view many educators have of technologists' claims and the wide-ranging impact that new technology infusion has in both the practice and culture of universities. The ubiquitous nature of two-way audio/one-way video distance learning in distance education will create no less distrust of computer-based distance learning systems. An implementation decision based on interactivity, a quintessential technologist claim, and a commonly understandable educational precept, may assist in acceptance and acclimation of the computer-based model.

Friedman (1981) very clearly described the problem facing educators in delivery system choices using the metaphor of a tree:

"We stand on the trunk of the tree (the present) looking upward toward the branches (the major likely alternative futures). Each step we take up the trunk toward the branches (each decision we make in the present) chops off a branch (greatly reduces the probability of a cluster of alternative futures). By the time we reach the branches-when the future becomes the present-all the branches are gone but one (the new trunk), and an alternative set of new futures stretches upwards"(p. 308).

Fletcher (1981) offers that when seeking new technology solutions, educators should be cognizant of four issues: (1) The technology must be deliverable to and available at the university. This means that considerations of technology choices for distance learning must consist of currently available and tested media such as those used in this study; (2) In addition to being accessible, the technology must have been used in similar university settings; (3) the technology must be current and relevant and have some basis for long-term future use and; (4) the technology must be intelligent and interactive. These reasons underlie the choice of interactive remote instruction and two-way audio/one-way video for this study. Hofstetter (1981) reinforces Fletcher's findings in his five categories of system selection criteria. Hofstetter lists many requirements of instructional technology such as high-resolution graphics, dissemination capabilities and dissemination networks that implies a strong emphasis on system selection of only the most capable products.

Chute (1999) offers an overall phased strategy for applying instructional and technological solutions to higher education problems. He describes three phases of technology implementation: 1) Assessment Phase, 2) Prescription Phase and 3) Technology Phase. In the assessment phase, user abilities are compared with performance criteria, such as interactivity, required in a given situation. If a gap is found, then intervention is required until an acceptable level of performance exists. In the prescription phase, the intervention considering the psychological requirements of the learning task (including interactivity) and the instructional capabilities of the information delivery system is considered. In the technology phase, after a number of possible intervention strategies are prescribed, specific information delivery options are considered. The interactive characteristics of the system could be an important aspect of consideration in each of the three phases.

Technology delivery system and policy choices made by urban educators are not made in an organizational vacuum however and are affected by their organizational culture. Birnbaum (1991) believes that universities can be classified into four models; 1) collegial where power and values are shared in a community of equals; 2) bureaucratic institutions with rationalized structure and decision making; 3) political institutions which have many groups competing for power and resources and 4) anarchical institutions where no fixed pattern of choice or involvement exist. Individuals choosing delivery systems within urban institutions must carefully analyze the type of environment they operate in. Policy makers and decision makers must guard that external environmental considerations do not cloud and override strict efficacy based decisions, such as the consideration of interactivity forwarded in this study.

Cohen, March and Olson (1976) (cited in Birnbaum, 1991) offer a possible solution for the choices in delivery system environments that urban educators and policy makers face in their institutions. Their solution, the "garbage can" theory of decision making offers that the stream of choice opportunities available to educators can be thought of metaphorically as offering large receptacles, or garbage cans, through which flow the other streams of problems, solutions and participants. One way of visualizing the relationship is to think of the streams of problems, solutions and participants as three wriggling ropes loosely braided so that their contact points constantly shift. If one were to cut through the ropes at any one time, a cross section of the problem, solution and participant streams would be shown. The cut represents the available choices at that particular time.

In accordance with Cohen, March and Olsen's decision making model, the choice of distance learning delivery systems in urban institutions of higher education today includes participants and their unique urban demographics, the solutions to education problems which computer-based or two-way audio/one-way video distance learning systems may offer, and the decision of which efficacy measures to base delivery system choices upon, student perceptions of interactivity being one such measure, offered in this study.

Research Hypotheses:

To find evidence of interactivity in two distance learning systems to aid in measures of efficacy and delivery system choices, the following null hypotheses were tested:

(Ho1) There is no difference between learner perceptions of their level of individual interaction between computer-based and two-way remote instruction environments.

(Ho2) There is no difference between learner perceptions of levels of overall classroom interaction between computer-based and two-way remote instruction environments.

(Ho3) There is no difference in learner satisfaction between computer-based and two-way remote instruction environments.

(Ho4) There is no difference in learner attitudes between computer-based and two-way remote instruction environments.

(Ho5) There is no difference in learner observed interaction between computer-based and two-way remote instruction environments.

(Ho6) There is no difference in learner perceptions of their direct participation between computer-based and two-way remote instruction environments.

(Ho7) There is no significant relationship between computer-based environment learner perceptions of individual interaction, overall interaction, satisfaction, attitude, observed interaction and direct participation

(Ho8) There is no significant relationship between two-way audio/one-way video environment learner perceptions of individual interaction, overall interaction, satisfaction, attitude, observed interaction and direct participation

(Ho9) Learner perceptions of individual interaction, perceptions of overall interaction, student attitude, observed interaction and direct participation do not predict satisfaction in a computer-based distance learning environment.

(Ho10) Learner perceptions of individual interaction, perceptions of overall interaction, student attitude, observed interaction and direct participation do not predict satisfaction in a two-way audio/one-way video distance learning environment.

(Ho11) There is no difference in the significant predictors of satisfaction between computer-based and two-way remote instruction environments

(Ho12) Computer-based learner perceptions of individual interaction, perceptions of overall interaction, student attitude, observed interaction and direct participation overall interaction do not vary significantly over time.

(Ho13)Two-way television learner perceptions of individual interaction, perceptions of overall interaction, student attitude, observed interaction and direct participation overall interaction do not vary significantly over time.

Summary

This chapter provided a review of the literature considering interactivity in technology acquisition and implementation in distance learning. Research covering interaction, interactivity and their component makeup was related along with pertinent learning theories and environmental considerations of the two environments under study. Writings on distance learner perceptions and satisfaction were reviewed. Literature on interactional analysis was reviewed and a framework for developing an instrument to quantify the events in an interactive computer-based distance learning environment was formed.

CHAPTER III

METHODOLOGY

Introduction

This chapter describes: (a) the purpose of this research; (b) data collection procedures; (c) the location of the research study; (d) variables; (e) sampling design; (f) treatments; (g) instrumentation; (h) instrument validity; (i) the research designs for each research question including the procedures for that question's statistical analysis; (j) confounding variables; (k) internal and external validity threats; (l) developmental conventions for the automated assessment instrument; (m) the pilot study and; (n) demographic questionnaires.

Purpose

The purpose of this research was to measure (1) student perceptions of overall and individual interaction, observed interaction, attitude, direct participation and satisfaction in computer-based interactive remote instruction (IRI) and two-way audio/one-way video television (TELETECHNET) distance learning environments. The following specific questions were addressed:

1. What effects does a computer-based distance learning course have on student perceptions of individual and overall interaction, satisfaction, attitude, observed interaction and direct participation classroom interaction over three observations in a semester period?

2. What effects does a two-way audio/one-way video distance learning course have on student perceptions of individual and overall interaction, satisfaction, attitude, observed

interaction and direct participation classroom interaction over three observations in a semester period?

3. What, if any of the factors of student perception of individual interaction, overall interaction, student attitude, observed interaction and direct participation predicts student satisfaction in a computer-based distance learning environment?

4. What, if any of the factors of student perception of individual interaction, overall interaction, student attitude, observed interaction and direct participation predicts student satisfaction in a two-way audio/one-way video distance learning environment?

5. What are the differences between predictors of satisfaction and perceptions of personal and overall interaction, satisfaction, attitude and student observations of overall classroom interaction in computer-based and two-way audio/one-way video television distance education environments?

6. What type of automated interactional event analysis tool can be developed to quantify events occurring in a computer-based distance learning environment and frame them to overall and individual perceptions of interaction?

This research made measurements and comparisons between five dependent variables of student perceptions of individual interaction, overall interaction, attitude, observed interaction and direct participation in the two distance learning environments of computer-based and two-way audio/one-way video. This research also if any of the dependent variables predicted learner satisfaction in these two environments and developed a computerized assessment instrument for collecting event data in an interactive remote instruction classroom.

Survey research and a quantitative approach in a quasi-experimental design was used to determine student perceptions of their level of individual interaction in each distance learning environmental sample, their perception of the level of overall classroom interaction in each environmental sample and each sample's individual level of satisfaction. Statistical analysis of the survey data was conducted to find evidence to suggest which learner perception of interaction, individual or overall, is a significant predictor and component of satisfaction in each of these two distance learning environments. Instructor perceptions, student attitudes and demographic data were also collected. Descriptive data, correlational analysis, multiple regression, analysis of variance including interaction effects, narrative of the findings and trend analysis was utilized in the findings of evidence. A portion of this study was devoted to developing an automated, hypertext markup language assessment instrument that is capable of characterizing and quantifying the events occurring in a computer-based distance learning environment. This instrument was developed for use in quantification of levels of interactivity particular to the interactive remote instruction environment. Protocols for validation and assessment of the instrument in future studies were suggested.

A semantic-differential scale survey instrument was administered to students in a distance learning computer-based Interactive Remote Instruction (IRI) environment (treatment group 1) and a distance learning two-way audio/one-way video television (TELETECHNET) environment (treatment group 2) in a repeated measures study at the beginning, midpoint and end of a course semester. An instrument designed to measure student attitudes, perceptions and satisfaction developed by Fulford and Zhang (1993) was utilized as the primary data collection instrument. The instrument was chosen as it adequately measures Moore's (1992) framework for studying interaction. Moore suggested three distinct, but closely related types of interaction: learner-instructor, learner-learner, and learner-content. This study concentrated on the first two types as equivalent content across environmental treatment domains was not obtained. The Fulford and Zhang instrument has been designed to measure the specific variables of a) Individual Interaction, b) Overall Interaction, c) Satisfaction, d) Student Attitudes, e) Observed Interaction, and f) Direct Participation.

The variables measured in this instrument parallel the phenomenon of interaction and satisfaction both conceptualized in the literature review of this study and as embodied in the research questions.

In-class data collection was conducted to control for mortality and to provide more immediate and precise perception recall for students completing the survey instrument. According to Creswell (1994) a survey is the preferred method of data collection for this study because it offers economy of design, rapid return in data collection, and the ability to identify attributes of a population from a small group of individuals. Reactivity of the instrument is considered low due to student testing acclimation and the non-invasiveness of the instrument and data collection procedures.

Data Collection Procedures

A pilot study was conducted to refine collection procedures and collect consistency and reliability data. The survey was directly administered over three semesters in a single academic year to participant learners in IRI and TELETECHNET environments at the beginning (between 2-4 weeks after commencement of a term), midpoint (within a three-week interval around midpoint of a term) and end of a course (4-

2 weeks prior to end of a term) semester representing three levels of the independent variable time. Survey instruments were presented 20 minutes prior to the end of a class session, simultaneously at both the main campus and the remote locations. Instrument forms were pre-staged at remote classroom sites prior to commencement of the measured class period. Participants were polled prior to the survey for a volunteer to distribute and collect the forms (following researcher instructions from the main site). The researcher monitored to ensure that no extraneous experimenter effects from the student involvement occurred from their assistance in remote site disbursement of the forms. The student volunteer dropped off completed forms after the survey at a central at-site location for later retrieval by the researcher.

Survey research started two class sessions after the commencement of the semester to control for novelty effects and to allow students' basic acclimation to the environment and technology. This procedure also allowed subjects to have a basic knowledge and understanding of the two environments' capabilities and to command a clearer perception of the particular environment's interactive capabilities. All data collection for each separate trial in a particular environment occurred within a maximum 21-day window. The measurement and treatment interval is summarized in Table 7 and a test schedule is promulgated in Table 8.

Subject participation was voluntary. Each surveyed course received similar orientations (see Appendix A). Each student who volunteered was required to complete a consent form (see Appendix B). In order to improve the volunteer rate, the following actions were taken as recommended by Rosenthal and Rosnow (1975) and Ary (1996):

1. The request to volunteer was made in a non-threatening manner. Data confidentiality was assured.

2. The study's importance was stressed.

3. Requirements imposed on volunteers was brief and conducted during normal class time.

The following categories of subjects were not eligible for participation in the study:

1. Subjects who did not complete the consent form.

2. Subjects below the age of 18 who required parental consent.

3. Students who expressed the intent of not remaining in class throughout the class period, visitors or other temporary observers and instructors.

All students without regard to study participation eligibility were asked to complete an initial demographic questionnaire (IDQ) (Appendix D) in order to collect background information. Students were allowed to fill out all forms (except the informed consent document) anonymously through the use of a sequence code if so desired.

Table 7

Measurement and Treatment Intervals

Group 1 (IRI Environment)	X	O	X	O	X	O	X
Group 2 (TELETECHNET Environment)	X	O	X	O	X	O	X

Note. Four-week intervals between measurements (O).

Research Location

Research was conducted at Old Dominion University, an urban, state university with over 18,000 student population enrollment located in a metropolitan setting, on its main campus in the city of Norfolk, Virginia and at its graduate center in

Table 8

Test Schedule

	Pilot Study					Main Study				
	IDQ	Trial 1	Trial 2	Trial 3	FDQ	IDQ	Trial 1	Trial 2	Trial 3	FDQ
Instrument										
IDQ	X					X				
Survey		X	X	X			X	X	X	
FDQ					X					X
Instructor Survey		X	X	X			X	X	X	

	Pilot Study	Semester 1	Semester 2
Environment			
IRI	X	X	
TELETECHNET		X	X
TRADITIONAL	X		

Note. The main study was conducted over three separate semesters to improve sample sizes. IDQ/FDQ Initial and Final Demographic questionnaires, were given as part of trials 1 and 3 respectively.

the neighboring urban setting of the city of Virginia Beach, Virginia, located approximately 26 miles east.

Research was conducted at:

Computer-based IRI Environment Sites:

Main:

Norfolk, Virginia (Main Campus, Old Dominion University)

Darden College of Education, Hampton Boulevard, 23529.

Remote:

Virginia Beach, Virginia (Higher Education Center, Old Dominion University). 3300 South Building, 397 Little Neck Road, 23452.

Two-way television TELETECHNET Environment Sites:

Main:

Norfolk, Virginia (Main Campus, Old Dominion University)

Gornto Building, 43rd Street, 23529.

Remote:

Virginia Beach, Virginia (Higher Education Center, Old Dominion University) 3300 South Building, 397 Little Neck Road, 23452.

Variables

There are three independent variables and six dependent variables in this study. All five dependent variables are operationalized using items on the survey questionnaire and as follows:

Variables:

Independent Variable 1: Time

3 levels:

Level 1: Beginning of course: Two lesson/week period between two and four weeks after the start of a semester.

Level 2: Midpoint: Two lesson/week period on either side of the midpoint of a term.

Level 3: End of course. Two lesson/week period between four and two weeks prior to the end of a term.

Independent Variable 2: Distance Learning Environment

2 levels:

Level 1: Computer-Based Distance Learning Environment

Level 2: Two-Way Television Distance Learning Environment

Independent Variable 3: Location

2 levels:

Level 1: Main Site (on campus)

Level 2: Remote (off campus)

Dependent variables are affective variables measured on six point semantic-differential scales with six levels ranging from the lowest value – 1 (extremely negative response) to the highest value – 6 (extremely positive response).

Dependent Variable 1: Perception of Personal Interaction

6 Levels, scale of 1-6

Dependent Variable 2: Perception of Overall Interaction

6 Levels, scale of 1-6

Dependent Variable 3: Satisfaction

6 Levels, scale of 1-6

Dependent Variable 4: Student Attitude

6 Levels, scale of 1-6

Dependent Variable 5: Observed Interaction

6 Levels, scale of 1-6

Dependent Variable 6: Direct Participation

6 Levels, scale of 1-6

The variables are defined as:

Distance Learning Environment Independent Variables

Three semester-long environmental treatments were utilized in this study. Computer science curriculum courses within the computer-based interactive remote instruction environment and computer science curriculum courses among two-way audio/one-way video television environment were chosen to aid internal validity in terms of selection.

The treatment environments are specifically defined as follows:

1) The IRI treatment environment.

A distance learning system in which computer processors utilizing modem delivery and computer networks act as a real-time synchronous conduit for two-way interaction between two or more separate groups for the purposes of instruction. Each learner individually operates a personal computer workstation utilizing a monitor and keyboard and embedded software to receive instruction and to interact with other students and instructor. Software is multi-functional with outside Web retrieval, Web co-browsing, screen-in-screen capability, collaborative whiteboards, and personal notepad screens. Several computers may be co-located in a single room or operated independently at dispersed locations. Dispersed site connectivity is terrestrial, via satellite or a combination of both. Instruction is real-time without taped delay (Maly, 1996, Cravener and Michael, 1998).

2) The TELETECHNET two-way audio/one-way video television treatment environment.

A two-way synchronous electronic audio and one-way video communications between two or more groups in dispersed locations for the purposes of instruction. Student groups are either located at the same site as the instructor or at remote sites viewing the instructor or other class members via a television monitor (or monitors) centrally located and jointly used by other members of the class. Open seating classroom settings. Students and instructor may electively pan cameras on themselves or other students or interact via audio only. Dispersed site connectivity is terrestrial, via satellite or a combination of both. Instruction is real-time without taped delay (Willis,1998).

Dependent Variables

a) Perception of Individual Interaction (PI): Perceived individual involvement of each participant in a two-way audio/one-way video or computer-based course (Fulford and Zhang, 1993). Variable measurement is obtained through measurement of the mean score of seven semantic-differential questions measuring frequency of (1) answering instructor questions; (2) volunteering opinion; (3) asking questions; (4) participation in overall activities; (5) level of interaction between student and instructor; (6) level of interaction between student and classmates and (7) how well the instructor motivated personal interaction. The scaling adjectives are never-often, low-high, and ineffective-effective (see Appendix C).

b) Perception of Overall Interactions (PO): Perceived involvement of other members of the class by an individual in a two-way audio/one-way video televised course or a computer-based course (Fulford and Zhang, 1993). Variable measurement is based upon subject response to the item: (1) What level of interaction do you think occurred today? The scale is anchored by the adjectives low and high at the two extremes (see Appendix C).

c) Perception of Satisfaction (S): Perceived value and quality of instruction by an individual in a two-way audio/one-way video televised course or a computer-based course (Fulford and Zhang, 1993). Variable measurement is obtained through the response to the questions: (1) How do you feel about today's lesson as a whole? The scaling adjectives are negative and positive, (2) How would you rate the value of the question and answer portion, (3) How would you rate your knowledge content after the lesson? The scaling adjectives are low and high and (4) How of the material you learned today do you feel is valuable to you? The scaling adjectives are none of it and all of it. (see Appendix C).

d) Student Attitude Toward Interaction (STUATT): Measured by response to the question: (1) How did the level of the interaction make you feel? The scaling adjectives were negative and positive (see Appendix C).

e) Observed Interaction (OI): The mean of four items, all of which ask for the student's impressions of other people's participatory behaviors: (1) what level of interaction was there between the instructor and class? (2) What level of interaction was there between all other participants? The scaling adjectives were low and high. (3) How well did the instructor motivate interaction in general? The scaling adjectives were effective and ineffective. (4) What percentage of the time were the instructor and participants interacting. The scaling adjective pairs were 0%-100%.

f) Direct Participation (DP): The mean of six items: (1) How often did you answer questions asked by the instructor? (2) How often did you volunteer your opinion? (3) How often did you ask a question? (4) How often did you participate in overall activities? (5) What level of interaction was there between you and the instructor? And (6) What level of interaction was there between you and your classmates. The scaling adjectives were never-often, low-high, and ineffective-effective(see Appendix C).

Demographic Data

Demographic data suitable for further entry and analysis as variables in accordance with methodology from the National Opinion Research Center (1990) will be collected on (a) course, (b) age, (c) sex, (d) race/ethnicity (e) class standing, (f) location where survey is taken (main campus or remote site), (i) number of hours student has participated in computer-based or two-way television environments or both, (j) preferences, if any, between the methodologies, (k) academic major, (l) computer ownership and use.

Instrumentation

The entire data collection instrumentation for the study consisted of (a) an initial demographic and (b) final demographic questionnaires, (c) an informed consent document, (d) instructions, learner survey instrument and demographic questions and (e) instructions, instructor survey instrument and demographic questions.

Mean completion time for completion of the informed consent documents was 7 minutes, for completion of the learner survey instrument was 8 minutes, instructor survey instrument 7 minutes and for completion of both initial and final demographic instruments, 4 minutes (in pre-pilot tests conducted by the researcher among a similar sample populations). Actual completion times for the pilot and main studies are presented in chapter IV. Surveys were proctored at equal intervals utilizing the guidelines contained in a pre-prepared subject orientation (see Appendix A). The instrument structure consists of seventeen closed-ended semantic-differential scale items divided into six subscales. One to seven questions of 20 words or less per subscale. The six subscales as mentioned previously are: 1) Perceptions of Individual Interaction (7 questions), 2) Perception of Overall Interaction (1 question), 3) Perception of Satisfaction (4 questions), 4) Student Attitude Toward Interaction (1 question) and 5) Observed Interaction (4 questions) and 6) Direct Participation (6 questions) (Please refer to Appendix C).

Instrument Scales:

a. Six point semantic-differential scales to compel a forced choice of negative or positive answers for each question were used. Each scale is anchored by two antonyms at extreme ends. Non-technical, unambiguous wording is used.

b. Lowest value – 1, extremely negative response

Highest value – 6, extremely positive response

Nunnally (1978) states that reliability of instrumentation levels off after seven steps in a scale, therefore the instrument authors felt that additional steps would increase frustration and consequently limited the scale from one to six (Zhang and Fulford, 1994).

The instructor survey instrument consisted of content item excerpts from the learner survey addressed to the instructor of the course being surveyed, description of three aspects of teacher methodology and demographic data. The instructors were surveyed in three areas; 1) their perception of interactivity relative to their teaching experience in general 2) their perception of the level of interactivity in the surveyed class in particular and 3) their teaching methodology.

Teacher perception of interactivity relative to their teaching experience in general was surveyed using the following questions:

Throughout your experience as an instructor:

1) How often do you ask questions of the students?

2) How often do students ask you questions?

3) How often do students volunteer their opinion?

4) What level of interaction is there between you and the student?

5) What levels of interaction are there among the students themselves?

6) What percentage of the time do you and participants in your class spend interacting?

Teacher perception of the level of interactivity in the surveyed class in particular was surveyed using the following questions:

During this class:

1) How often did you ask questions of the students?

2) How often did students ask you questions of the students?

3) How often did students volunteer their opinion?

4) What level of interaction was there between you and the student?

5) What level of interaction was there among the students?

6) Overall, what level of interaction do you think occurred today?

7) What percentage of the time did you and participants in your class spend interacting?

8) How did the level of interaction make you feel?

9) How do you feel about today's lesson as a whole?

Teachers were observed and queried specifically as to their pedagogical equitability in accordance with Kozma, Belle and Williams (1978) three characteristics of standard pedagogy:

1. Content Presentation: Formal or informal presentations of pre-determined curriculum content, related information, concepts or principles by faculty, guest speakers or students, and illustration (procedural presentations or event sequence demonstrations).

2. Verbal Techniques: Rendition of written documentation, text or materials. Group interaction whether ad-hoc or planned. Question and answer periods and social conversations.

3. Interactive Application Techniques: Two-way television environment: Multimedia referencing (overhead projectors) or similar display tools and live camera feeds. Computer-based distance learning mediums encompass separate or parallel (ongoing)

interactions for audio, imported video, electronic presentations, whiteboards, Web page displays, Web co-browsing, and computer-driven simulations.

Those instructors falling outside these guidelines were not utilized in the study. Demographic data was also collected including years of teaching experience and years of teaching experience within the distance learning environment observed.

Instrument Validity

The instrument was previously used in a study of two-way television student perceptivity in the peer reviewed and refereed journal, The American Journal of Distance Education and subsequently referenced in Sherry (1998) and Zhang and Fulford (1994). The authors utilized this instrument in a 1993 survey of a similar population of 233 two-way television distance learning students. Two locations were two-way audio/one-way video locations (n=98) and three locations were two way audio/one-way video locations (n=135). Specific findings from this study for this sample population are available in The American Journal of Distance Education, Volume 7 (3), pp. 8-21. The instrument was used with a population similar in characteristics to both the target and experimentally accessible population of this study. The variables measured have adequate face validity to the phenomenon of interaction and interactivity conceptualized in the review of the literature and as embodied in this study's research question in particular.

The authors reported the six direct participation items of the survey had a Cronbach's alpha of 0.78, and the five observed participation items had a Cronbach's alpha of 0.61. Combined, the two sets had an internal consistency index of 0.82, which the is judged satisfactory.

The instrument was piloted with a sample of computer-based interactive remote instruction computer science students' representative of the target population and with students in a traditional computer science course taught by the same instructor. A reliability coefficient and report of internal consistency reliability of the instrument utilizing Chronbach's Alpha from pilot study sample data along with descriptive data and standard errors of measurement for the learner instrument only is introduced in chapter IV.

The learner and instructor instruments were assessed and found valid for both congruent face validity and content validity by a panel of 4 Old Dominion University professors expert in the field of distance learning and research design. The learner instrument was then field-tested with students representing both the interactive remote instruction and two-way television target populations. Comments were incorporated into the final instruments to improve questions, format and scales as necessary.

Sampling Design

The target population for this study is main campus and remote site upper-division (300-400 level) undergraduate and graduate (500-600 level) higher education computer science students enrolled in computer-based and two-way television distance learning environments in an urban university. The experimentally accessible population for this study is main campus and higher education center (remote site) upper-division undergraduate and graduate higher education computer science students enrolled in distance learning computer-based and two-way television environments at Old Dominion University, Norfolk, Virginia and Virginia Beach, Virginia in 1999. Each distance learning environment will be sampled using intact groups.

An adequate number of semesters offering courses within these two environments was surveyed to ensure n>20 sample sizes from each environment. The intact groups chosen across each environment were students enrolled in the following computer-based and two-way television distance learning environments:

Computer-based distance learning environment:

CS 350 Principles of Programming

CS 410 Computer-based Productivity

CS 451 Software Engineering Survey

CS 778 Networked Multimedia Systems

Two-way television distance learning environment:

CS 311 Navigating the Internet

CS 350 Principles of Programming

CS 451 Software Engineering Survey

These intact classes are a representative, heterogeneous mix of computer science environments across educational and technological experience levels, representative of the experimentally accessible population and generalizable to the target population.

Assumptions:

(1) Participants are chosen on the hypothesis that the two treatment groups (distance learning environments) share similar characteristics based on:

(a) Course content (Computer Science).

(b) Computer skill levels.

(c) Attitudes and adaptability towards distance learning technology. Computer Science students are hypothesized to have adaptive facility for technology-based environments, tending to negate issues of anxiety or acclimation.

(d) Subject perceptive abilities.

(e) Subject academic levels (graduate and upper-division undergraduate) therefore comparisons amongst the population research findings are appropriate.

University Computer Science Departments are likely location candidates for initial implementations of computer-based distance learning instruction, therefore samples of students from these areas would be most useful for study and generalization of the findings.

The subject pool for this study is a non-stratified purposive sample, consisting of Old Dominion University students participating in the previously described or similar IRI and TELETECHNET environments. While stratification is not a specific objective of the study, demographic data detailing (a) name, (b) course, (c) age, (d) sex, (e) race/ethnicity (f) class standing, (g) location where survey is taken (main campus or remote site), (h) number of hours student has participated in computer-based or two-way television environments, (i) preferences, if any, between the methodologies, (j) academic major, (k) computer ownership and (l) computer use were collected for further analysis and interpretation.

An alpha level of .05 was utilized. Large effects were projected and thus a sample size (n) of greater than 22 for each distance learning environment was set as a benchmark for data collection. Both main site and remote locations of each population was surveyed. Post Hoc's utilized Scheffe's analysis methodology. Missing values of 15% of the total data collected were deemed allowable and replacement of individual scores was conducted by using the means of surrounding values (SPSS (Statistical Package for the Social Sciences) span of nearby points procedure) utilizing like question trial means.

Research Hypotheses and Statistical Analysis Procedures

Data was analyzed utilizing Statistical Package for the Social Sciences (SPSS), SPSS Inc. Chicago: Ill. Version 9.0 and Bruning and Kintz's Computational Handbook of Statistics (4th Ed.).

The following abbreviations are used:

CBDL: Computer-Based Distance Learning Environment

TWA: Two-way audio/One-way Video Environment

PI: Perceptions of Individual Interaction

PO: Perceptions of Overall Interaction

S: Satisfaction

STUATT: Student (subject) Attitude

OI: (Subject's) Observed Interaction

DP: (Subject's) Direct Participation

Individual perceptions of interaction (PI and PO) were studied under the following null hypothesis:

(Ho1) There is no difference between learner perceptions of their level of individual interaction between computer-based and two-way audio/one-way video environments

Learner perceptions of overall interaction were studied under the following null hypothesis:

(Ho2) There is no difference between learner perceptions of levels of overall interaction between computer-based and two-way audio/one-way video environments.

Individual perceptions of satisfaction were studied under the following null hypothesis:

(Ho3) There is no difference in learner satisfaction between computer-based and two-way audio/one-way video environments.

Individual attitudes were studied under the following null hypothesis:

(Ho4) There is no difference in learner attitudes between computer-based and two-way audio/one-way video environments.

Individual perceptions of their observed interaction were studied under the following null hypotheses:

(Ho5) There is no difference in learner observed interaction between computer-based and two-way audio/one-way video environments.

Individual perceptions of their direct participation were studied under the following null hypothesis:

(Ho6) There is no difference in learner perceptions of their direct participation between computer-based and two-way audio/one-way video environments.

The statistical analysis methodology for the previous hypotheses (Ho1 - Ho2 - Ho3 – Ho4 –Ho5 – Ho6) included descriptive data and two-way ANOVA's for each dependent variable utilizing environment (2 levels, computer-based and two-way audio/one-way video) and location (main or remote site) as the independent variables and considered the interaction effect of environment over location.

The relationship of the six dependent variables of perceptions of individual interaction, overall interaction, satisfaction, attitude, observed interaction and direct participation were studied under the following hypotheses:

(Ho7) There is no significant relationship between computer-based environment learner perceptions of individual interaction, overall interaction, satisfaction, attitude, observed interaction and direct participation.

(Ho8) There is no significant relationship between two-way audio/one-way video environment learner perceptions of individual interaction, overall interaction, satisfaction, attitude, observed interaction and direct participation

The statistical analysis methodology for Ho7 and Ho8 was (for each treatment):

1. Pearson's product-moment correlation (Pearson's r) matrix and correlation means using Fisher Z transformations for each dependent variable.

Fisher Z to determine the mean of the correlations for each dependent variable taken during the three trial time series.

All Fisher Z transformations were conducted utilizing the procedures contained in Bruning and Kintz (1997) Computational Handbook of Statistics.

The five dependent variables of perceptions of individual interaction, perceptions of overall interaction, student attitude, observed interaction and direct participation ability to predict satisfaction in a computer-based distance learning environment were studied under the following hypothesis:

(Ho9) Learner perceptions of individual interaction, perceptions of overall interaction, student attitude, observed interaction and direct participation do not predict satisfaction in a computer-based distance learning environment.

The five dependent variables of perceptions of individual interaction, perceptions of overall interaction, student attitude, observed interaction and direct participation ability to predict satisfaction in a two-way audio/one-way video distance learning environment were studied under the following hypothesis:

(Ho10) Learner perceptions of individual interaction, perceptions of overall interaction, student attitude, observed interaction and direct participation do not predict satisfaction in a two-way audio/one-way video distance learning environment.

The statistical analysis methodology for the hypotheses (Ho9, Ho10) was (for each trcatment) standard multiple regression.

The difference between significant predictors of satisfaction between computer-based distance learning environments and two-way television environments was studied under the following hypotheses:

(Ho11) There is no difference in the significant predictors of satisfaction between computer-based and two-way remote instruction environments

The analysis methodology was a narrative analysis of the differences in the discoveries of significant predictors between the research findings for null hypotheses 9 and 10.

Each of the dependent variables of perceptions of individual interaction, overall interaction, satisfaction, attitude, observed interaction and direct participation's variance over time was studied under the following two hypotheses:

(Ho12) Computer-based environment learner perceptions of individual interaction, perceptions of overall interaction, student attitude, observed interaction and direct participation overall interaction do not vary significantly over time.

(Ho13)Two-way audio/one-way video environment learner perceptions of individual interaction, perceptions of overall interaction, student attitude, observed interaction and direct participation overall interaction do not vary significantly over time.

The method for statistical analysis of the previous research questions (HO11-12) was:

For each treatment:

A 2 X 2 X 3 repeated measures Analysis of Variance (ANOVA) was conducted using the independent variable of environment (two levels, computer-based and two-way television), the independent variable of time (with three levels, beginning, midpoint and end of class measurements) and the independent variable of location (two levels, remote and main site) for each dependent variable. The main effect of environment, the main effect of time and the interaction effects of environment over time, environment and location and location over time was analyzed for each dependent variable.

Table 9

2 X 2 X 3 Repeated Measures ANOVA

	IV3 (Time)		
	T1	T2	T3
	X	X	X
IV2 Environment ---------------(Mean Score)(Each DV)-------------------------------			
	X	X	X
IV3 Location----- ---------------(Mean Score)(Each DV)-------------------------------			

Note. The Interaction effects are included.

An assessment instrument to characterize events occurring within a computer-based distance learning environment was developed to answer the following research question:

Research Question: What instrument can be developed to aid assessment of interactional events in distance education computer-based remote instruction environments?

Developmental methodology for this instrument was as follows:

a. Review of Interactional Analysis Methodology Literature as a part of literature review.

b. Delineation of computer-based events occurring within an IRI environment through expert panel review (see Appendix F).

c. Classification through expert panel review of events to categories of interaction (see Appendix F).

d. Assimilation of Findings (see Appendix F).

e. Development of software package that allows observer to record computer-based course events within interaction analysis methodology categories.

f. Beta testing of final instrument (see Appendix F).

Threats to Validity

Confounding Variables

Instructor methods, instructor competency and course content were confounding variables. The following techniques were implemented as controls:

Instructors in the various treatment environments were surveyed and observed for operation within a general pedagogical framework to control for differences in instructor method and competencies. This framework, described by Kozma, Belle and Williams (1978) consisted of the following:

1. Content Presentation: Formal or informal presentations of pre-determined curriculum content, related information, concepts or principles by faculty, guest speakers or students, and illustration (procedural presentations or event sequence demonstrations).

2. Verbal Techniques: Rendition of written documentation, text or materials. Group interaction whether ad-hoc or planned. Question and answer periods and social conversations.

3. Interactive Application Techniques: Two-way television environment: Multimedia referencing (overhead projectors) or similar display tools and live camera feeds. Computer-based distance learning media encompass separate or parallel (ongoing) interactions for audio, imported video, electronic presentations, whiteboards, Web page displays, Web co-browsing, and computer-driven simulations.

Those instructors falling outside these guidelines were not utilized in the study. Instructors were also surveyed as to their perceptions of the level of interactivity present in their classrooms in general and in the measured interval class in particular. Instructor interactivity perception survey data (combined into a mean for each environment) was compared with student perception survey data combined for each environment. Instructor survey and accompanying demographic data on experience was screened for significant differences (see Appendix G). Instructors from the same academic department and similar academic background were chosen in each environment.

Course content was chosen among upper-division undergraduate and graduate level computer science courses in both environments as a control. Survey items address subjects' interactivity-based perceptions of the environment and are not content based.

The treatments differed primarily in the nature of their distance learning environment conduit of interactivity. Computer-based distance learning student perceptual focus was on individual workstation monitors vice the shared focus of a two-way television course class on a central monitor. While interactive remote instruction environments were offered in settings wherein a student is seated at an individual monitor, for the most part visually remote from other classmates, some level of overall interactivity akin to the two-way television classroom was inherent. This was mitigated by the high level of individual engagement required by the computer-based method, lack of visual access to classmates and the observed consistent and singular focus by the individual student on the computer as the primary interactive medium.

The second portion of this study suggested an instrument for interactive assessment and data collection of events occurring in interactive remote instruction. This instrument can find use in future studies to quantify and allow more precise comparisons of actual interactivity types and levels observed in a particular classroom independent of the content and instructor with surveyed learner perceptions in that classroom.

Threats

Various threats to internal validity of this study were present. They are (a) Selection; (b) Mortality and (c) Testing. External threats are: (a) Interaction of Testing and Treatment.

Each threat and its controls are described as:

Differential Selection of Subjects

Selection threats are internal validity threats involving differences between experimental and control groups.

Control: Subjects were chosen among students taking computer science environments in both of the two distance learning environments. Sample subjects were limited to upper-division undergraduate and graduate level students. The intention was to equate the groups on similar characteristics such as

(1) Environments chosen. Based on the hypothesis that the subjects in the two methodology treatment groups share similar characteristics based on:

(a) Course content (Computer Science).

(b) Computer skill levels.

(c) Attitudes and adaptability towards technology. Computer Science students are hypothesized to have adaptive facility for technology-based environments, tending to negate issues of anxiety or acclimation.

(2) Perceptive abilities. Upper-division undergraduate and graduate students have a wealth of previous classroom interactions from which to refer to in assessing present classroom interactivity.

(3) Academic levels of achievement (upper-division graduate and undergraduate). Various Computer Science courses within a treatment environment were chosen to dampen the effect of instructor and content on the measured perceptions of interactivity.

Mortality

Mortality is the differential loss of respondents from the comparison groups.

Controls: Tracking of each subject by name (or symbol at the subject's choosing) and contact point. Use of class time to encourage participation. Comparing dropouts and non-dropouts on pre-study and other collected data.

Testing

Testing threats to internal validity involve the reactive effect of previous tests to subsequent tests.

Controls: Allowed sufficient recovery time between measurements and used non-cueing initial demographic questions.

Interaction of Testing and Treatment

This threat to the study's external validity occurs if researcher testing cues the subjects and affects their response to follow on treatment.

Controls: Non-reactive nature of the testing instrument and through the testing interval length (Campbell and Stanley, 1963).

Pilot Study

A pilot study was conducted to improve survey procedures and refine data collection techniques. Reliability and validity of the survey instrument and the initial and final demographic questionnaires was analyzed in particular. Pilot study goals were as follows:

(a) Expert panel reviews were held for determination of instrument validity and research design.

(b) Assessment of Chronbach's Alpha was obtained in pilot testing to determine preliminary indicators of the survey instrument's utility and validity.

(c) Refinement of survey techniques, analysis of instrument validity and instrument re-phrasing was completed based upon recommendations of focus groups from the experimentally accessible population. Completion mean times were recorded with sample members of the experimentally accessible population.

Pilot study findings were incorporated into the final survey instrument and procedures.

Initial Demographic Questionnaire

The initial demographic questionnaire (IDQ) (see Appendix D) was developed by the researcher and administered to all subjects. The purpose of the questionnaire was to: (a) gather demographic information on subjects, (b) measure distance learning or computer-based experience and determine the extent of cross-pollination of these environmental experiences and (c) control for experimental mortality.

The initial demographic questionnaire gathered the following demographic data: (a) name (or identifying symbol if requested); (b) contact point (E-mail, address or phone number); (c) sex; (d) birth year (e) class standing and (f) race/ethnicity. The number of two-way television or interactive remote instruction environments taken previously and simultaneously with the studied course and whether subjects were enrolled in both methodologies concurrently was gathered. Analysis of this data was conducted as part of the proposed study.

Final Demographic Questionnaire

The final demographic questionnaire (FDQ) (see Appendix E) gathered data primarily to control for mortality. Subjects were asked to comment on items relating to: (a) recent acclimation to computer-based technology (new computer purchase or new

Internet service purchase) (b) interactional adequacy of the environment, i.e.; detractions and contributions to interactivity.

Results and Conclusions

This chapter provided an overview of the location of research for the study, the characteristics of the study population including target population and experimentally accessible population and sample. Survey instrumentation and assessment protocol was discussed. Objectives and the conduct of the pilot study were covered along with description of the variables and threats to validity. A test schedule was promulgated.

FINDINGS AND INTERPRETATIONS

Introduction

This study sought to answer the following questions using quasi-experimental methodologies:

1. What effects does a computer-based distance learning environment have on subject perceptions of individual and overall interaction, satisfaction, attitude, observed interaction and direct participation over three observations in a semester period?
2. What effects does a two-way audio/one-way video distance learning environment have on student perceptions of individual and overall interaction, satisfaction, attitude, observed interaction and direct participation over three observations in a semester period?
3. Which, if any, of the factors of student perception of individual interaction, overall interaction, student attitude, observed interaction and direct participation predict subject satisfaction in a computer-based distance learning environment?
4. Which, if any, of the factors of student perception of individual interaction, overall interaction, student attitude, observed interaction and direct participation predict student satisfaction in a two-way audio/one-way video distance learning environment?
5. Is there a difference between predictors of satisfaction and perceptions of personal and overall interaction, satisfaction, attitude and student observations of overall classroom interaction in computer-based and two-way audio/one-way video television distance education environments?
6. What type of automated interactional event analysis tool can be developed to quantify events occurring in a computer-based distance learning environment and frame them to overall and individual perceptions of interaction?

Chapter IV contains this study's statistical analysis results including types of tests used and the reasoning in their selection, experimentally accessible sample characteristics using descriptive statistics, tests of assumption and descriptions of the statistical significance of important results. Separate sections address the pilot study and the main study, with the main study section organized around research questions one through thirteen. Research question fourteen is addressed separately in Appendix F. Discussions and interpretations of results are contained in Chapter V. An alpha level of .05 was used for all statistical tests, except where specified.

The study was conducted over three semesters in eight separate courses of instruction. The total subject pool included 141 students with 18 dropouts resulting in 123 measured subjects. Twenty-two traditional course students were included as a part of the pilot study only. The pilot and main study courses included CS 350, Introduction to Software Engineering (traditional environment) $\underline{n} = 22$; CS 350, Introduction to Software Engineering (computer-based environment) $\underline{n} = 8$; CS 350, Introduction to Software Engineering (two-way audio/one-way video environment) $\underline{n} = 18$; CS 410/510, Computer-Based Productivity, $\underline{n} = 15$; CS 451/551, Software Engineering Survey (computer-based environment) $\underline{n} = 15$; CS 451/551, Software Engineering Survey (two-way audio/one-way video environment) $\underline{n} = 9$; CS 778/878, Networked Multimedia Systems (computer-based environment) $\underline{n} = 12$ and CS 311, Navigating the Internet (two-way audio/one-way video environment) $\underline{n} = 23$. The computer-based environment was stratified across four courses while the two-way audio/one-way video environment was stratified across three courses.

Methodology and Results

The pilot study used a sample drawn from the experimentally accessible population in order to: a) improve the procedures used in the administration of the experiment and to improve researcher developed instrumentation; b) develop timelines; c) assess congruent and face validity of the survey instrument; d) assess volunteer and mortality rates and e) gather traditional classroom environment reliability data on the survey instrument utilized for use in generalizability and comparison.

The pilot study was conducted using volunteers enrolled in CS 350, Introduction to Software Engineering, in the traditional environment (Tuesdays and Thursdays, 545 – 700 PM) and volunteers enrolled in CS 350 Introduction to Software Engineering in the computer-based distance learning environment (Mondays and Wednesdays, 420-535 PM) taught at Old Dominion University. Traditional and computer-based environments were chosen to provide missing validity data in these environments for the survey instrument, which has previous use in the two-way audio one-way video distance learning environment. One Computer Science Department instructor taught each environment's course. Data collection consisted of administration of the initial demographic questionnaire, the perceptions of interaction surveys, the instructor interactivity surveys and the final demographic questionnaire over a three trial period with each trial separated by three-week intervals.

Descriptive Results

The sample consisted of thirty volunteers, twenty-two volunteers from the traditional environment of instruction and eight from the computer-based interactive remote instruction environment. Five subjects (16.6%) were females (four in the traditional environment and one in the computer-based environment) and twenty-five subjects (83.4%) were males (eighteen in the traditional environment and seven in the computer-based environment). The mean age was 21.73 years (SD = 7.01) with a range of 21 to 48 years. 53.3% of the subjects were seniors (thirteen in the traditional environment and three in the computer-based environment), 43.3% were juniors (eight in the traditional environment and five in the computer-based environment) and one traditional student held sophomore standing. 66% of the volunteers were of Caucasian descent (fourteen in the traditional environment and six in the computer-based environment), 10% were of Asian descent (three in the traditional environment and zero in the computer-based environment), 10% were of African-American descent (three in the traditional environment and zero in the computer-based environment) and 14% described their ethnicity as other (two in the traditional environment and two in the computer-based environment).

A total of 63.3% (sixteen in the traditional environment and three in the computer-based environment) of the subjects had experienced both the two-way audio/one-way video and computer-based learning environments in present or previous environments and 36.6% (six in the traditional environment and five in the computer-based environment) of the subjects had experienced only one learning environment. Mean previous two-way audio/one-way video experience was 3.9 hours (SD = 2.63 hours) with a range of 0 to 9 hours. Mean current two-way audio/one-way video experience was 2.2 hours (SD = 1.91 hours) with a range of 0 to 6 hours. Mean previous computer-based experience was .9 hours (SD = 1.39 hours) with a range of 0 to 3 hours. Mean current computer-based learning environment experience was 1.2 hours (SD = 1.49

hours) with a range of 0 to 3 hours. A total of 26.6% of the volunteers expressed no preference for either learning environment (7 in the traditional environment and 1 in the computer-based environment). A total of 33.3% preferred the computer-based environment (five in the traditional environment and five in the computer-based environment) and 40% preferred the two-way audio/one-way video environment (10 in the traditional environment and two in the computer-based environment).

Volunteers and Dropouts

The volunteer rate was 100%. Thirty-four students volunteered to participate in the pilot study with no non-volunteers. Eight (seven two-way audio/one-way video and one computer-based) subjects failed to complete all three trials of the study and were unavailable for follow-up questioning. These subjects were therefore dropped from the study resulting in an actual completion rate of 78.94%. All eight of the dropout subjects were white males of senior standing. Three of the subjects had 3 hours of both previous and current two-way audio/one-way video learning environment experience and five subject had no previous and 3 hours of current two-way audio/one-way video experience. None of the study dropouts had previous computer-based learning environment experience.

Test Administration Procedures

Prior to the pilot study a field test was conducted with seven subjects who possessed previous computer-based and/or two-way audio/one-way video instruction environment experience. These subjects were representative of the target population in terms of class standing and were used to test the survey instrument for format and readability and to measure instrument completion times. Field test subjects suggested half-inch indentation of instrument questions that were subsequently incorporated into the final test instrument. Time allotted for completion of the instrument and the ability by subjects to comprehend all the separate instruments to be included in the study were otherwise found adequate.

No major problems were experienced with test administration procedures. Survey instruments were presented approximately 20 minutes prior to the end of a class session, simultaneously at both the main campus and the remote locations. Instrument forms were pre-staged and clearly marked by the researcher at remote classroom sites prior to commencement of the measured class period. Participants were polled at the remote site prior to the survey for a volunteer to distribute and collect the forms (following researcher instructions from the main site). The researcher monitored these procedures to ensure that no extraneous experimenter effects from the student involvement occurred during their assistance in remote site disbursement of the forms. The student volunteer dropped off completed forms after the survey with a secretary located at-site for later retrieval by the researcher.

The research instrument was not administered until the third class session after the commencement of the semester to control for novelty effects and to allow students' basic acclimation to the environment and technology. This procedure also allowed subjects to gain a basic knowledge and understanding of the two environments' capabilities and to therefore command a clearer perception of the particular environment's interactive capabilities. All data collection for each separate trial in a particular environment occurred within a 7-day window.

Pilot study students were interviewed collectively by group after they completed each trial. One misspelling of the word ineffective was corrected and a recommendation that the researcher briefly explain the computer-based IRI system to persons unfamiliar with the environment in two-way audio/one-way video environments was offered and incorporated into the survey procedure. One change in the pre-study instrument of a scale from 3-9 to 4-9 hours was recommended and made. No changes in the actual survey instrument were found necessary.

Mean time for subjects to complete the informed consent documents was 2 minutes, 6 minutes for completion of the learner survey instrument, 2 minutes for completion of the initial demographic instrument, and 3 minutes for completion of the final demographic instrument. The mean time for subjects to complete all the instruments that made up trial one of the study was 11 minutes with a range of 9 to 21 minutes. Trial two instrumentation completion time was 8.5 minutes with a range of 6 to 11 minutes and completion time for trial three was 10 minutes with a range of 6 to 16 minutes.

Scale Reliability

The Cronbach's Alpha method was used to calculate the coefficient of internal consistency statistic using pilot study data where two or more scale items were available. Where the survey authors used single item scales, descriptive statistics are provided. The instrument authors reported in the Journal of Educational Technology, Volume 34 (4), p. 60 that the six direct participation (DP) items of their survey had a Cronbach's Alpha of 0.78, and the five observed interaction (OI) items had a Cronbach's alpha of 0.61. Combined, the authors reported the two scales had an internal consistency index of 0.82 (Zhang and Fulford, 1994). The authors collected their reliability from student subjects in a two-way audio/one-way video environment equitable to the environment for similar subjects in this study. Reliability analysis in this pilot study therefore focused on providing instrument reliability data for students in a traditional classroom environment as well as a computer-based environment to allow extended generalizability of the instrument and assessment of survey results. Six separate subscales within the instrument were analyzed. These subscales were a) Perception of Individual Interaction (PI), b) Perception of Overall Interactions (PO), c) Perception of Satisfaction (S), d) Subject Attitude Toward Interaction (STUATT), e) Observed Interaction (OI), and f) Direct Participation (DP).

Perception of Individual Interaction Scale (PI)

Perception of Individual Interaction (PI) is defined as the perceived individual involvement of each participant in a two-way audio/one-way video or computer-based course. Variable measurement was obtained through the mean score of seven semantic-differential questions measuring subject perceptions of their level of (1) answering instructor questions; (2) volunteering opinion; (3) asking questions; (4) participation in overall activities; (5) the level of interaction between subject and instructor; (6) level of interaction between subject and classmates, and (7) how well the instructor motivated personal interaction. Semantic-differential choices for each question are listed in chapters three and in appendix C. Table 10 provides PI scale summary statistics for the traditional pilot course

Table 10

Perceptions of Individual Interaction Scale Traditional Environment Item-Total Summary Statistics

Statistics for Scale:

	Mean	Variance	Std Dev.	N of Variables
	20.66	75.15	8.66	7

	Mean	Minimum / Maximum	Range	Max / Min Variance
Item Means:				
	Mean	Minimum / Maximum	Range	Max / Min Variance
	2.95	2.56 / 3.52	.9593	1.37 / .12
Item Variances:				
	Mean	Minimum / Maximum	Range	Max / Min Variance
	2.38	2.23 / 2.57	.34	1.15 / .01
Inter-Item Correlations:				
	Mean	Minimum / Maximum	Range	Max / Min Variance
	.58	.40 /.79	.39	1.96 / .01

Reliability Coefficients:

Alpha = .90 Standardized item alpha = .90

Table 11 provides PI scale summary statistics for the computer-based pilot course. At .9081 and .7632 respectively, both environmental scale alphas were found adequate.

Perception of Overall Interactions Scale (PO)

Perception of Overall Interactions Scale (PO) measures the subject's perceived involvement and classroom interaction of other student members of a two-way audio/one-way video televised environment or a computer-based learning environment.

Variable measurement is based upon subject response to the item: (1) what level of interaction do you think occurred today?

Table 11

Perceptions of Individual Interaction Scale Computer-Based Environment Item-Total Summary Statistics

Statistics for Scale:					
	Mean	Variance	Std Dev	N of Variables	
	29.75	6.21	2.49	7	
Item Means:					
	Mean		Minimum / Maximum	Range	Max / Min Variance
	4.25		3.87 / 4.62	.75	1.19 / .08
Item Variances:					
	Mean		Minimum / Maximum	Range	Max / Min Variance
	.45		.26 / .98	.71	3.66 / .10
Inter-Item Correlations:					
	Mean		Minimum/Maximum	Range	Max/Min Variance
	.13		-.46 / .77	1.24	-1.65 / .07
Reliability Coefficients:					
	Alpha = .76		Standardized item alpha = .71		

Cronbach's Alpha was not computed on this single item instrument but item pilot study descriptive statistics were compiled and are presented in Table 12. Analysis of distribution characteristics found them adequate for the purposes of this study.

Perception of Satisfaction Scale (S)

Satisfaction in a two-way audio/one-way video televised or a computer-based course is termed perception of satisfaction (S) and is defined as the perceived value and quality of instruction. Variable measurement is obtained through the response to the questions: (1) how do you feel about today's lesson as a whole? (2) How would you rate the value of the question and answer portion, (3) how would you rate your knowledge content after the lesson? 4) How much of the material you learned today do you feel is

Table 12

Perceptions Of Overall Interaction Single Item Scale Traditional and Computer-Based Environment Descriptive Statistics

		Environment	
		Traditional	Computer-Based
N	Valid	22 (0 Missing)	8 (0 Missing)
Mean		2.68	2.62
Std. Error of Mean		.27	.49
Median		3.00	2.50
Mode		3.00	1.00
Std. Deviation		1.28	1.40
Variance		1.65	1.98
Skewness		.21	.48
Std. Error of Skewness		.49	.75
Kurtosis		-.91	-.56
Std. Error of Kurtosis		.95	1.48

Table 12 (Continued).

Range		4.00	4.00
Minimum		1.00	1.00
Maximum		5.00	5.00
Sum		68.00	21.00
Percentiles	25th	2.00	1.25
	50th	3.00	2.50
	75th	4.00	3.75

valuable to you? Cronbach's Alpha and scale statistics are provided in Table 13 for a traditional learning environment and in Table 14 for a computer-based environment. Cronbach's Alpha within both the traditional and computer-based environments were found to have acceptable alpha values of .7293 and .8299 respectively.

Table 13

Perception of Satisfaction Scale Traditional Environment Item-Total Summary Statistics

Statistics for Scale:

Mean	Variance	Std Dev.	N of Variables
14.54	12.06	3.47	4

Item Means:

Mean	Minimum / Maximum	Range	Max / Min	Variance
3.63	3.13 / 3.86	.7273	1.23 / .11	

Table 13 (Continued)

Item Variances:

Mean	Minimum / Maximum	Range	Max / Min Variance
1.36	.58 / 2.59	2.01	4.41 / .74

Inter-Item Correlations:

Mean	Minimum / Maximum	Range	Max / Min Variance
.66	.19 / .85	.64	3.8 / .06

Reliability Coefficients:

Alpha = .72 Standardized item alpha = .79

Table 14

Perception of Satisfaction Scale Computer-Based Environment Item-Total Summary Statistics

Statistics for Scale:

Mean	Variance	Std Dev.	N of Variables
11.62	9.41	3.06	4

Item Means:

Mean	Minimum / Maximum	Range	Max / Min Variance
2.90	2.50 / 3.62	1.12	1.45 / .24

Item Variances:

Mean	Minimum / Maximum	Range	Max / Min Variance
.88	.78 / .12	.33	1.43 / .02

Inter-Item Correlations:

Mean	Minimum / Maximum	Range	Max / Min Variance
.56	.18 / .87	.68	4.58 / .05

Table 14 (Continued)

Reliability Coefficients:

Alpha = .82 Standardized item alpha = .83

Subject Attitude Toward Interaction Scale (STUATT)

Subject attitude toward interaction (STUATT) is measured by response to the question: (1) How did the level of the interaction make you feel? Table 15 provides descriptive statistics for both environments. Analysis of the data characteristics and distribution data found the item adequate for use in the main study.

Table 15

Student Attitude Single Item Scale Traditional And Computer-Based Environment Descriptive Statistics

		Environment	
		Traditional	Computer-Based
N	Valid	22 (0 Missing)	8 (0 Missing)
Mean		3.09	2.62
Std. Error of Mean		.24	.49
Median		3.00	3.23
Mode		3.00	2.00
Std. Deviation		1.15	2.00
Variance		1.32	.91

Table 15 (Continued)

Skewness		.01	.99
Std. Error of Skewness		.49	.75
Kurtosis		-.35	1.03
Std. Error of Kurtosis		.95	1.48
Range		4.00	2.00
Minimum		1.00	2.00
Maximum		5.00	4.00
Sum		68.00	21.00
Percentiles	25th	2.00	2.00
	50th	3.00	2.00
	75th	4.00	3.75

Observed Interaction Scale (OI)

Observed Interaction (OI) is measured by the mean of four items, all of which ask for the subject's impressions of other environment subject's participatory behaviors. The scale questions consist of: (1) What level of interaction was there between the instructor and class? (2) What level of interaction was there between all other participants? (3) How well did the instructor motivate interaction in general? (4) What percentage of the time were the instructor and participants interacting? Tables 16 and 17 statistically summarize scale, item means, item variances, inter-item correlations and reliability coefficients for both the traditional and computer-based environments respectively. An alpha value of .9052 for the traditional environment and .7318 for the computer-based environments were computed and deemed adequate for conduct of the study.

Table 16

Observed Interaction Scale Traditional Environment Item-Total Summary Statistics

Statistics for Scale:

Mean	Variance	Std Dev.	N of Variables
11.18	29.29	5.41	4

Item Means:

Mean	Minimum / Maximum	Range	Max / Min Variance
2.79	2.50 / 3.13	.63	1.25 /.10

Item Variances:

Mean	Minimum / Maximum	Range	Max / Min Variance
2.35	1.97 3.07	1.10	1.55 / .24

Inter-Item Correlations:

Mean	Minimum / Maximum	Range	Max / Min Variance
.71	.66 / .77	.1074	1.16 / .0018

Reliability Coefficients:

Alpha = .90 Standardized item alpha = .90

Table 17

Observed Interaction Scale Computer-Based Environment Item-Total Summary Statistics

Statistics for Scale:

Mean	Variance	Std Dev	N of Variables
1.87	14.69	3.83	4

Item Means:

Mean	Minimum / Maximum	Range	Max / Min Variance
2.96	2.25 / 3.37	1.25	1.50 / .28

Table 17 (Continued)

Item Variances:

	Mean	Minimum / Maximum	Range	Max / Min Variance
	1.93	1.0 / 2.98	1.91	2.78 / .96

Inter-Item Correlations:

	Mean	Minimum / Maximum	Range	Max / Min Variance
	.27	-.15 / .58	.74	-3.89 /. 08

Reliability Coefficients:

Alpha = .73 Standardized item alpha = .70

Direct Participation Scale (DP)

The direct participation subscale measured each student's direct participation in interaction by the mean of six items: (1) How often did you answer questions asked by the instructor? (2) How often did you volunteer your opinion? (3) How often did you ask a question? (4) How often did you participate in overall activities? (5) What level of interaction was there between you and the instructor? And (6) What level of interaction was there between you and your classmates? Cronbach's Alpha for both the traditional and computer-based environments are presented in Tables 18 and 19 and were computed to an acceptable .8619 and .7072 respectively.

Table 18

Direct Participation Scale Traditional Environment Item-Total Summary Statistics

Statistics for Scale:

Mean	Variance	Std Dev	N of Variables
14.72	45.73	6.76	6

Item Means:

Mean	Minimum / Maximum	Range	Max / Min	Variance
2.45	1.95 / 2.90	.95	1.48 / .14	

Item Variances:

Mean	Minimum / Maximum	Range	Max / Min	Variance
2.14	1.09 / 3.03	1.94	2.78 / .63	

Inter-Item Correlations:

Mean	Minimum / Maximum	Range	Max/Min	Variance
.53	.36 / .76	.40	2.10 / .01	

Reliability Coefficients:

Alpha = .86 Standardized item alpha = .87

Table 19

Direct Participation Scale Computer-Based Environment Item-Total Summary Statistics

Statistics for Scale:

Mean	Variance	Std Dev	N of Variables
25.75	5.92	2.43	6

Table 19 (Continued)

Item Means:

	Mean	Minimum / Maximum	Range	Max / Min Variance
	4.29	3.87 /4.62	.75	1.19 / .08

Item Variances:

	Mean	Minimum / Maximum	Range	Max / Min Variance
	.48	.26 / .98	.71	3.66 / .11

Inter-Item Correlations:

	Mean	Minimum / Maximum	Range	Max / Min Variance
	18	-.46 / .77	1.24	-1.65 / .09

Reliability Coefficients:

Alpha = .70 Standardized item alpha = .69

Summary of Results

The internal consistency reliability and stability coefficients of the instrument to measure the new population sample, computer-based students, in this study was found acceptable in accordance with George and Mallery's (1999) standard of $\alpha > .9 =$ excellent, $\alpha > .8 =$ good, $\alpha > .7 =$ acceptable and $\alpha > .6 =$ questionable. Cronbach's Alpha computations ranged from a standardized item alpha low of .6995 (.7072 non-standardized) in Direct Participation scale consistency to a standardized item alpha high of .8397 in Satisfaction scale consistency for computer-based environment subjects and from a standardized item alpha low of .7970 in satisfaction scale consistency to a standardized item alpha high of .9075 in perceptions of individual interaction consistency for traditional environment subjects A comparison of instrument author Direct Participation scale consistency values of .78 with .70 (computer-based) and .86 (traditional) findings and Observed Interaction scale values of .61 with .70 (computer-based) and .90 (traditional) findings found the pilot study results to be equal to or better than the original instrument findings.

The skewness and kurtosis of the distribution of the single-item scales were analyzed for normality. Skewness, the measure of the symmetry of the sample distribution fluctuated from 0 by .014 for traditional environment students and .999 for computer-based students in the Student Attitude scale and by .219 and .480 respectively in the Perception of Overall interaction scale. Kurtosis, a measure of distribution peakedness fluctuated from 0 by -.357 for traditional environment students and 1.039 for computer-based students in the Student Attitude scale and by -.915 and -.569 respectively in the Perception of Overall interaction scale.

The ratio of each the skewness and kurtosis statistic to their respective standard of error was used as a benchmark to test for each scale's distribution's normality. The traditional environment's Perceptions of Overall Interaction scale ratio for skewness was .44 and for kurtosis was -.96. The computer-based environment scale's ratio for skewness was .63 and for kurtosis was -.38. The traditional environment's Student Attitude Interaction scale ratio for skewness was .02 and for kurtosis was -.37 The computer-based environment scale's ratio for skewness was 1.32 and for kurtosis was .70. Since the ratios fell within the generally accepted bounds of –2 to +2 (SPSS, 1999) the distributions were accepted as normal. An analysis of boxplots and histograms showed no anomalies or significant outliers for either distribution.

A panel of four Old Dominion University professors, expert in the field of computer-based and two-way audio/one-way video environments and research procedures assessed the instrument for face and content validity and found it acceptable. The variables measured in the suggested instrument were found to parallel the phenomenon of interaction and satisfaction both conceptualized in the literature review of this study and as embodied in the research questions. Following analysis of scale reliability data a decision to advance with the study was given. Since the research included a multi-semester design and no major changes to the instrument or administration procedures of the pilot study were found necessary. A decision to incorporate data from the 8 computer-based subjects of the pilot study into the body of the main study was made.

Main Study

The main study survey was proctored on three occasions at three-week intervals over three separate semesters. The completed study included 101 students in seven courses of instruction under six different instructors. The computer-based environment was stratified into four courses and three courses stratified the two-way audio/one-way video environment. All courses were upper-division undergraduate or graduate level Computer-Science Courses.

The study was conducted in the computer-based environment in the following courses and semesters; semester one, eight volunteers (four main site, four remote, 1 drop-out) from CS 355, Principles of Programming Languages, taught Fridays from 4:20 to 7 p.m., semester two; fifteen volunteers (seven main site, eight remote, 0 drop-outs) from CS 410/510, Computer Based Productivity, taught Thursdays from 10 a.m. to 1215 p.m., fifteen volunteers (six main site, nine remote, 0 drop-outs) from CS 451/551, Software Engineering Survey taught Thursdays from 545 p.m. to 700 p.m., and twelve volunteers (eight main site, four remote, 0 drop outs) from CS 778/878, Networked Multimedia Systems taught Tuesdays from 710 p.m. to 950 p.m. The two-way audio/one-way video environment included; semester two; twenty-three volunteers (twelve main site, eleven remote, 5 drop outs) from CS 311, Navigating the Internet taught Thursdays from 115 p.m. to 230 p.m., eighteen volunteers (ten main site, eight remote, 3 drop outs) from CS 350, Principles of Programming Languages taught Fridays from 715 p.m. to 10 p.m. and nine volunteers (five main site, four remote, 1 drop out) from CS 451/551, Software Engineering Survey taught Fridays from 315 p.m. to 6 p.m.

Descriptive Results

The sample consisted of 101 volunteers, 50 volunteers from the computer-based environment of instruction and 51 from the two-way audio/one-way video instruction environment. 21 subjects (20.79%) were females (10 in the two-way audio/one-way video environment and 11 in the computer-based environment) and 80 subjects (79.2%) were males (41 in the two-way audio/one-way video environment and 39 in the computer-based environment). The mean age for computer-based environment students was 26.28 years (SD = 5.574) with a range of 19 to 46 years. The mean age for two-way audio/one-way video environment students was 25.72 years (SD = 6.3216) with a range of 18 to 47 years.

Table 20 presents Class standing of all subjects by environment organized by frequency and percentages.

Table 20

Subject Class Standing

Computer-Based/Two-Way Audio, One-Way Video Environment

		Frequency	Percent	Valid Percent	Cumulative Percent
Freshman		2/0	3.9/0	3.9/0	5.9
Sophomore		6/0	11.8/0	11.8	17.6
Junior		13/12	25.5/24	25.5/24	43.1/24
Senior		26/22	51/44	51.0/44	94.1/68
Graduate		3/16	5.9/32	5.9/32	100 / 100
	Total	50/51	100 / 100	100 / 100	

N = 101

Table 21 presents subject ethnicity for both the computer-based and two-way audio/one-way video environments respectively organized by frequency and percent. Fifty-nine of a hundred respondents in the survey had previous two-way audio/one-way video experience. (30 of 51 in the two-way audio/one-way video environment and 29 of 50 in the computer-based environment) Forty-two respondents had previous computer-based experience. (22 of 51 in the two-way audio/one-way video environment and 20 of 50 in the computer-based environment). Fifty-nine of the subjects had experienced both the two-way audio/one-way video and computer-based learning environments. (27 in the two-way audio/one-way video environment and 32 in the computer-based environment). Forty-one of the subjects had experienced only one learning environment (24 in the two-way audio/one-way video environment and 18 in the computer-based environment).

Table 21

Subject Ethnicity

Computer-Based/Two-Way Audio, One-Way Video Environment

	Frequency	Percent	Valid Percent	Cumulative Percent
African-American	3/5	6.0/9.8	6.0/9.8	6.0/9.8
Asian Descent	5/8	10.0/15.7	10.0/15.7	16.0/25.5
Caucasian	33/31	66.0/60.8	66.0/60.8	82.0/86.3
Hispanic	1/4	2.0/7.8	2.0/7.8	84.0/94.1
Other	8/3	16.0/5.9	16.0/5.9	100 / 100
Total	50/51	100 / 100	100 / 100	

N = 101

Mean previous two-way audio/one-way video experience for the surveyed population was 2.4 hours (SD = 2.6 hours) with a range of 0 to 15 hours. Mean current two-way audio/one-way video experience was 2.7 hours (SD = 1.78 hours) with a range of 0 to 6 hours. Mean previous computer-based experience was 1.26 hours (SD = 1.81 hours) with a range of 0 to 12 hours. Mean current computer-based learning environment experience was 2.1 hours (SD = 1.6 hours) with a range of 0 to 6 hours.

Table 22 presents the statistical description of current and previous computer-based subject experience within the two environments under study.

Table 22

Computer-Based Environment Population Experience

	TWA Previous Experience	TWA Current Experience	CBDL Previous Experience	CBDL Current Experience
Mean	2.58	.90	1.38	2.88
Median	3.00	.00	.00	3.00
Mode	3.00	.00	.00	3.00
Std. Deviation	3.03	1.51	2.11	1.30
Variance	9.18	2.29	4.48	1.69
Range	15.00	6.00	12.00	6.00
Minimum	.00	.00	.00	.00
Maximum	15.00	6.00	12.00	6.00

Note. TWA: Two-way audio/one-way video environment, CBDL: Computer-based distance learning environment.

N = 101

Table 23 presents the complementary data for current and previous two-way audio/one-way video subject experience within the two environments under study.

Study Volunteers and Dropouts

The subject pool consisted of 112 possible subjects. Eleven subjects or 9.82% of the pool failed to complete all three trials of study. These subjects consisted of two computer-based and nine two-way audio/one-way video subjects representing 3.8% of

Table 23

Two-way Audio/One-way Video Environment Population Experience

		TWA Previous Experience	TWA Current Experience	CBDL Previous Experience	CBDL Current Experience
N	Valid	50	51	51	51
Missing		1	0	0	0
Mean		2.22	3.23	1.15	1.41
Median		3.00	3.00	.00	.00
Mode		3.00	3.00	.00	00
Std. Deviation		2.33	1.17	1.46	1.62
Variance		5.44	1.38	2.13	2.64
Range		9.00	6.00	3.00	6.00
Minimum		.00	.00	.00	.00
Maximum		9.00	6.00	3.00	6.00

Note. TWA: Two-way audio/one-way video environment, CBDL: Computer-based distance learning environment.

the computer-based and 15% of the two-way audio/one-way video environment. This resulted in an overall return rate of 90.18%. There were no non-volunteers. All study dropouts were males between the ages of 19 to 36. Eight dropouts listed their ethnicity as Caucasian, two dropouts marked their ethnicity in the other category and one volunteer did not respond. Since dropouts were considered a possible source of bias in the study statistical tests were conducted to determine whether dropouts differed from non-dropouts in the interval scale variables measured in the study. Missing values for dropouts were replaced by the series mean method with the range of values consisting of trial instrument measurements conducted either prior to or after the missing values depending upon availability. Independent sample t-tests were conducted to compare the means of dropouts and non-dropouts on the test instrument interval scales. Tables 24 and 25 present the results of this comparison by listing the relevant degrees of freedom, means, standard deviations and t ratios for both the computer-based and two-way audio/one-way video environments respectively. These tests revealed no significant differences between dropouts and non-dropouts on any of the interval scale variables tested when either equal variances or non-equal variances were assumed. Levene's test for equality of variance showed that the interval scale variable of perceptions of overall interaction was violated among computer-based dropouts and computer-based non-dropouts (F= 4.376, p = .041). Consequently the Mann-Whitney U test, a nonparametric equivalent to the independent samples t test was conducted to test the hypothesis that the dropouts differed from the non-dropouts on this variable. This test resulted in a U of 46 and a nonsignificant p = .813.

Test Administration Procedures

No significant problems were experienced with test administration procedures. Due to conflicting class schedules, trial three of CS 451/551 in the two-way audio/one-way video environment required presentation of surveys at the start of class with actual

Table 24

Comparison of Computer-Based Dropouts and Non-Dropouts on Interval Scale Variables

		Dropouts		Non-Dropouts		2-Tailed
Variable	df	M	SD	M	SD	Sig.
Individual Interaction	51	4.38	.40	4.47	.64	.84
Overall Interaction	51	3.66	.00	3.44	.90	.69
Observed Interaction	51	3.34	.09	3.42	.70	.87
Student Attitude	51	3.66	.47	3.65	.95	.98
Satisfaction	51	3.59	.35	4.00	1.17	.51
Direct participation	51	4.30	.43	4.41	.70	.82

Note. All t-ratios are non-significant and are displayed for assumed equal variances. Non-equal variance assumptions also resulted in non-significance

collection following the end of the class. There was no loss of data. Subject orientation was conducted utilizing guidance found in Appendix A in order to conduct uniform data collection and provide the same level of orientation and explanation to all subjects. Subjects were not

required to repeat demographic data duplicated in various parts of the instruments. All subscales were included as part of a single instrument along with informed consent and pre-study documents in trial one and post-study documents in trial three. Instrumentation was administered to all volunteers by group during normally scheduled class sessions. Students were interviewed collectively by group in smaller classes and individually as

Table 25

Comparison of Two-Way Audio/One-Way Video Dropouts and Non-Dropouts on Interval Scale Variables

		Dropouts		Non-Dropouts		
						2-Tailed
Variable	df	M	SD	M	SD	Sig.
Individual Interaction	59	2.58	.27	2.37	.58	.31
Overall Interaction	59	3.48	.72	3.62	.96	.61
Observed Interaction	59	3.76	.69	3.96	.86	.52
Student Attitude	59	3.85	.55	4.01	.74	.98
Satisfaction	59	4.04	.79	4.05	.70	.96
Direct participation	59	2.50	.29	2.28	.60	.30

Note. All t-ratios are non-significant and are displayed for assumed equal variances. Non-equal variance assumptions also resulted in non-significance.

they turned in surveys in larger classes concerning administration procedures and instrument fidelity. No significant changes were found necessary.

Mean time for subjects to complete the informed consent documents was 2 minutes, for completion of the learner survey instrument was approximately 4 minutes, for completion of the initial demographic instrument, 2 minutes and for completion of the final demographic instrument, 2 minutes. The mean time for subjects to complete all the instruments that made up trial one of the study was 6 minutes with a range of 3 to 12 minutes, trial two instrumentation completion time was 5 minutes with a range of 4 to 11 minutes and completion time for trial three was 6 minutes with a range of 5 to 15 minutes.

Scale Reliability

Scale reliability for two-way audio/one-way video environment students was analyzed at the first trial to confirm reliability and compatibility with the instrument author findings. Table 26 presents the findings for the perceptions of individual

Table 26

Perceptions of Individual Interaction Scale Two-Way Audio/One-Way Video Environment Item-Total Summary Statistics

Statistics for Scale:

	Mean	Variance	Std Dev.	N of Variables
	16.88	37.38	6.11	7

Item Means:

	Mean	Minimum / Maximum	Range	Max / Min Variance
	2.37	1.90 / 3.21	1.31	1.69 / .24

Item Variances:

	Mean	Minimum / Maximum	Range	Max/Min Variance
	1.68	1.21 / 1.97	.76	1.62 / .07

Inter-Item Correlations:

	Mean	Minimum / Maximum	Range	Max / Min Variance
	.36	.00 / .67	.67	-9.12 / .03

Reliability Coefficients:

Alpha = .79 Standardized item alpha = .80

interaction scale and an acceptable alpha of .7981. Descriptive statistics for the single-item scale of perceptions of overall interaction for two-way audio/one-way video subjects are presented in Table 27.

The skewness and kurtosis of the distribution of the single-item scale of perception of overall interaction was analyzed for normality. Skewness fluctuated from 0 by -.166. Kurtosis fluctuated from 0 by -.207.

Table 27

Perceptions Of Overall Interaction Single Item Scale Traditional And Computer-Based Environment Descriptive Statistics

N	Valid 51	(0 Missing)
Mean		3.61
Std. Error of Mean		.17
Median		3.00
Mode		4.00
Std. Deviation		1.23
Variance		1.53
Skewness		-.16
Std. Error of Skewness		.33
Kurtosis		-.20
Std. Error of Kurtosis		.65
Range		5.00
Minimum		1.00
Maximum		6.00
Sum		164.00
Percentiles	25th	2.00
	50th	3.00
	75th	4.00

Since the ratios fell within the generally accepted bounds of –2 to +2 the distributions were accepted as normal. An analysis of boxplots and histograms showed no anomalies or significant outliers for either distribution.

Table 28 presents the trial one survey data for the two-way audio/one-way video observed interaction scale. An adequate alpha value of .8245 was computed.

Table 28

Observed Interaction Scale Two-Way Audio/One-Way Video Environment Item-Total Summary Statistics

Statistics for Scale:					
	Mean	Variance	Std Dev.	N of Variables	
	14.33	7.94	4.23	4	
Item Means:					
	Mean	Minimum / Maximum		Range	Max / Min Variance
	3.96	3.23 / 3.86		.62	1.19 / .08
Item Variances:					
	Mean	Minimum / Maximum		Range	Max / Min Variance
	1.71	1.28 / 1.93		.65	1.50 / .08
Inter-Item Correlations:					
	Mean	Minimum / Maximum		Range	Max / Min Variance
	.54	.46 / .71		.25	1.54 / .0.36
Reliability Coefficients:					
	Alpha = .82	Standardized item alpha = .82			

Table 29 presents the single-item observed interaction scale descriptive statistics for two-way audio/one-way video subjects.

The skewness and kurtosis of the distribution of the single-item scales were analyzed for normality. Skewness fluctuated from 0 by .046. Kurtosis fluctuated from 0 by -.467. The ratio of each the skewness and kurtosis statistic to their respective standard of error was used as a benchmark to test for the scale's distribution normality. The scale ratio for skewness was -.49 and for kurtosis was -.70. Since the ratios fell within the generally accepted bounds of –2 to +2 the distributions were accepted as normal. An analysis of boxplots and histograms showed no anomalies or significant outliers for either distribution.

Table 29

Student Attitude Single Item Scale Traditional and Computer-Based Environment Descriptive Statistics

N	Valid 51	(0 Missing)
Mean		4.06
Std. Error of Mean		.16
Median		4.00
Mode		4.00
Std. Deviation		1.15
Variance		1.32
Skewness		.04
Std. Error of Skewness		.32
Kurtosis		-.46
Std. Error of Kurtosis		.66
Range		4.00

Table 29 (Continued)

Minimum		2.00
Maximum		6.00
Sum		203.00
Percentiles	25th	3.00
	50th	4.00
	75th	5.00

Table 30 presents the satisfaction scale item summary for the two-way audio/one-

Table 30

Satisfaction Scale Two-Way Audio/One-Way Video Environment Item-Total Summary Statistics

Statistics for Scale:					
	Mean	Variance	Std Dev.	N of Variables	
	15.95	10.79	3.28	4	
Item Means:					
	Mean	Minimum / Maximum		Range	Max / Min Variance
	4.05	3.71 / 4.20		.48	1.13 / .04
Item Variances:					
	Mean	Minimum / Maximum		Range	Max / Min Variance
	1.16	.89 / 1.41		.52	1.58 / .05
Inter-Item Correlations:					
	Mean	Minimum / Maximum		Range	Max / Min Variance
	.44	.38 / .55		.17	1.44 / .00
Reliability Coefficients:					
	Alpha = .75	Standardized item alpha = .76			

way video environment subjects. An acceptable alpha of .7573 was computed

Finally, Table 31 presents the direct participation scale item summary for the two-way audio/one-way video environment subjects. An acceptable alpha of .7696 was computed.

Table 31

Direct Participation Scale Two-Way Audio/One-Way Video Environment Item-Total Summary Statistics

Statistics for Scale:					
	Mean	Variance	Std Dev.	N of Variables	
	13.66	27.42	5.23	6	
Item Means:					
	Mean	Minimum / Maximum		Range	Max / Min Variance
	2.27	1.90 / 2.74		.84	1.44 / .13
Item Variances:					
	Mean	Minimum / Maximum		Range	Max / Min Variance
	1.63	1.21 / 1.91		.70	1.58 / .07
Inter-Item Correlations:					
	Mean	Minimum / Maximum		Range	Max / Min Variance
	.36	.00 / .67		.67	-9.12 / .0
Reliability Coefficients:					
	Alpha = .76	Standardized item alpha = .77			

Data Screening

Data collected on perceptions of individual and overall interaction, observed interaction, student attitude, satisfaction and direct participation were examined for data entry accuracy, extreme outliers (more than three box lengths from center in a ox plot) and multicollinearity (correlation in excess of .70).

Kolmogorov-Smirnov Z tests were conducted to test differences in the locations and shapes of the two independent sample distributions on each of the dependent variables. The Kolmogorov-Smirnov test is based on the maximum absolute difference between the observed cumulative distribution functions for both samples. When this difference is significantly large, the distributions are considered different from a hypothesized normal distribution. The null hypothesis tested was that there were no differences on the dependent variables for each of the environments from that hypothesized of a normal distribution. None of the significance values calculated from the Kolmogorov-Smirnov test for either of the environments among the dependent variables indicated a departure from normality.

Table 32

Summary of Raw Scores for Computer-Based Environment Subjects

	Observation					
	Trial 1		Trial 2		Trial 3	
	M	SD	M	SD	M	SD
Variable						
Perceptions of Individual Interaction	4.15	1.30	4.23	1.20	5.04	.99
Perceptions of Overall Interaction	3.22	1.47	3.70	1.37	3.34	1.11

Table 32 (Continued)

Observed Interaction	3.30	1.11	3.72	.99	3.29	1.01
Student Attitude	3.54	1.28	3.78	1.13	3.68	1.28
Satisfaction	4.00	.89	4.15	2.54	3.98	1.18
Direct Participation	3.63	1.30	3.43	.70	5.27	.63

Note. N=50

Table 33

Summary of Raw Scores for Two-Way Audio/One-Way Video Environment Subjects

	Observation					
	Trial 1		Trial 2		Trial 3	
Variable	M	SD	M	SD	M	SD
Perceptions of Individual Interaction	3.34	.87	3.32	.70	3.41	.78
Perceptions of Overall Interaction	3.21	1.23	3.52	1.33	4.09	1.51
Observed Interaction	3.58	1.05	3.96	1.07	4.28	1.32
Student Attitude	4.06	1.15	4.00	1.09	3.99	.75
Satisfaction	4.26	1.31	3.92	.81	4.00	.81
Direct Participation	3.27	.87	3.23	.72	3.35	.79

Note. N=51

An analysis of box plots and data showed no extreme outliers on the interval scale variables after the eleven study dropouts were removed. The means and standard deviation for each interval scale variable are presented in Table 32 for the computer-based environment and in Table 33 for the two-way audio/one-way video environment.

To help identify issues of inter-variable multicollinearity, a correlation matrix was computed for the overall study and is presented in Table 34. This table demonstrates

Table 34

Combined Environment Intercorrelation Matrix

Variable	1	2	3	4	5	6
1. Perceptions of Individual Interaction	--	.03	-.17	-.14	.55*	.99*
2. Perceptions of Overall Interaction		--	.32*	.46*	.74*	.03
3. Observed Interaction			--	..57*	.37*	-.17
4. Student Attitude				--	..47*	-.17
5. Satisfaction					--	.23
6. Direct Participation						--

$p < .05$.

significant relationships between all dependent variables with the exclusion of the two variables of perceptions of individual interaction and direct participation, which show a significant relationship among each other and the potential for high multicollinearity.

Testing of Hypotheses

Hypotheses testing was conducted using a variety of statistical techniques appropriate to each specific question. Research questions one through six were hypothesis difference questions grouped on the independent variable of environment for each dependent variable of the study. The independent variable of location (remote or main site) was also considered as part of an overall 2 X 2 analysis of variance (ANOVA). Based on the results of the intercorrelation matrix, separate univariate ANOVA's for each dependent variable were conducted versus a single multivariate analysis of variance (MANOVA). Questions seven and eight were questions regarding the relationships between each environment's specific dependent variables. Questions nine and ten sought to determine the ability of each of the environment's dependent variables to predict the single dependent variable of satisfaction utilizing multiple regression. Question eleven analyzed the difference between question nine and ten's findings. Questions twelve and thirteen sought to determine the effects of time on the dependent variables utilizing repeated measures analysis of variance.

The following abbreviations were used:

CBDL: Computer-Based Distance Learning Environment

TWA: Two-way audio/One-way Video Environment

PI: Perceptions of Individual Interaction

PO: Perceptions of Overall Interaction

S: Satisfaction

STUATT: Student (subject) Attitude

OI: (Subject's) Observed Interaction

DP: (Subject's) Direct Participation

Research Questions One through Six

Separate 2 X 2 analysis of variance for each of the dependent variables of; perceptions of overall interaction, observed interaction, satisfaction, student attitude, perceptions of individual interaction and direct participation were computed for each environment utilizing the independent variables of environment (two levels; computer-based and two-way audio/one-way video) and location (two levels; main site and remote).

Research questions were studied under the null hypotheses that there is no difference between learner perceptions of these dependent variables and the two environments.

Analysis considered the main effect of environment, the main effect of location and the interaction effect of environment by location for the dependent variable of perception of personal interaction. Previously, Table 32 presented the mean score for each dependent variable by trial in the computer-based environment and Table 33 presented the mean score for each dependent variable by trial in the two-way audio/one-way video environment. Table 35 presents the mean of the combined trial scores for each of the dependent variables. Table 36 through Table 41 present 2 X 2 ANOVA results for each dependent variable. Results indicate that the main effect of environment was significant for perceptions of individual interaction $\underline{F}$ (1, 101) = 8.79, $p<.05$, for observed interaction $\underline{F}$ (1, 101) = 11.420, $p<.05$ and for direct participation $\underline{F}$ (1, 101) = 7.49, $p<.05$ therefore the null hypotheses of no difference among the two environments is not supported for these variables. The main effect of location and the interaction effect of location by environment were non-significant across the dependent variables.

Research Questions Seven and Eight

Research questions seven and eight sought to answer the question: what are the significant relationships between the variables of perceptions of individual interaction,

Table 35

Summary of Overall Scores for Each Dependent Variable by Environment

	Environment			
	CBDL		TWA	
	M	SD	M	SD
Variable				
Perceptions of Individual Interaction	4.47	.64	3.38	.58
Perceptions of Overall Interaction	3.44	.90	3.62	.95
Observed Interaction	3.43	.70	3.96	.86
Student Attitude	3.65	.70	4.01	.75
Satisfaction	4.52	.95	4.05	.70
Direct Participation	4.41	1.17	3.28	.59

Note. N=50 and 51 for the CBDL and TWA Environments respectively

Table 36

Analysis of Variance of Perception of Personal Interaction by Environment and Location

Source	SS	DF	MS	F
Intercept	1177.09	1	1177.09	31.30
Environment	111.32	1	111.32	8.79*
Location	.78	1	.78	2.07
Environment X Location	.12	1	.12	.34
Error	36.47	97	.37	
Total	1339.43	101		

* $p < .05$

Table 37

Analysis of Variance of Perception of Overall Interaction by Environment and Location

Source	SS	DF	MS	F
Intercept	1247.55	1	1247.55	1.01
Environment	1.12	1	1.12	1.28
Location	.76	1	.76	.87
Environment X Location	.71	1	.71	.81
Error	84.99	97	.87	
Total	1337.77			

Table 38

Analysis of Variance of Observed Interaction by Environment and Location

Source	SS	DF	MS	F
Intercept	1375.3	1	1375.39	21.86
Environment	7.18	1	7.18	11.42*
Location	4.24	1	4.24	.06
Environment X Location	7.69	1	7.69	.12
Error	67.01	97	.62	
Total	1446.07	101		

* $p < .05$

Table 39

Analysis of Variance of Student Attitude by Environment and Location

Source	SS	DF	MS	F
Intercept	1478.26	1	1478.26	3.15
Environment	3.03	1	3.03	4.25
Location	2.63	1	2.63	3.70
Environment X Location	1.27	1	1.27	1.78
Error	69.16	97	.71	
Total	1557.91	101		

Table 40

Analysis of Variance of Satisfaction by Environment and Location

Source	SS	DF	MS	F
Intercept	1653.00	1	1653.00	.273
Environment	3.74	1	3.742	.00
Location	.33	1	.33	.35
Environment X Location	.43	1	.43	.45
Error	92.40	97	.95	
Total	1753.25	101		

Table 41

Analysis of Variance of Direct Participation by Environment and Location

Source	SS	DF	MS	F
Intercept	1127.50	1	1127.50	9.05
Environment	115.59	1	115.59	7.49*
Location	.48	1	.48	1.12
Environment X Location	.19	1	.19	.45
Error	41.91	97	.43	
Total	1299.11	101		

* $p < .05$

overall interaction, satisfaction, attitude, observed interaction and direct participation in computer-based and two-way audio/one-way video distance learning environments?

The relationship of the six dependent variables of perceptions of individual interaction, overall interaction, satisfaction, attitude, observed interaction and direct participation were studied under the following hypotheses:

(Ho7) There is no significant relationship between computer-based environment learner perceptions of individual interaction, overall interaction, satisfaction, attitude, observed interaction and direct participation.

(Ho8) There is no significant relationship between two-way audio/one-way video environment learner perceptions of individual interaction, overall interaction, satisfaction, attitude, observed interaction and direct participation.

A Pearson's product-moment correlation (Pearson's r) matrix for each environment is presented in Table 42. Correlation means using Fisher Z transformations were computed for each dependent variable's aggregate score across three trials. Fisher Z transformations determine significance of correlation coefficient relationships between samples on like data and were conducted utilizing the procedures contained in Bruning and Kintz (1997) Computational Handbook of Statistics.

Perceptions of Individual Interaction and Direct Participation, which share seven of eight scale items are highly correlated ($r > .99$ for the two-way audio/one-way video environment and $r > .98$ for the computer-based environment). Table 42 reveals the variables of perceptions of overall interaction and observed interaction which are semantically similar but do not share like items are also highly correlated with an $r > .77$ for the two-way audio/one-way video environment and an $r > .74$ for the computer-based environment. Each environment has similarly significant correlations with the exception of perceptions of personal interaction and perceptions of overall interaction which are significantly related for the two-way audio environment only.

The correlation coefficients of perceptions of personal interaction and student attitude and perceptions of overall interaction and satisfaction were found have significant z-score of .341 and .241 respectively showing their relationships differ significantly among the environments. While both PI and STUATT were non-significant for each environment, the correlation coefficient for two-way audio/one-way video environments was higher than the computer-based environment by .06. For OI and S, both environment's relationships were significant and the coefficient for two-way audio/one-way video environments more than double the computer-based environment (.55 to .24).

These results demonstrate that the null hypotheses of no difference between the dependent variable relationships in the study is disproved for the relationships between perceptions of individual interaction and student attitude observed interaction and

Table 42

Intercorrelation Between Variables By Environment

Subscale	1	2	3	4	5	6
Two-way Audio/One-way Video Environment (n= 51)						
1. Perceptions of Individual Interaction	--	.18*	.09*	.07	.54*	.99*
2. Perceptions of Overall Interaction		--	.77*	.57*	.50*	.12
3. Observed Interaction			--	.53*	.55*	.05
4. Student Attitude				--	.51*	.02
5. Satisfaction					--	.20
6. Direct Participation						--
Computer-based Environment (n = 50)						
1. Perceptions of Individual Interaction	--	.34	.30	.01	.57*	.98*
2. Perceptions of Overall Interaction		--	.74*	.31*	.08*	.36
3. Observed Interaction			--	.61*	.24*	.30
4. Student Attitude				--	.42*	.01
5. Satisfaction					--	.27
6. Direct Participation						--

p < .05.

satisfaction. The relationship of perceptions of individual interaction(PI) and perceptions of overall interaction (PO) which is non-significant for the computer-based environment but not statistically different from the two-way audio/one-way video environment's PI/PO coefficient also differs in this respect.

Research Questions Nine and Ten

Research questions nine and ten sought to answer the question: which of the variables of student perceptions of individual interaction, perceptions of overall interaction, student attitude, observed interaction or direct participation predict student satisfaction in computer-based and two-way audio/one-way video distance learning environments?

The five predictor variables of perceptions of individual interaction, perceptions of overall interaction, student attitude, observed interaction and direct participation ability to predict satisfaction in each environment were studied under the following summary hypotheses:

(Ho9) Learner perceptions of individual interaction, perceptions of overall interaction, student attitude, observed interaction and direct participation do not predict satisfaction in a computer-based distance learning environment.

(Ho10) Learner perceptions of individual interaction, perceptions of overall interaction, student attitude, observed interaction and direct participation do not predict satisfaction in a two-way audio/one-way video distance learning environment.

Initial data screening revealed that the means and standard deviations of all variables were acceptably distributed with skewness and kurtosis values between +/- 1 and no out of range or missing values identified. Boxplots for each of the variables

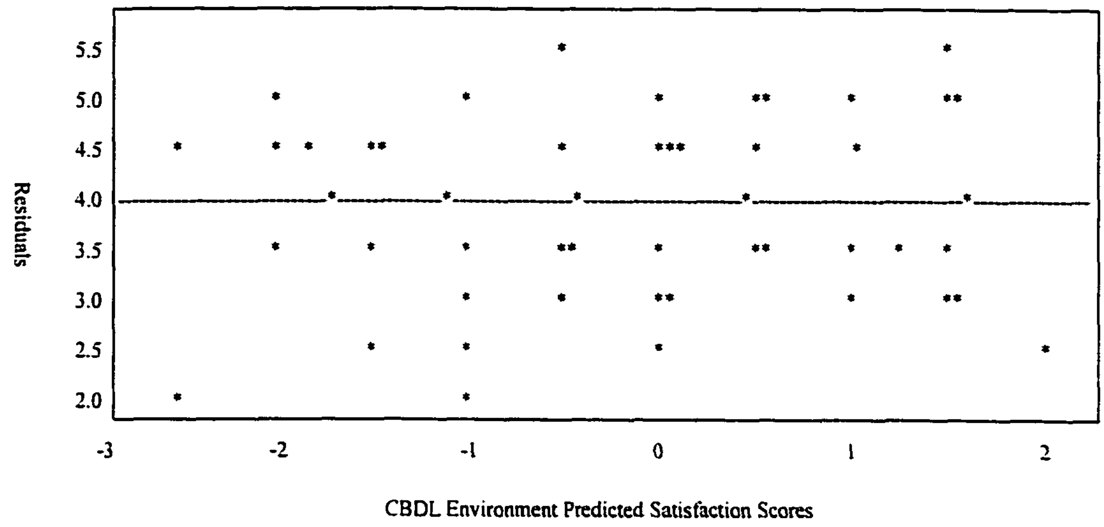


Figure 10. Computer-Based Environment Scatterplot of Residuals Against Regression Standardized Predicted Satisfaction Score Values.

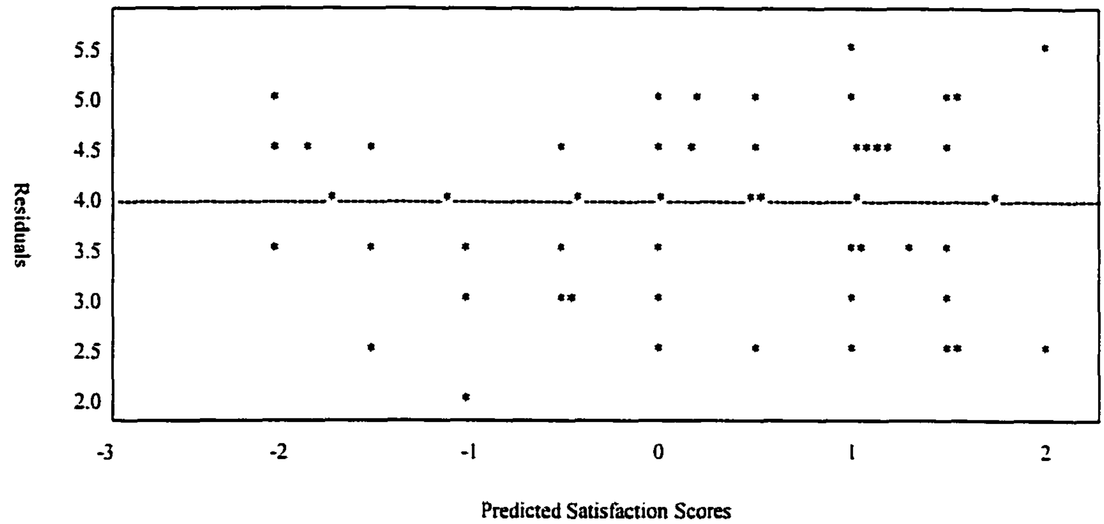


Figure 11. Two-Way Audio/One-Way Video Environment Scatterplot of Residuals Against Regression Standardized Predicted Satisfaction Score Values.

confirmed that there were no extreme univariate outliers (cases over three box-lengths from the upper and lower edge of the box). Analysis of the residuals scatterplot for computer-based and two-way audio/one-way video environments in Figures 10 and 11 respectively demonstrate that assumptions of normality (normal distribution around predicted scores, linearity (residuals have a linear relationship with predicted scores) and homoscedasticity (variance of residuals about the predicted scores) are tenable.

Analysis of the correlation matrix of possible predictor variables uncovered a collinearity problem with the subscale variables of perceptions of personal interaction and direct participation. These two variables had correlations in excess of .90 for each environment and inclusion of both variables would have seriously compromised the interpretability and power of the multiple regression's predictive capability. Therefore only one of the predictor variables, that of perception of individual interaction was selected for inclusion in the multiple regression because this variable's correlation with satisfaction was much higher (.57 versus .27 for TWA and .54 versus .20 for CBDL) than that of direct participation. The predictor variable of direct participation was omitted.

A standard multiple regression utilizing the stepwise method was performed using overall satisfaction as the criterion variable and nonordered predictor variables of perceptions of individual interaction, perceptions of overall interaction, student attitude and observed interaction. The results of the unstandardized regression coefficients (B), the standard errors of the predicted values (SE B), the standardized regression coefficients (β), and the t ratios for the computer-based environment are presented in Table 43.

Table 43

Summary of Standard Multiple Regression Analysis for Variables Predicting Satisfaction In A Computer-Based Distance Learning Environment

Variable	B	SE B	β	t
Step 3				
Student Attitude	.35	.08	.42	2.90*
Perceptions of Individual Interaction	.24	.11	.19	2.152*

Note. R = .79 and R^2 = .63.

N = 50

*p < .05.

The adjusted R^2 was .60. The multiple regression analysis yielded the following equation:

$$y' = 2.221 + .351\, x_1 + .248\, x_2$$

where y′ is the predicted satisfaction score, x_1 is student attitude and x_2 is perception of individual interaction.

The null hypothesis that the multiple regression in the population was zero was tested using an ANOVA. Table 44 provides a summary of this analysis. It provides the observed variability attributable to the regression (Regression) and the observed variability that was not attributable to the regression (Residual). The null hypothesis was disproved by the significance of the regression

Table 44

Analysis of Variance for the CBDL Regression Model

Source	dF	F
Regression	2	19.5*
Residual	47	

* $p < .05$

$N = 50$

Analysis of the tolerance for the significant predictor of student attitude was .649 with an accompanying variance inflation factor of 1.54 and for the predictor of perception of personal interaction a tolerance of .960 with a variance inflation factor of 1.04 demonstrating stable elements with low multicollinearity. The Durbin-Watson test was also used to test the assumption of independence of residuals. For this sample the Durbin-Watson statistic was 1.77 which implies a low degree of correlation between residuals with some degree of positive auto correlation occurring. Analysis of the residual scatterplot showed no curvilinear trend and found assumptions of normality, linearity and homoscedasticity to be tenable.

Another stepwise multiple was performed using overall satisfaction as the criterion variable and nonordered predictor variables of perceptions of individual interaction, perceptions of overall interaction, student attitude and observed interaction for the two-way audio/one-way video environment. Table 45 presents the results of the

Table 45

Summary of Standard Multiple Regression Analysis for Variables Predicting Satisfaction In A Two-Way Audio/One-Way Video Environment

Variable	B	SE B	β	t
Step 3				
Student Attitude	.39	.12	.47	3.16*
Perceptions of Individual Interaction	.39	.13	.36	2.96*

Note. $R = .65$ and $R^2 = .57$

$N = 51$

*$p < .05$.

unstandardized regression coefficient (B), the standard errors of the predicted values (SE B), and the standardized regression coefficients (β), and the t ratios for the two-way audio/one-way video environment.

The adjusted R^2 was .47. The multiple regression analysis yielded the following equation:

$$y' = 1.432 + .399\, x_1 + .394\, x_2$$

where y' is the predicted satisfaction score, x_1 is student attitude and x_2 is perception of individual interaction.

The null hypothesis that the multiple regression in the population was zero was tested using an ANOVA. Table 46 provides a summary of this analysis. It provides the observed variability attributable to the regression (Regression) and the observed variability that was not attributable to the regression (Residual). The null hypothesis was disproved by the significance of the regression

Table 46

Analysis of Variance for the TWA Regression Model

Source	dF	F
Regression	2	8.55*
Residual	48	

* $p < .05$

$N = 51$

Analysis of the tolerance for the significant predictor of student attitude was .562 with an accompanying variance inflation factor of 1.78 and for the predictor of perception of personal interaction a tolerance of .843 with a variance inflation factor of 1.18 demonstrating stable elements with low multicollinearity. The Durbin-Watson test was also used to test the assumption of independence of residuals. For this sample the Durbin-Watson statistic was 2.22 which implies a low degree of correlation between residuals. Analysis of the residual scatterplot showed no curvilinear trend and found assumptions of normality, linearity and homoscedasticity to be tenable.

Research Question 11

Research question eleven sought to answer the question: what is the difference between the predictors of satisfaction in computer-based and two-way audio/one-way video distance learning environments?

The difference between significant predictors of satisfaction between computer-based distance learning environments and two-way television environments was studied under the following hypothesis:

(Ho_{11}) There is no difference in the significant predictors of satisfaction between computer-based and two-way remote instruction environments.

A narrative analysis of the differences in the discoveries of significant predictors between the research findings for null hypotheses 9 and 10 uncovers that the null hypothesis of no difference is correct. Both environment's significant predictors were student attitudes and perception of individual interaction for the dependent variable of satisfaction. The B coefficients, which indicate that a higher score on the associated variable will increase the value of the dependent variable, were both positive and similarly valued for student attitude at .351 for the CBDL environment and .399 for the TWA environment. Perception of individual interaction in the CBDL environment was only 62% of the value of the same B value for the TWA environment, at .248 and .394, respectively, however. The Beta values, which are standardized scores that allow direct comparisons of the relative strengths of the relationships between variables in the regression equation demonstrate that perceptions of individual interaction make up less than half of the predictor portion of the equation in the computer-based environment while those same perceptions and student attitude are nearly equal in the two-way audio/one-way video environment (.198 to .426 for CBDL and .360 to .472 for TWA). Finally, the R^2 value that represents the proportion of the variation in the dependent variable that is explained by the independent variables was more significant in the CBDL environment over the TWA environment (.63 (adjusted: .60) to .57 (adjusted: 47)).

Research Questions 12 and 13

Research question twelve and thirteen sought to answer the question: do student perceptions of individual interaction, perceptions of overall interaction, student attitude, observed interaction, direct participation and satisfaction vary over time in computer-based and two-way audio/one-way video distance learning environments?

Each of the dependent variables variance over time was studied under the following hypotheses:

(Ho_{12}) Computer-based and two-way audio/one-way video (Ho_{13}) learner perceptions of individual interaction, perceptions of overall interaction, student attitude, observed interaction, direct participation and satisfaction do not vary significantly over time.

A 2 X 2 X 3 repeated measures Analysis of Variance (ANOVA) was conducted using the independent variable of environment (two levels; computer-based and two-way audio/one-way video), the independent variable of time (with three levels; beginning, midpoint and end of class measurements) and the independent variable of location (two levels; remote and main site) for each dependent variable. The main effect of environment, the main effect of time, the main effect of location and the interaction effects of environment over time, environment over location and location over time was analyzed for each of the dependent variables.

Tables 33 and 34 present the three trial means for computer-based distance learning and two-way audio/one-way video environments dependent variables respectively.

The assumption of normality of the distribution of residuals for perceptions of individual interaction was verified using the residual scatterplot. Mauchly's test of sphericity provided no evidence to disprove the null hypothesis that the error covariance matrix is proportional to, and not significantly different from, an identity matrix ($\underline{W}$ = .919, χ^2=8.09).

Table 47 shows the results of the repeated measures ANOVA for perceptions of individual interaction. It contains the sources of variation, the degrees of freedom and the $\underline{F}$ ratios. The between subjects null hypothesis tested was that there was no difference between environments rejected in an earlier two-way ANOVA was confirmed on the basis of the significant $\underline{F}$ ratio for the environment effect. The within subjects null hypothesis tested was that mean perceptions of individual interaction levels did not vary among the three trials. This null hypothesis was rejected on the basis of the significant within subject's $\underline{F}$ ratio for trial shown in Table 47. Additionally, a significant $\underline{F}$ ratio of trial by environment was discovered.

Table 47

Repeated Measures Analysis of Variance of Perception of Individual Interaction by Environment and Location

Source	SS	dF	MS	F
		Between Subjects		
Intercept	3531.29	1	3531.29	31.30**
Environment	333.96	1	333.96	29.66**
Location	2.34	1	2.34	2.07
Environment X Location	.388	1	.388	.344
Error	109.41	97	1.12	
		Within Subjects		
Trial	30.77	2	15.38	22.89**
Trial X Environment	25.34	2	12.67	18.89**
Trial X Location	1.21	2	.605	.900
Trial X Environment X Location	1.53	2	.768	1.14
Error	130.40	194	.672	

** $p < .01$

Trend analysis using orthogonal polynomial contrasts was conducted in order to identify the trend in the pattern of perceptions of individual interaction. Table 48 shows the results of this analysis by listing the linear and quadratic sources of variance by environment with their associated degrees of freedom and F ratios.

Table 48

Trend Analysis for Perceptions of Individual Interaction

	Environment			
	CBDL		TWA	
	df	F	df	F
Linear	1	68.05**	1	.040
Error	49	(.91)	50	(.49)
Quadratic	1	.02	1	1.36
Error	49	(.79)	50	(.42)

Note. Values in parentheses are mean square errors.

**$p < .001$

Table 48 displays a significant linear contrast and a non-significant quadratic contrast for computer-based environment subjects and both a non-significant linear and quadratic contrast for two-way audio/one-way video subjects.

Figure 12 shows that perceptions of individual interaction were consistently higher for CBDL subjects and relatively flat across trials one and two, with a linear increase and increased positive value at trial three for CBDL subjects.

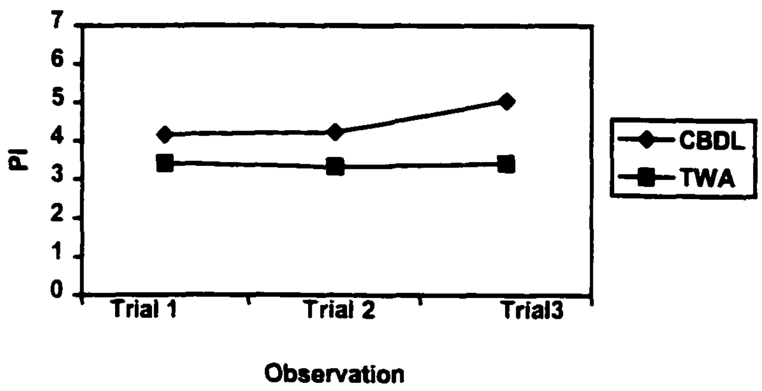


Figure 12. Trend line for perceptions of individual interaction.

The assumption of normality of the distribution of residuals for perceptions of overall interaction was verified using the residual scatterplot. Mauchly's test of sphericity provided evidence of departure from the assumption of sphericity disproving the null hypothesis that the error covariance matrix is proportional to, and not significantly different from, an identity matrix ($W = .998$, $\chi^2 = .165$, $p < .05$) therefore the within subjects degrees of freedom were adjusted for the tests of significance (Huynh-Feldt ε = 1.00).

Table 49 shows the results of the repeated measures ANOVA for perceptions of overall interaction. It contains the sources of variation, the degrees of freedom and the F ratios. The between subjects null hypothesis tested was that there was no difference between environments confirmed in an earlier two-way ANOVA was again confirmed on the basis of the non-significant F ratio for the environment effect. The within subjects null hypothesis tested was that mean perceptions of individual interaction levels did not

Table 49

Repeated Measures Analysis of Variance of Perception of Overall Interaction by Environment and Location

Source	SS	dF	MS	F
		Between Subjects		
Intercept	3742.67	1	3742.67	14.23*
Environment	3.37	1	3.37	1.28
Location	2.30	1	2.30	.87
Environment X Location	2.13	1	2.13	.81
Error	254.98	97	2.62	
		Within Subjects		
Trial	15.941	2	7.97	5.88*
Trial X Environment	17.55	2	8.77	6.48*
Trial X Location	6.69	2	3.34	2.47
Trial X Environment X Location	7.05	2	3.52	2.60
Error	262.76	194	1.35	

* $p < .05$

vary among the three trials. This null hypothesis was rejected on the basis of the significant within subject's F ratio for trial and trial X environment shown in Table 49.

Trend analysis using orthogonal polynomial contrasts was conducted in order to identify the trend in the pattern of perceptions of overall interaction. Table 50 shows the results of this analysis by listing the linear and quadratic sources of variance by environment with their associated degrees of freedom and F ratios.

Table 50

Trend Analysis for Perceptions of Overall Interaction

	Environment			
	CBDL		TWA	
	df	F	df	F
Linear	1	.26	1	12.01**
Error	49	(1.38)	50	(.16)
Quadratic	1	4.10*	1	.46
Error	49	(1.43)	50	.(1.19)

Note. Values in parentheses are mean square errors.

*p < .05

**p < .001

Table 50 displays a significant quadratic contrast and a non-significant linear contrast for computer-based environment subjects and a significant linear and non-significant quadratic contrast for two-way audio/one-way video subjects.

Figure 13 shows that perceptions of overall interaction were similar and linear for both CBDL and TWA environment subjects across trials one and two, with a quadratic and lower third trial trend for CBDL environment and an opposite linear increase at trial three for TWA environment subjects.

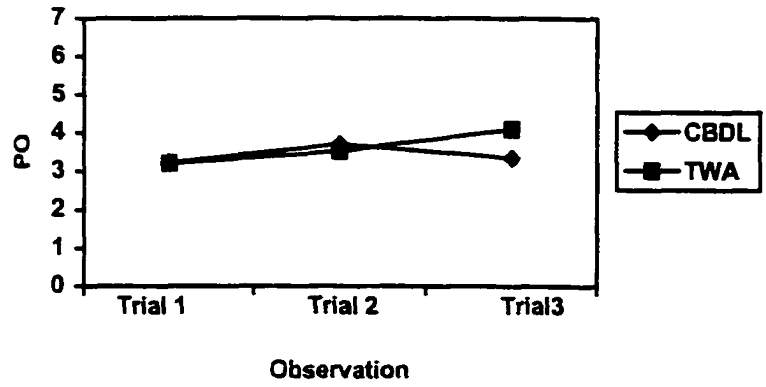


Figure 13. Trend line for perceptions of overall interaction

The assumption of normality of the distribution of residuals for observed interaction was verified using the residual scatterplot. Mauchly's test of sphericity provided no evidence of departure from the assumption of sphericity proving the null hypothesis that the error covariance matrix is proportional to, and not significantly different from, an identity matrix ($W = .445$, $\chi^2 = 77.78$).

Table 51 shows the results of the repeated measures ANOVA for observed interaction. It contains the sources of variation, the degrees of freedom and the F ratios. The between subjects null hypothesis tested was that there was no difference between environments rejected in an earlier two-way ANOVA was again rejected on the basis of the significant F ratio for the environment effect. The within subjects null hypothesis tested was that mean perceptions of individual interaction levels did not vary over

Table 51

Repeated Measures Analysis of Variance of Observed Interaction by Environment and Location

Source	SS	dF	MS	F
		Between Subjects		
Intercept	4044.59	1	4044.59	19.58*
Environment	9.08	1	9.08	4.40*
Location	.47	1	.47	.476
Environment X Location	5.60	1	5.60	.02
Error	200.36	97	2.06	
		Within Subjects		
Trial	8.34	2	4.17	9.77*
Trial X Environment	1.53	2	.75	1.76*
Trial X Location	.41	2	.20	.48
Trial X Environment X Location	.45	2	.22	.52
Error	82.79	194	.42	

* $p < .05$

among the three trials. This null hypothesis was rejected on the basis of the significant within subject's F ratio for trial and trial X environment shown in Table 51.

Trend analysis using orthogonal polynomial contrasts was conducted in order to identify the trend in the pattern of perceptions of observed interaction. Table 52 shows the results of this analysis by listing the linear and quadratic sources of variance by environment with their associated degrees of freedom and F ratios.

Table 52

Trend Analysis For Observed Interaction

	Environment			
	CBDL		TWA	
	df	F	df	F
Linear	1	.260	1	12.01**
Error	49	(1.40)	50	(.16)
Quadratic	1	4.10*	1	.46
Error	49	(1.43)	50	.(1.19)

Note. Values in parentheses are mean square errors.

*p < .05

**p < .001

Table 52 displays a significant quadratic contrast and a non-significant linear contrast for computer-based environment subjects and a significant linear and non-significant quadratic contrast for two-way audio/one-way video environment subjects.

Figure 14 shows that perceptions of observed interaction were similar and linear for both CBDL and TWA environment subjects across trials one and two, with a quadratic and lower third trial trend for CBDL environment and an opposite linear increase at trial three for TWA environment subjects.

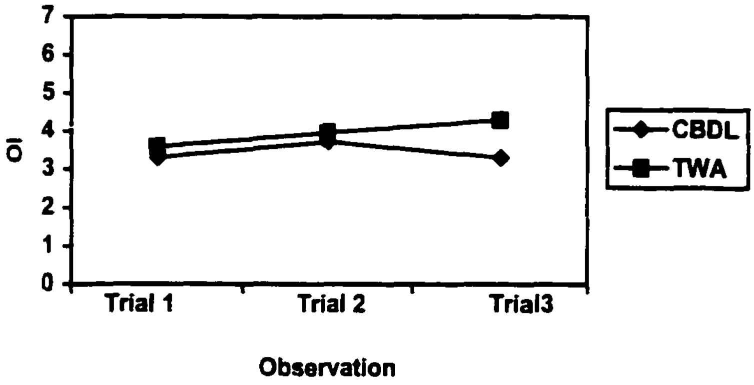


Figure 14. Trend line for observed interaction

The assumption of normality of the distribution of residuals for student attitude was verified using the residual scatterplot. Mauchly's test of sphericity provided no evidence of departure from the assumption of sphericity proving the null hypothesis that the error covariance matrix is proportional to, and not significantly different from, an identity matrix ($W = .998$, $\chi^2 = 1.175$).

Table 53 shows the results of the repeated measures ANOVA for student attitude. It contains the sources of variation, the degrees of freedom and the F ratios. The between subjects null hypothesis tested was that there was no difference between environments confirmed in an earlier two-way ANOVA was confirmed on the basis of the non-significant F ratio for the environment effect. The within subjects null hypothesis tested was that mean perceptions of individual interaction levels did not vary among the three trials. This null hypothesis was confirmed on the basis of the non-significant within subject's F ratio for trial shown in Table 53.

Table 53

Repeated Measures Analysis of Variance of Student Attitude by Environment and Location

Source	SS	dF	MS	F
		Between Subjects		
Intercept	4396.47	1	4396.47	2.09
Environment	10.10	1	10.10	4.82
Location	8.87	1	8.87	4.27
Environment X Location	2.59	1	2.59	1.23
Error	199.49	97	2.10	
		Within Subjects		
Trial	.98	2	.49	.51
Trial X Environment	.68	2	.34	.35
Trial X Location	1.75	2	.88	.91
Trial X Environment X Location	1.52	2	.76	.78
Error	183.00	194	.96	

Trend analysis using orthogonal polynomial contrasts was conducted in order to identify the trend in the pattern of perceptions of individual interaction. Table 54 shows the results of this analysis by listing the linear and quadratic sources of variance by environment with their associated degrees of freedom and F ratios.

Table 54

Trend Analysis for Student Attitude

	Environment			
	CBDL		TWA	
	df	F	df	F
Linear	1	.261	1	12.01
Error	49	(1.38)	50	(1.65)
Quadratic	1	4.10	1	.46
Error	49	(1.43)	50	(1.19)

Note. Values in parentheses are mean square errors.

Table 54 displays a flat and stable trend for both the CBDL and TWA environments and a non-significant quadratic contrast for both computer-based and two-way audio/one-way video environment subjects.

Figure 15 shows that student attitudes were consistently similar and linear for both environment subjects across all three trials.

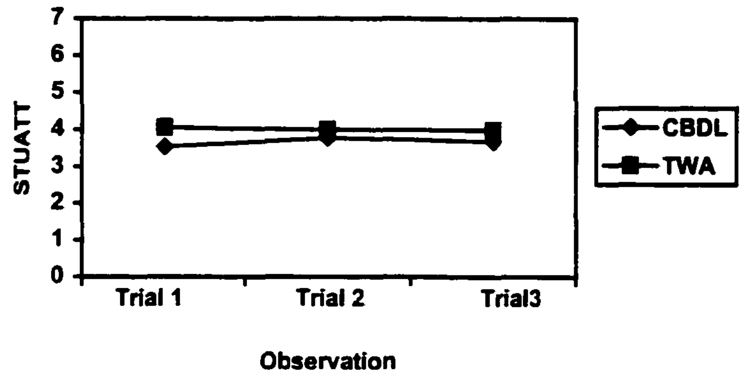


Figure 15. Trend line for student attitude.

The assumption of normality of the distribution of residuals for perceptions of satisfaction was verified using the residual scatterplot. Mauchly's test of sphericity provided no evidence of departure from the assumption of sphericity to disprove the null hypothesis that the error covariance matrix is proportional to, and not significantly different from, an identity matrix (W = .994, χ^2=.601).

Table 55 shows the results of the repeated measures ANOVA for perceptions of satisfaction. It contains the sources of variation, the degrees of freedom and the F ratios. The between subjects null hypothesis tested was that there was no difference between environments confirmed in an earlier two-way ANOVA was again confirmed on the basis of the non-significant F ratio for the environment effect. The within subjects null hypothesis tested was that mean perceptions of individual interaction levels did not

Table 55

Repeated Measures Analysis of Variance of Satisfaction by Environment and Location

Source	SS	dF	MS	F
		Between Subjects		
Intercept	4772.72	1	4772.72	3.10
Environment	24	1	.24	.16
Location	.11	1	.11	.07
Environment X Location	.56	1	.56	.36
Error	149.33	97	1.54	
		Within Subjects		
Trial	3.41	2	1.71	.02
Trial X Environment	2.693	2	1.34	2.25
Trial X Location	.246	2	.12	.20
Trial X Environment X Location	1.06	2	.53	89
Error	115.83	194	.59	

vary among the three trials. This null hypothesis was confirmed on the basis of the non-significant within subject's F ratio for trial shown in Table 55.

Trend analysis using orthogonal polynomial contrasts was conducted in order to identify the trend in the pattern of perceptions of satisfaction. Table 56 shows the results of this analysis by listing the linear and quadratic sources of variance by environment with their associated degrees of freedom and F ratios.

Table 56

Trend Analysis for Satisfaction

	Environment			
	CBDL		TWA	
	df	F	df	F
Linear	1	.100	1	.482
Error	49	(.62)	50	(.65)
Quadratic	1	1.96	1	1.38
Error	49	(.55)	50	(.54)

Note. Values in parentheses are mean square errors.

Figure 16 shows that perceptions of individual interaction were similar and linear for both CBDL and TWA environment subjects across trials one and two and three.

The assumption of normality of the distribution of residuals for direct participation was verified using the residual scatterplot. Mauchly's test of sphericity provided evidence of departure from the assumption of sphericity confirming the null hypothesis that the error covariance matrix is not proportional to, and is significantly different from, an identity matrix ($W = .926$, $\chi^2 = 7.52$, $p < .05$) therefore the within subjects degrees of freedom were adjusted for the tests of significance (Huynh-Feldt $\varepsilon = .978$).

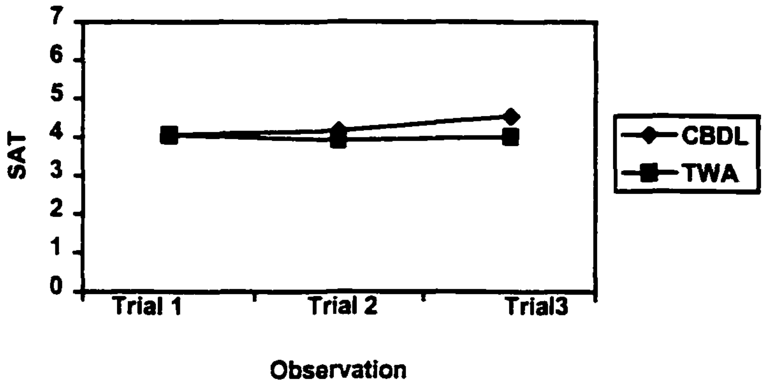


Figure 16. Trend line for satisfaction.

Table 57 shows the results of the repeated measures ANOVA for perceptions of direct participation. It contains the sources of variation, the degrees of freedom and the F ratios. The between subjects null hypothesis tested was that there was no difference between environments rejected in an earlier two-way ANOVA was again rejected on the basis of the significant F ratio for the environment effect. The within subjects null hypothesis tested was that mean perceptions of individual interaction levels did not vary among the three trials. This null hypothesis was rejected on the basis of the significant within subjects' F ratio for both trial and trial x environment shown in Table 57.

Trend analysis using orthogonal polynomial contrasts was conducted in order to identify the trend in the pattern of perceptions of direct participation. Table 58 shows the results of this analysis by listing the linear and quadratic sources of variance by environment with their associated degrees of freedom and F ratios.

Table 57

Repeated Measures Analysis of Variance of Direct Participation by Environment and Location

Source	SS	dF	MS	F
		Between Subjects		
Intercept	3382.52	1	3382.52	26.09*
Environment	346.79	1	346.79	26.7*
Location	1.46	1	1.46	1.12
Environment X Location	.58	1	.58	.45
Error	125.75	97	1.29	
		Within Subjects		
Trial	36.48	2	18.24	24.48**
Trial X Environment	25.64	2	12.82	17.20**
Trial X Location	1.09	2	.54	.73
Trial X Environment X Location	1.57	2	.78	1.05
Error	144.56	194	.74	

** $p < .01$

Table 58 displays a significant quadratic contrast for computer-based environment and a non-significant linear and quadratic contrast for two-way audio/one-way video environment subjects.

Figure 17 shows that perceptions of individual interaction were similar and linear for both CBDL and TWA environment subjects across trials one and two but CBDL scores took a strong but non-significant upward trend at trial three.

Table 58

Trend Analysis for Direct Participation

	Environment			
	CBDL		TWA	
	df	F	df	F
Linear	1	2.341	1	.003
Error	49	(1.22)	50	(1.13)
Quadratic	1	2.05*	1	1.28
Error	49	(1.08)	50	(.65)

Note. Values in parentheses are mean square errors.

*$p < .05$

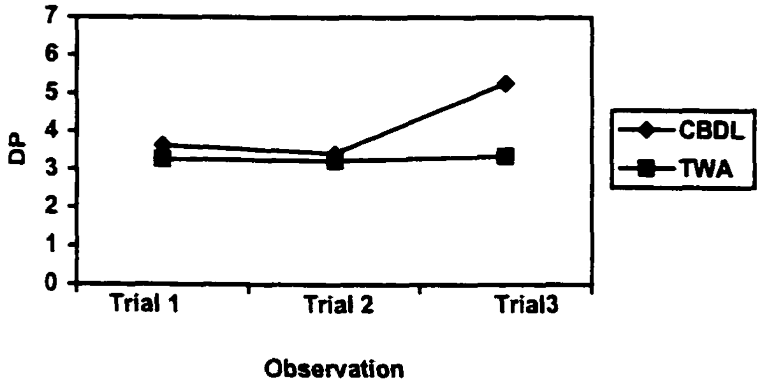


Figure 17. Trend line for direct participation.

Research Question 14

Research question fourteen sought to answer the question: what instrument could be developed to aid assessment of interactional events in distance education computer-based remote instruction environments? The hypertext markup language instrument code, protocol, methodology of preliminary testing and results of preliminary testing are provided separately in Appendix F.

In summation, computer-based distance learning means for the dependent variables student perceptions of individual interaction and direct participation were found to be higher and statistically significant from those perceptions in the two-way audio/one-way video environment. Observed interaction in the two-way audio/one-way video environment was found to be higher and statistically significant from the measures of this dependent variable in the computer-based environment.

Significant predictors of satisfaction were perceptions of individual interaction and student attitude for both environments. Chapter V elaborates on these findings.

CONCLUSIONS

Introduction

Chapter V consists of: (a) a summary of the significant findings of this study, (b) a discussion and interpretation of the results of the pilot study and the main study, (c) a description of the implications of the findings, and (d) suggestions for further research.

This study sought to answer the following questions using quasi-experimental methodologies:

1. What effects does a computer-based distance learning environment have on subject perceptions of individual and overall interaction, satisfaction, attitude, observed interaction and direct participation over three observations in a semester period?
2. What effects does a two-way audio/one-way video distance learning environment have on subject perceptions of individual and overall interaction, satisfaction, attitude, observed interaction and direct participation over three observations in a semester period?
3. Which, if any, of the factors of student perception of individual interaction, overall interaction, student attitude, observed interaction and direct participation predicts subject satisfaction in a computer-based distance learning environment?
4. Which, if any, of the factors of student perception of individual interaction, overall interaction, student attitude, observed interaction and direct participation predicts student satisfaction in a two-way audio/one-way video distance learning environment?
5. What are the measured differences between predictors of satisfaction and perceptions of personal and overall interaction, satisfaction, attitude and student observations of overall classroom interaction in computer-based and two-way audio/one-way video television distance education environments?

6. What type of automated interactional event analysis tool can be developed to quantify events occurring in a computer-based distance learning environment and frame them to overall and individual perceptions of interaction?

Pilot Study

The pilot study provided evidence that the dependent variables of perceptions of individual interaction, perceptions of overall interaction, observed interaction, direct participation, student attitude and satisfaction were manifested in the populations under study in sufficient amounts to proceed with the main study. The pilot study yielded evidence validating test instrument reliability among the previously untested population of computer-based students and provided a new instrument baseline comparison with students in a traditional learning environment. The pilot study also ascertained what corrections and refinements were necessary to decrease mortality, simplify administration of the test and clarify procedures. Minor modifications to refine the demographic collection instrument were incorporated.

The pilot study sample population compared equitably to main study sample population participants. Slightly more pilot study participants were male (83.4% in the pilot study vice 79.2% in the main study) and slightly less were female (16.6% vice 20.79%). Pilot study ethnicity was 6% less Caucasian than the main study with the missing percentages consisting primarily of an increased Asian population of 5.7%. African American and other ethnicities differed only slightly in the pilot study by .2% and .3% respectively.

Reliability data collected in the pilot study concentrated on increasing the generalizability and determining the validity of the instrument author's original reliability findings by producing reliability estimates on both a traditional classroom environment and on a computer-based distance learning environment. Reliability findings using Chronbach's coefficient alpha for the traditional environment were adjudged both sufficient and consistently higher across all dependent variables measured than those reported by the instrument authors for their own study's two-way audio/one-way video environment population subjects. Traditional classroom environment dependent variable reliability estimates were also higher than those for the computer-based distance learning environment subjects introduced in this particular study. Single scale variable measures of skewness and kurtosis deviate less from zero for the traditional environment than those same measures of the computer-based distance learning population's dependent variables. All single scale variables measured in both environments deviated less than a positive or negative 2 from zero suggesting normality of distribution. Reliability coefficients for each environment measured .6995 or above suggesting, at a minimum, good reliability in their estimating ability. To confirm the assumption of reliability for all samples under study, reliability estimates were made at trial one in the main study once again for the two-way audio/one-way video environment using Chronbachs coefficient alpha. Non-standardized coefficients ranged from .7573 to .8245 affirming sufficiency in their reliability and with acceptable skewness and kurtosis deviations for the single-item scales.

These findings suggested evidence of acceptable instrument reliability for the newly introduced computer-based distance learning environment, relative generalizability of instrument reliability findings to a traditional classroom environment and provided reliability findings for the two-way audio/one-way video environment that were acceptable and consistent with the original instrument author's findings.

Main Study

A quasi-experimental design was used to determine how different learning environments affected perceptions of individual interaction, perceptions of overall interaction, observed interaction, direct participation and satisfaction over time. Analysis of variance of the mean scores for these five dependent variables summed across three trials, correlation analysis of the dependent variables summed across three trials, multiple regression utilizing the predictor variables of all the dependent variables (with the exception of direct participation) and repeated measures of the five dependent variables conducted over three observations in three separate thirteen-week intervals were conducted. One hundred and one subjects were exposed to the two treatment environments, 50 in the computer-based distance learning (CBDL) environment and 51 in the two-way audio/one-way video (TWA) environment. Study results were obtained across a cross section of upper division computer science courses within both the computer-based distance learning environment and the two-way audio/one-way video distance learning environments. Sample subjects in the computer-based environment were stratified across four courses of instruction while two-way audio/one way video environment courses were stratified across three.

The modal study subject was a Caucasian male, 25 years old with senior standing having one previous computer-based environment course experience and one previous two-way audio/one-way video course experience. The ethnic makeup of the two environments was remarkably similar. A majority of both environment's study participants were Caucasian (60.8% TWA/66% CBDL) with Asian (15.7%TWA/10% CBDL) and African-American (9.8% TWA/6% CBDL) completing the remaining ethnic demography. Ethnicity listed as other made up the remaining demography for the two-way audio/one-way video environment participants while the CBDL environment differed in that participants chose Hispanic ethnicity at 7.8%. The difference in mean age was similar between the two environments, differing by only .56 years. The mean age was 25.72 years for the two-way audio/one-way video environment participants and 26.28 years for the computer-based environment participants. Gender findings were very consistent between the two environments with roughly an equal 81% male, 21% female diversity for both environments.

Subjects in both environments were similarly experienced with fifty-nine percent of the two-way audio/one-way video environment participants having an average of 2.4 hours of two-way audio/one-way video environment classroom experience compared with 1.9 hours for fifty-eight percent of the computer-based environment subjects. Forty-three percent of the two-way audio/one-way video environment participants had an average of 1.26 hours of computer-based environment classroom experience compared with 2.1 hours for forty percent of the computer-based environment subjects.

These findings suggest evidence of considerable demographic similarity between the two populations under study in terms of gender, ethnicity, age and familiarity with the environments in which they were participating. Knowledge of the study's other environment (either the computer-based distance learning or two-way audio/one-way video environment dependent upon the sample questioned) was also similar with 52.94% of the TWA subjects and 64% of the CBDL subjects.

Volunteers and Dropouts

One hundred and twelve subjects were enrolled across the seven courses under study. Eleven subjects or 9.82% of the possible pool of participants failed to complete all three trials of study. These subjects consisted of two computer-based and nine two-way audio/one-way video subjects representing 3.8% of the computer-based and 15% of the two-way audio/one-way video environment. This resulted in an overall return rate of 90.18% (96.2% CBDL, 85% TWA). There were no refusals to participate (non-volunteers). Data on completed trials by dropouts revealed that all study dropouts were males between the ages of 19 to 36. Eight dropouts listed their ethnicity as Caucasian (2 CBDL, 6 TWA), two as other and one was not listed (all TWA)

Dropouts were considered a possible source of bias. Statistical tests were conducted to determine whether dropouts differed from non-dropouts in the interval scale variables measured in the study. Missing values for dropouts were replaced utilizing the series mean method with the range of values consisting of trial instrument measurements conducted either prior to or after the missing values dependent upon availability of the measure. Independent sample t-tests were conducted to compare the means of dropouts and non-dropouts on the test instrument interval scales. Tables 24 and 25 present the results of this comparison by listing the relevant degrees of freedom, means, standard deviations and t ratios for both the computer-based and two-way audio/one-way video environments respectively. These tests revealed no significant differences between dropouts and non-dropouts on any of the interval scale variables tested when either equal variances or non-equal variances were assumed. Levene's test for equality of variance showed that the interval scale variable of perceptions of overall interaction was violated among computer-based dropouts and computer-based non-dropouts (F= 4.376, p = .041). Consequently the Mann-Whitney U test, a nonparametric equivalent to the independent samples t test was conducted to test the hypothesis that the dropouts differed from the non-dropouts on this particular variable. This test resulted in a U of 46 and a non-significant p = .813. Further tests using series means interjected values for the correlation matrix and multiple regression analysis caused only minor changes in the multiple regression equation (between .00 and .05) for both environments and no changes in the significant predictors. No significant differences at the .05 alpha level were found on demographic variables between volunteers (N = 101) and dropouts for whom complete demographic data was available (N = 9). Consequently, there was no evidence of bias between volunteers and dropouts in the study.

Test Administration Procedures

No meaningful problems were experienced with test administration procedures during either the pilot or the main study. Due to conflicting class schedules, trial three of CS 451/551 in the two-way audio/one-way video environment required presentation of surveys at the start of class with actual collection following the end of the class. There was no loss of data. Subject orientation was conducted utilizing guidance contained in Appendix A in order to conduct uniform data collection and provide the same level of orientation and explanation to all subjects. Subjects were not required to repeat demographic data duplicated in various parts of the instruments. All subscales were included as part of a single instrument along with informed consent and pre-study documents in trial one and post-study documents in trial three. Instrumentation was administered to all volunteers by group during normally scheduled class sessions.

Students were interviewed collectively by group in smaller classes and individually as they submitted the questionnaires with minor variation dependent upon ongoing classroom activities. The only significant change to procedures occurred over time as the researcher was required to either sit in on courses to collect non-interfering interactional observation data or to ensure his/her availability at the day's course conclusion. No interview or statistical evidence was found to suggest that orientation or data collection procedures caused significant researcher effects or bias in the results.

Analysis of Variance

Separate 2 X 2 analysis of variance for each of the dependent variables of perceptions of overall interaction, observed interaction, satisfaction, student attitude, perceptions of individual interaction and direct participation were computed for each environment utilizing the independent variables of environment (two levels; computer-based and two-way audio/one-way video) and location (two levels; main site and remote).

Research questions were studied under the null hypotheses that there is no difference between learner perceptions of these dependent variables and the two environments. The mean score of three trials was utilized to obtain an average score in determining environmental differences. The researcher sought to discern whether the increasing technology involved at the remote sites may have caused differing perceptions of the dependent variables, therefore the independent variable of location was also introduced at this juncture.

The assumption of no extreme outliers was tenable for each of the dependent variables. None of the subject scores was more than 3 box-lengths from the lower edge of a measured variable's box plot. The assumption of normality of distribution of the residuals was verified by an examination of residuals scatterplots for each dependent variable. The assumption of independence of observations between subjects was found tenable. Subjects did not discuss results among each other during surveys. Administrative procedures outlined in the study proposal were adhered to with only minor or no deviations and instructor/researcher influence was minimized to the point of non-interference.

The null hypothesis that there was no differences among subjects (N = 101) was rejected for : (a) Perceptions of Individual Interaction (PI), F (1, 97) = 8.799 (see table 36); (b) Observed Interaction (OI), F (1, 97) = 11.420 (see table 38); and Direct Participation (DP), F (1, 97) = 7.493 (see table 41), p<.05. The computer-based distance learning environment had a higher mean for perceptions of individual interaction at 4.47 than the two-way audio/one-way video environment at 3.38. Observed interaction was higher for two-way audio/one-way video participants with 3.96 versus 3.43 for computer-based distance learners. Direct participation was rated higher among computer-based distance learners than two-way audio/one-way video distance learners (mean score of 4.41 Vs 3.28).

Neither the independent variable of location nor the interaction effect of location over environment was found to be significantly different. Furthermore, no significant differences between subject satisfaction and attitude were found among the independent variables of location and environment.

Each separate class in the study was entered as an independent variable in a univariate analysis of variance for each of the significant dependent variable described above. Class was found to be significant, F (6, 94) = 55.875. Scheffe Post Hoc tests revealed that each computer-based course differed significantly from each of the other two-way audio/one way video courses. Subject gender was not significant in perceptions of individual interaction in either environment, F (1, 99) = .294. Subject ethnicity was also non-significant in perceptions of individual interaction for either environment, F (4, 96) = .204.

The independent variable of class was significant for observed interaction, F (6, 94) = 4.802. Each two-way audio/one-way video course differed significantly higher than each of the other computer-based distance learning courses utilizing Scheffe's post hoc analysis. Subject gender was found to be non-significant F (1, 99) = 1.77. Subject ethnicity was also found non-significant in observed interaction, F (4, 96) = .580.

For the dependent variable of direct participation, the independent variable of class was found to be significant, F (6, 94) = 4.802. Scheffe's post hoc analysis revealed significant difference between computer-based distance learning and two-way audio/one-way video environments to hold true for all courses except CS451, where no significant differences were found. Subject gender was found non-significant, F (1, 99) = .245. Subject ethnicity was also found non-significant, F (4, 97) = .1.513.

Correlation Analysis

Correlation analysis beyond that conducted as part of multiple regression analysis was undertaken to discern how the predictor variables varied in their inter-relationships between the two environments. Based upon the Pearson's product-moment correlation (Pearson's r) matrix for each environment presented in Table 42, Correlation means using Fisher Z transformations were computed for each dependent variable's aggregate score across three trials. This calculation was based on the premise that if there are two correlation's computed from data that were gathered from two separate groups of individuals, the correlation coefficients will be experimentally independent. Fisher Z transformations determine the significance of correlation coefficient differences between samples on like data and were conducted in this study utilizing the procedures contained in Bruning and Kintz (1997) Computational Handbook of Statistics.

As expected, Perceptions of Individual Interaction and Direct Participation, which share seven of eight scale items for either environment were highly correlated (r > .99 for the two-way audio/one-way video environment and r >.98 for the computer-based environment). The relationships between these two variables held steady and did not vary significantly between the two environments.

The variables of perceptions of overall interaction and observed interaction which are semantically similar but do not share like items like perceptions of individual interaction and direct participation were also found to be highly correlated with an r >.77 for the two-way audio/one-way video environment and an r>.74 for the computer-based environment. The relationships between these two variables also held steady and did not vary significantly between the two environments.

The correlation coefficients of perceptions of personal interaction and student attitude and perceptions of overall interaction and satisfaction were found to have significant Fisher z-score of .341 and .241 respectively, providing evidence that the relationships between the two variables involved differ significantly among the two environments. The correlation coefficient for personal interaction and student attitude for two-way audio/one-way video environments was higher than the computer-based environment by .06. For overall interaction and satisfaction the coefficient for two-way audio/one-way video environments was more than double the computer-based environment's (.55 to .24).

In summary, perceptions of individual interaction and direct participation and perceptions of overall interaction and observed interaction were highly correlated for both environments and in essentially equal amounts. Perceptions of individual interaction's relationship with student attitude in the two-way audio/one-way video environment was significantly different than that same relationship in the computer-based environment and had a higher z score (by .06). Since student attitude and perceptions of individual interaction are both significant predictors of satisfaction for both environments, these findings may suggest that computer-based distance learners student attitudes are made up of slightly broader components than the two-way audio/one-way video environments. Overall interaction and satisfaction relationship for the two-way audio/one-way video environment was significantly different than that for the computer-based environment by more than double the Z score (.55 to .24). Overall interaction did not make inclusion in the regression equation for either environment. The regression analysis conducted after this discussion revealed a majority of the residual variance in the prediction equation was made up of observed interaction and perceptions of individual interaction for two-way audio/one way video subjects while computer-based distance learning students residual variance consisted of equal amounts of perceptions of overall interaction, perceptions of individual interaction and observed interaction.

Multiple Regression Analysis

Flanders (1965) theorized direct participation and active engagement of the individual to be important components of student talk /teacher talk and direct/indirect influence in the learning environment. Interaction perceived by the student learners at their own individual levels and at the overall level of the class was theorized by Fulford and Zhang (1993) to predict satisfaction in a televised environment. Biner and Mellinger (1994) and Zhang (1994) among others included student attitude as an important predictor of satisfaction in both televised and traditional courses. The predictors selected for this analysis include all of the above components except the variable of direct participation which demonstrated significant collinearity with the predictor of perceptions of individual interaction utilized in the most appropriate instrument for the study. These two variables had correlations in excess of .90 for each environment and inclusion of both variables would have seriously compromised the interpretability and power of the multiple regression's predictive capability. Therefore only one of the predictor variables, that of perception of individual interaction was selected for inclusion in the multiple regression. This variable's correlation with satisfaction was much higher (.57 vice .27 for TWA and .54 vice .20 for CBDL) than that of direct participation.

A stepwise multiple regression was performed using overall satisfaction as the criterion variable and the three trial average of the nonordered predictor variables of perceptions of individual interaction, perceptions of overall interaction, student attitude and observed interaction. The results of the unstandardized regression coefficients (B), the standard errors of the predicted values (SE B), the standardized regression coefficients (β), and the t ratios for the computer-based environment were presented in

Table 43. Tabachnik and Fidell (1989) recommend a cases to predictor ratio of at least 5 times greater the number of cases than predictors. using this criterion, 20 subjects were required for each analysis. Since 50 and 51 cases were found for each environment, this requirement was fully met. The relationship between the predictor variables and the criterion variable for both environments overall was significant, $F\ (4, 96) = 47.56$, $p < .05$. For each individual environment the relationships were also significant, $F\ (4, 45) = 19.5$, $p < .05$ for the CBDL environment and $F\ (4, 47) = 8.55$, $p < .05$ for the TWA environment.

Regression assumptions of distribution, linearity and homoscedasticity were tenable from observations of the residuals plot in Figures 10 and 11. The shape of the scatterplot for each environments group of residuals is rectangular and of equal width demonstrating linearity and homoscedasticity respectively with normal distribution demonstrated by a preponderance of residuals in the center of the plot.

The multiple regression analysis for the computer-based distance learning environment yielded the following equation:

$$y' = 2.221 + .351\ x_1 + .248\ x_2$$

where y' is the predicted satisfaction score, x_1 is student attitude and x_2 is perception of individual interaction.

The multiple regression analysis for the two-way audio/one-way video environment yielded the following equation:

$$y' = 1.432 + .399\ x_1 + .394\ x_2$$

where y' is the predicted satisfaction score, x_1 is student attitude and x_2 is perception of individual interaction.

Student attitude played a large part in resultant satisfaction of subjects in both environments. In the two-way audio environment student attitude, $\beta = .472$ and in the computer-based environment, $\beta = .426$. Individual interaction was also found to be a significant predictor for both environments with a β value of .198 and .360 in the computer-based and two way audio/one-way video environments respectively. Taken together, the R2 value that represents the proportion of the variation in the dependent variable that is explained by the independent variables was .63 (adjusted: .60) for the CBDL environment and .57 (adjusted: 47) for the TWA environment. The other variables in the prediction equation did not account for any significant additional variance. These findings are consistent with Fulford and Zhang's (1993) findings. In their study student centered perceptions also predicted satisfaction. These findings are additionally consistent with the student-centered premise of Flander's theory of Interaction Analysis (1965) (see chapter II). The inability of perceptions of overall interaction and observed interaction to predict satisfaction may possibly be explained by their close relationship, $r = .53$ (TWA) and .61 (CBDL).

Cross validation, as recommended by Kachigan (1986) to determine the utility of the regression equation was conducted for each environment. The regression equation for semester one CBDL students (screening sample) was used to predict semester two CBDL students' scores (calibration sample) and the regression equation for semester two TWA students was used to predict semester three TWA students' scores. The Pearson r for the CBDL screening and calibration sample was .74 resulting in an estimated R^2 equal to .59. For the TWA sample the Pearson r for the screening and calibration sample was .81

resulting in an estimated $\underline{R}^2$ equal to .64. Estimated shrinkage for the CBDL environment was $\Delta\underline{R}^2 = .04$ and for the TWA environment: $\Delta\underline{R}^2 = .07$, both considered acceptable.

These results confirmed the ability, among these predictor variables, to reliably predict satisfaction in both computer-based and two-way audio/one-way video distance learning environments. The regression analysis however cannot be used to imply causal relationships because random assignment of the sample for either environment was not achieved. Additionally, even though the tenability of assumptions upon which the regression assumption is based appear well founded, no assurance can be made that the equation will be precise for a specific sample population.

Repeated Measures Analysis of Variance

Mauchly's test of sphericity (variances of differences between pairs of repeated measure factor levels are equal) provided no evidence to disprove the null hypothesis that the error covariance matrix is proportional to, and not significantly different from, an identity matrix in the analysis of variance for perceptions of individual interaction, observed interaction, student attitude and satisfaction. Measures of the perceptions of overall interaction and direct participation violated the assumption of sphericity (α is greater than $\underline{p}$). For these measures, the degrees of freedom used to calculate the within subjects effects utilized Huhn-Feldt ε which compensates for the amount of departure from sphericity.

Between Subjects Effects

The null hypotheses that there were no differences among environments ($\underline{N}$ = 101) was rejected for: (a) perceptions of individual interaction, $\underline{F}$ (1, 97) = 296.06 (see Table 47); (b) observed interaction, $\underline{F}$ (1, 97) = 4.40 (see Table 51); and (c) direct participation, F (1, 97) = 267.49 (see Table 57), ps < .05. These findings provide evidence that perceptions of individual interaction, observed interaction and direct participation varied significantly between the two environments and confirmed the findings of the 2 X 2 analysis of variance conducted previously on the dependent variables mean averages.

Within Subjects Effects

The dependent variables of perceptions of individual interaction, perceptions of overall interaction, observed interaction and direct participation each demonstrated significant difference in both the main effect of trial and in the interaction effect of trial by environment. For perceptions of individual interaction, trial effect was F (2, 194) = 22.89 and the interaction effect of trial x environment was F (2, 194) = 18.89, ps <.05 (see Table 47). Pairwise comparisons for the computer-based environment found significant differences using the least significant differences method between the trial means' mean difference for trials 1 and 3 (.480) and trials 2 and 3 (.420), but not for trials and 1 and 2 (.132), p < .05.). Pairwise comparisons for the two-way audio/one-way video environment found significant differences using the least significant differences method between the trial means' mean difference for trials 1 and 3 (.480) and trials 2 and 3 (.420), but not for trials and 1 and 2 (.132), p < .05.Independent samples t-test determined significant differences between trials 1, t (99) = 6.91, p < .001, trial 2 , t (99) = 7.12, p < .001 and for trial 3, t (99) = 12.835, p < .001 between each environment. Table 48 displays a significant linear contrast and a non-significant quadratic contrast for computer-based environment subjects and both a non-significant linear and quadratic contrast for two-way audio/one-way video subjects. Trend analysis presented in Figure

12 demonstrates that perceptions of individual interaction were consistently higher for CBDL subjects and relatively flat across trials one and two, with a large linearly increased positive value at trial three for CBDL subjects. Trial three showed a mean value of 5.28 for CBDL and 2.41 for TWA environment subjects.

For perceptions of overall interaction, trial effect was $F(2, 194) = 5.88$ and the interaction effect of trial x environment was $F(2, 194) = 6.48$, ps <.05 (see Table 49). Mauchly's test of sphericity provided evidence of departure from the assumption of sphericity disproving the null hypothesis that the error covariance matrix is proportional to, and not significantly different from, an identity matrix ($W = .998$, $\chi 2=.165$, $p<.05$) therefore the within subjects degrees of freedom were adjusted for the tests of significance (Huynh-Feldt $\varepsilon = 1.00$).

Pairwise comparisons for the computer-based environment found significant differences using the least significant differences method between the trial means' mean difference for trials 1 and 2 (.380) and trials 2 and 3 (-.320), but not for trials and 1 and 3 (.175), $p < .05$.). Pairwise comparisons for the two-way audio/one-way video environment found significant differences using the least significant differences method between the trial means' mean difference for all trials (.312 trials 1 and 2, .400 trials 2 and 3 and 421 trials 1 and 3), $p < .05$. Independent samples t-test determined no significant differences between trials 1, $t(99) = 1.11$ and trial 2, $t(99) = .12$, but did find significant differences for trial 3, $t(99) = 19.38$, $p < .001$ between the environments. Table 50 displays a non-significant linear contrast and a significant quadratic contrast for computer-based environment subjects and a significant linear and non-significant quadratic contrast for two-way audio/one-way video subjects. Trend analysis presented in

Figure 13 demonstrates that perceptions of overall interaction were consistently similar and linear for CBDL and TWA subjects across trials one and two, with a large linearly increased positive value at trial three for TWA subjects and a large quadratic and negative downturn for CBDL students. Trial three showed a mean value of 3.34 for CBDL and 4.49 for TWA environment subjects.

For observed interaction, trial effect was F (2, 194) = 9.77 and the interaction effect of trial x environment was F (2, 194) = 1.76, ps <.05 (see Table 51). Pairwise comparisons for the computer-based environment found significant differences using the least significant differences method between the trial means' mean difference for trials 1 and 2 (.420) and trials 2 and 3 (-.430), but not for trials and 1 and 3 (.01), $p < .05$. Pairwise comparisons for the two-way audio/one-way video environment found significant differences using the least significant differences method between the trial means' mean difference for trials 1 and 3 (.380) and trials 2 and 3 (.320), and for trials and 1 and 3 (.700), $p < .05$.Independent samples t-test determined no significant differences between trials 1, t (99) = .91, $p < .001$, trial 2 , t (99) = .12, but did find significance at the .05 level for trial 3, t (99) = 8.75, $p < .05$ between each environment. Table 52 displays a non-significant linear contrast and a significant quadratic contrast for computer-based environment subjects and both a significant linear and non-significant quadratic contrast for two-way audio/one-way video subjects. Trend analysis presented in Figure 14 demonstrates that perceptions of observed interaction were similarly linear for CBDL and TWA subjects across trials one and two, with a large linearly increased positive value at trial three for TWA subjects and a negative trend for CBDL students.

Trial three showed a mean value of 3.29 for CBDL and 4.28 for TWA environment subjects.

For direct participation, trial effect was $F(2, 194) = 24.48$ and the interaction effect of trial x environment was $F(2, 194) = 17.20$, ps <.05 (see Table 57). Mauchly's test of sphericity provided evidence of departure from the assumption of sphericity confirming the null hypothesis that the error covariance matrix is not proportional to, and is significantly different from, an identity matrix ($W = .926$, $\chi^2 = 7.52$, $p < .05$) therefore the within subjects degrees of freedom were adjusted for the tests of significance (Huynh-Feldt $\varepsilon = .978$). Pairwise comparisons for the computer-based environment found no significant differences using the least significant differences method between the trial means' mean difference for trials 1 and 2 (.400) but found significance in the mean differences between trials 1 and 3 (2.26), and 2 and 3 (1.84), $p < .05$. Pairwise comparisons for the two-way audio/one-way video environment found no significant differences using the least significant differences method between the trial means' mean difference for trials 1 and 2 (.230), trials 2 and 3 (.220) and for trials and 1 and 3 (.270). Independent samples t-test determined significant differences between trials 1, $t(99) = 3.31$, $p < .001$, trial 2 , $t(99) = 3.12$, $p < .001$ and for trial 3, $t(99) = 9.675$, $p < .001$ between each environment. Table 58 displays a significant quadratic contrast and a non-significant linear contrast for computer-based environment subjects and both a non-significant linear and quadratic contrast for two-way audio/one-way video subjects. Trend analysis presented in Figure 17 demonstrated that perceptions of direct participation were consistently higher for CBDL subjects and relatively flat across trials one and two, with a large linearly increased positive value at trial three for CBDL subjects. Trial three showed a mean value of 5.27 for CBDL and 3.35 for TWA environment subjects.

No significant differences were found in the dependent variables of subject attitude, F (1, 97) = 4.250 and satisfaction, F (1,97) = .004 between the two environments either in overall scores or individually across three trials. Student attitude stayed flat and nominally higher across all three trials for two-way audio/one-way video environment subjects while a similarly flat and slightly lower score for student attitude was observed for computer-based distance learning subjects. Measurements of the dependent variable of satisfaction showed similar characteristics. Satisfaction scores were at remarkably similar levels with flat trends for both environments with no statistical differences in scores either overall or as a function of trial.

Summary

Research questions one through six sought to answer the questions: what are the differences between computer-based and two-way audio/one-way video environment subjects' perceptions of their level of individual interaction (1) overall interaction (2) level of satisfaction (3) attitudes (4) perceptions of their observed interactions (5) and perceptions of their direct participation (6)? Each question's null hypothesis was one of no difference between the environments. Research question twelve and thirteen sought to answer the questions: do student perceptions of the variables of individual interaction, perceptions of overall interaction, student attitude, observed interaction and direct participation vary over time in computer-based (research question 12) and two-way audio/one-way video (research question 13) environments?

Subjects in the two learning environments differed significantly in the three trial mean of their perceptions of individual interaction. At the conclusion of the study, computer-based distance learning environment subjects had a higher overall mean score on perceptions of individual interaction than did their two-way audio/one-way video counterparts. Perceptions of individual interaction were consistently higher (with statistical significance at the .05 alpha level) for computer based distance learning students across all three trials. Trends for both environments were similar and flat through trials one and two. A flat trend for perceptions of individual interaction continued to trial three for two-way audio/one-way video environment subjects but took a marked linear increase at trial three for computer-based students.

Perceptions of overall interaction followed an increasing linear trend for both environments through trials one and two with no significant differences in mean trial scores. While the overall mean scores for each environment did not vary significantly for this dependent variable, trial three's mean scores did demonstrate significant statistical difference at the .05 alpha level. At trial three perceptions of overall interaction continued a consistent upward linear trend for two-way audio/one-way video subject participants but took a significant quadratic downturn for computer-based environment subjects.

Observed interaction for each environment followed a trend pattern very similar to perceptions of overall interaction. Scores for observed interaction were significantly higher for two-way audio/one-way video subjects both as an overall mean and as a function of trial. As for perceptions of overall interaction, observed interaction continued an increasing linear trend to trial three for two-way audio/one-way video subjects but took a negative quadratic curve at trial three for computer-based subjects.

Direct participation was significantly higher for computer-based students both as a function of the overall average score across the study and as a function of trial. The trend for direct participation stayed flat for both environments across trials one and two but took an upward trend at trial three for computer-based students while continuing to remain flat for two-way audio/one-way video environment students.

Subject attitude stayed nominally, but not significantly, higher in the two-way audio/one-way video environment both overall and by trial. The trend line for subject attitude in both environments stayed relatively flat throughout the study. Subject satisfaction showed the same characteristics as that of subject attitude between the two environments with flat trend lines and no statistical difference either overall or as a function of trial between the two environments.

Research questions seven and eight sought to answer the questions: what are the significant relationships between the variables of perceptions of individual interaction, overall interaction, satisfaction, attitude, observed interaction and direct participation in computer-based distance learning and two-way audio/one-way video environments respectively? Research questions nine and ten sought to answer the question: which variable of student perceptions of individual interaction, perceptions of overall interaction, student attitude, observed interaction and direct participation predict student satisfaction in computer-based (9) and two-way audio/one-way video (10) distance learning environment? Research question eleven sought to answer the question: what is the difference between the predictors of satisfaction in computer-based and two-way audio/one-way video distance learning environments?

Within each of the distance learning environments, the dependent variables showed varying relationships. While student attitude and perceptions of individual interaction were significant predictors of satisfaction for each environment, the regression equation had a higher R^2 value of .63 for the computer-based environment vice .57 for the two-way audio/one-way video environment. The strength of association between observed interaction and satisfaction in the two-way audio/one-way video environment showed a significant difference using Fisher Z transformations when compared to the computer-based environment and was more than double the computer-based Z score. The relationship of perceptions of individual interaction and student attitude also demonstrated statistically significant difference with a stronger relationship between these two dependent variables in the two-way audio/one-way video environment than the computer-based environment. Both environments demonstrated similarly high correlations between perceptions of individual interaction and direct participation and between perceptions of overall interaction and observed interaction.

Selected Data Comparisons

Subject ethnicity did not result in any statistically significant differences on any of the three trial mean dependent variable scores for either the computer-based or two-way audio/one-way video distance learning environments. Surprisingly, although a majority of the subjects reported their ethnicity as Caucasian, African American subjects had higher three trial mean scores on every dependent variable measured.

The variable of gender did prove significant on the three trial mean scores for satisfaction. Male subjects reported higher levels of satisfaction in both the computer-based distance learning environment, $\underline{F}$ (1, 48) = 1.249 and the two-way audio/one-way video environment, $\underline{F}$ (1, 49) = 3.103 than their female counterparts.

Class standing did not result in any significant differences on any of the dependent variables measured for either environment. This included differences in graduate or undergraduate standing and in differences among individual grade levels.

Instructor Perceptions

The instructor survey instrument consisted of content item excerpts from the learner survey addressed to the instructor of the course being surveyed, description of three aspects of teacher methodology and demographic data. The instructors were surveyed in three areas; 1) their perception of interactivity relative to their teaching experience in general 2) their perception of the level of interactivity in the surveyed class in particular and 3) their teaching methodology.

Teacher perception of their individual interactivity relative to their teaching experience in general was surveyed via the following questions:

Throughout your experience as an instructor:

1) How often do you ask questions of the students?

2) How often do students ask you questions?

3) How often do students volunteer their opinion?

4) What level of interaction is there between you and the student?

Teacher perception of their overall interactivity relative to their teaching experience in general was surveyed via the following questions:

5) What levels of interaction are there among the students themselves?

6) What percentage of the time do you and participants in your class spend?

interacting?

Teacher perception of the level of individual interactivity in the surveyed class in particular was surveyed using the following questions:

During this class:

7) How often did you ask questions of the students?

8) How often did students ask you questions of the students?

9) How often did students volunteer their opinion?

Teacher perception of the level of overall interactivity in the surveyed class in particular was surveyed using the following questions:

10) Overall, what level of interaction do you think occurred today?

Teacher perception of the level of observed interaction in the surveyed class in particular was surveyed using the following questions:

11) What level of interaction was there between you and the students?

12) What level of interaction was there among the students?

13) What percentage of the time did you and participants in your class spend interacting?

Teacher attitude was measured via the question:

14) How did the level of interaction make you feel?

Teacher satisfaction was measured via the question:

15) How do you feel about today's lesson as a whole?

These questions were slightly modified versions of the same dependent variable questions asked student subjects in the two learning environments.

Instructors consisted of six males and one female. All instructors were of Caucasian ethnicity with one male instructor's ethnicity listed as Arab-American. The mean age was 49, SD = 5.7 years. All instructors reported at least two previous courses of teaching experience within their respective teaching environment with a minimum of seven years teaching experience overall.

A 2 X 2 analysis of variance for each of the dependent variables of; perceptions of overall interaction, observed interaction, satisfaction, student attitude and perceptions of individual interaction were computed for each environment utilizing the independent variables of instructor (two levels; computer-based and two-way audio/one-way video) and student group (two levels; computer-based and two-way audio/one-way video).

Research questions were studied under the null hypotheses that there is no difference between these dependent variables and the levels of the two independent variables. The assumption of no extreme outliers was tenable for each of the dependent variables and the assumption of normality of distribution of the residuals was verified by an examination of residuals scatterplots for each dependent variable. The assumption of independence of observations between subjects was found tenable.

The null hypothesis that there was no differences among computer-based and two-way audio/one-way video instructors (N = 6) was not rejected for any of the dependent variables measured. Multivariate analysis did uncover significant differences between computer-based environment instructors and their students on (a) Attitude, $F(4, 116) = 6.850$; (b) Observed Interaction, $F(4, 116) = 6.098$; and Satisfaction, $F(4, 116) = 6.813$, $p<.05$. Computer-based distance learning environment instructors had a higher mean score for Attitude at 5.66 than their computer-based students at 3.65. Observed interaction was higher for computer-based environment instructors with 5.00 vice 3.43 for computer-based distance learners. Satisfaction was rated higher among computer-based distance instructors than their computer-based students (mean score of 5.44 Vs 4.54). Two-way audio/one-way video instructor students differed significantly from their two-way audio/one-way video students on the dependent variable of satisfaction, F (4, 116) = 6.098, $p < .05$. Satisfaction was rated higher among two-way audio/one-way video instructors than their students (mean score of 5.11 Vs 4.05).

It is important to reiterate that in comparing instructor perceptions to student perceptions, the small sample size and quasi-experimental design used is subject to difficulties in interpretation. Although comparisons offer insight into differing perceptions of the same experience, one cannot be assured that bias from an overlooked confounding variable was introduced or that the two groups are equitable .

Implications of the Findings

The results of this study have important implications for the selection and application of educational delivery systems that may be the funding and policy focus of higher education administrators. Consideration of the findings on interactivity presented in this study are essential in the choice of present or future educational delivery systems because as Moore (1973) states, "The very nature of distance learning itself requires any distance learning educational interaction attempted to be mediated, or shaped, by the use of the electronic, mechanical or other device used to transmit the educational interactions via a distance" (p. 662). Saba (1988) claims that this technological mediation is the single most important differentiating factor in distance educational delivery systems.

The technology of distance learning bounds and shapes the educational experience to a greater degree than any other pedagogical tool or type of educational technology ever considered. Stubbs and Burnham (1990) argue that one critical factor in delivery acquisition choices by educators considering the distance learning milieu is their evaluation of the distance learning technology as not only an information delivery system, but also as a flexible methodological conduit of choice through which interaction must pass. The evidence in this study suggests that the instrumentation and methodology contained herein can adequately evaluate the interactivity of these two types of distance learning environments and that important differences may exist between the two environments.

Distance learning has been long established as an urban to rural or inter-urban interactive educational transport system. Increasingly though distance learning is becoming an intra-urban service between the providing institution and the component parts of the local community or city in which it resides. Urban universities reach out through the technology of distance learning to satellite campuses (as was the case in this study) as well as to other local universities and local community colleges. Urban universities traditional civic and governmental ties means that distance learning providing institutions can offer connectivity through these systems to local governmental and community collaborative efforts including meetings, symposiums and governing initiatives. The interactivity of these systems has potential to influence far beyond the realm of academic concerns and into all facets of an urban community.

Implication 1

Study findings suggest that the computer-based distance learning environment is perceived by subjects in that environment to have more positive levels of both variables of subject perceptions of individual interaction and direct participation than subjects' perceptions of those same variables in a two-way audio/one-way video distance learning environment. The perceptions of individual interaction and direct participation in the computer-based environment tend to increase over time while the two-way audio/one-way video environment remains lower and relatively unchanged over the duration of a semester of instruction.

Distance learning technology assessment based in the context of individual interaction and direct participation is significant. The commonly endorsed educational concepts of one-on-one instruction, tailored pedagogy and small class sizes are based upon the perceived value of their individual interactional richness. It is axiomatic that perceived proximity in interpersonal communication enriches interaction. Shale and Garrison (1990) state that "in its most fundamental form education is an interaction among teacher, student, and subject content" (p. 2). Keegan (1990) believes that individual interaction is the key to effective learning and information exchange and Moore (1992) considers interaction a defining characteristic of education. Wetzel (1994) found that increasing the fidelity of interactivity generally increases effectiveness and satisfaction and is essential for the student to remain interested and steered toward success. Distance educators in general contend that one of the most significant attributes of the technologies used in current and future distance learning systems is their capacity for real time interactivity (Wagner, 1990).

Gagne (1985) developed a hierarchical task analysis theory that required psychoanalysis of the component steps a student needed to learn in order to perform a complex skill. Gagne stressed an individual's ability to select stimuli at different points in the learning hierarchy. This theory may suggest a special teaching capability to computer-based distance learning for some types of instruction if the pedagogy and technology offer a more interactive individualized learning experience coupled with selectable stimuli and jointly manipuable or collaborative tools. Cognition of this heightened level of individual interactivity would be consistent with findings of increased efficacy of the environment.

Scandura's (1973) structural learning theory describes teaching as using simple rules that build upon more complex rules and then instructors illustrating applications of those rules. His approach is designed for individual instruction and his strategy is for educators to interact on a strong individual level with students to teach those paths of rules the student has not learned. The issue for distance educators is whether the distance learning system employed allows sufficient interactivity at the individual level in the distance learning classroom to be facilitative of this theory. Under Scandura's theory, a distance learning delivery system choice for computer-based systems based upon the heightened levels of interactivity of the computer-based distance learning environment as evidenced in this study may be appropriate.

The evidence found in this study that perceptions of individual interaction increase as a function of time suggests that earlier incorporation of distance learning courses, or courses introducing the technology of distance learning, by policy makers and curriculum developers into the curriculum may possibly result in a higher initial baselines of perceived interactivity in subsequent distance learning courses that a student may take. Early introduction of distance learning methodologies, especially if offered as part of most courses of study in the form of a technology credit may ensure retention and acceptance of future distance learners who have on-campus access.

The higher levels of direct participation and individual interaction in a computer-based environment may suggest to educators that this environment is efficacious for home use where learners have little or no other outside stimulus. Educators may want to consider whether classroom "sites" are strictly necessary and may want to include the possibility of disbursing individual workstations for computer-based distance learning to dormitories, libraries and university common areas. These outlying sites could possibly include other areas of the urban landscape including churches, recreation centers and community centers. If introduced with proper endorsement, initiation and training, the increased engageability of computer-based environments may facilitate increased access and retention of marginalized urban populations from outlying or widely dispersed urban areas in the majority culture institutions that provides this type of distance learning outreach.

Both learner and instructor control and use of computer-based interactive tools coupled with the now common design purpose of individual user functionality and physical engagement of the learner may possibly be the deciding factors in the higher perception levels of individual interaction and direct participation in computer-based distance learning environments. The event analysis instrument developed in this study will assist in mapping pedagogical and technological aspects of computer-based distance learning environments that correlate to the varying levels of interactive perceptivity by environmental participants.

Increased individual engagement without commensurate oversight by educators can come at some cost. More private, individualized learning is less likely to transform learners in a positive manner or in ways intended by the instructor, subject matter and curriculum. Higher individualization, learner control of the computer-based environment and varying environmental synchrony between learners and the instructor can also shift the locus of control of the educational environment more towards the individual student. While ideally this may lead to a kind of color-blind, socio-economically neutral Socratic collaborative learning environment, it could also lead to the possibility that learners will not tailor their environments to the outside stimulus that is best for them and may not receive sufficient stimulus from instructors or fellow learners to recognize or alter this fact. Disadvantaged or disenfranchised members of the urban milieu may not have the necessary role models or be too deficient in learning skills and strategies to engage in properly guided didactic conversations in highly individualized and remote distance learning environments. Loss of environmental synchrony between learner and instructor may allow higher levels of cognitive speed but at a distracting cost to other forms of learner involvement.

Analysis of the pattern of means through scatterplots and Fisher Z transformations shows that there is not a corresponding increase in perceptions of overall interaction as perceptions of individual interaction increases among learners. This evidence suggests that the technology of computer-based distance learning does not guarantee an equally satisfying or engaging environment for all learners. Although no significant differential findings arose from the data, educator maintenance of situational awareness and levels of individual learner involvement should still be regarded as essential, especially in regards to gender, ethnicity and socioeconomic backgrounds.

Implication 2

Students in the two-way audio/one-way video environment have higher perceptions of observed interaction than computer-based distance learning students. Both perceptions of overall interaction and observed interaction increase at a strong linear rate for two-way audio/one-way video distance learning environment students throughout their course of instruction while computer-based student perceptions of both these same dependent variables peaks at midcourse and falls off to beginning levels by the end of the course.

The social aspects of the classroom setting are an important facet of the student's educational experience and an important consideration in both the attainment and pursuit of education for a majority of students (Jonassen Peck and Wilson, 1999). The results of this study provide evidence to suggest that students in two-way audio/one-way video distance learning environments perceive higher levels of observed in their classrooms than computer-based distance learning students.

This study's findings may suggest to educators and policy makers that two-way audio/one-way video distance learning environments may be more appropriate to collaborative learning and teaching techniques that rely on group participation than computer-based distance learning courses. Community outreach and collaboration efforts by the university may find higher participation and acceptance of this distance learning environment because of the higher levels of observed interaction and initial familiarity, especially to those groups outside academia. This environment may also be more socially rewarding and more in line with the group learning experiences and expectations common to students' expectations of traditional classroom courses. Implications are that less training is required for environmental acclimation by students if the two-way audio environment more accurately reflects what students are already accustomed to. This could be an important marketing point for both parents of students and students less comfortable with increased technology. The two-way audio/one-way video environment may also be more appropriate for use as an introduction to first time distance learners by curriculum developers because of its familiarity. Differing levels of observed interaction suggested by this study of the two distance learning environments should be considered carefully in regards to their ability to aid in socialization of various urban minorities into majority culture universities. Higher levels of observed interaction may assist in this area if the interaction observed includes all participants and may have the side benefit of facilitating acclimation into the academic culture.

These findings are also important if contextualized under Bandura's (1969) theory of observational learning wherein one set of effective teaching techniques relies on the ability to observe or mimic the instructor or other students.

The findings in this study also suggest appropriate modifications to Trenholm's (1986) continua of the characteristics and the situational contexts of an educational environment introduced in chapter two and as demonstrated in Figure 18. Trenholm's contexts ranged from interpersonal and small group at one end, to public and mass communication at the other, with measures from left as low and right as high. Trenholm's "many persons" refers to the large, open and traditional class sizes and rooms inherent in two-way audio/one-way video environments. The two environment's differing points on the continua seem to be borne out by the statistically significant and higher levels of observed interaction uncovered by this study. Proximity of interactants refers to the physical and perceptual distance of other students and the instructor. The assumption made in chapter two that because learners in computer-based distance learning

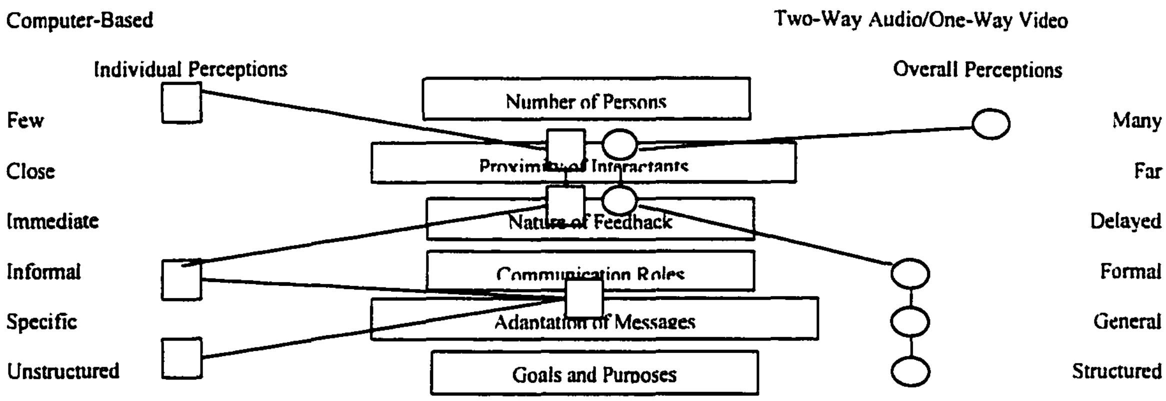


Figure 18. Modified Characteristics of Two-way Audio/One-way Video and Computer-Based Interaction. This figure adapted from Trenholm (1986, p.18). The location of the two environment's characteristics has been superimposed on the original chart.

environments view their learning environment primarily through workstations, reduced vicarious interaction may mitigate face to face interaction and confine the subjects perceptivity of individual interactivity was not borne out by the evidence. Feedback in Trenholm's model was observed to be similar in the two environments especially with currently available wider bandwidths and separate channel video streaming in the computer-based environment. Communication roles are informal in computer-based distance learning. The learner can engage in numerous interactive tools at will in their primary interactive venue (the workstation) without knowledge or participation of fellow students or instructors (Maly et al., 1994). This may lead to partial explanation of the quadratic trend of observed interaction in computer-based subjects. Computer-based subjects may eventually depart from increasing levels of observed interaction in their classroom to devote more time to utilization of the interactive tools at their workstation including notepads and outside web retrievals. Both learner and instructor control of these interactive tools and the ability to tailor messages with artwork, animation, pointers and other enhancements may lead to inter/intra classroom message adaptability skewing this study's findings to higher levels of individual perceptivity in computer-based distance learning environments. This capability, coupled with a common design purpose and goal of individual interactivity and engagement of the computer-based distance learning system may help to further explain the differences in perceptions of individual interactivity and direct participation between the two learning environments.

Lessened perceptions of individual interaction and direct participation may suggest that televised courses are a more passive activity for learners than the computer-based environment. This is unfortunate if learners fall into familiar and passive television watching patterns, as cognitive change is less likely to occur under these conditions.

Lack of observed interaction in computer-based environments is likewise problematic. Limited "social presence" in these environments means that learner to learner interaction is lacking, greatly diminishing the social appeal and familiarity of these environments. This may in turn negatively affect the pursuit, retention and attainment of education for many students through this medium for whom the rituals and connectedness of a typical classroom environment are essential. Low levels of observed interaction may suggest that computer-based environments appeal primarily to highly individualized learners or those who enjoy or pursue only limited social interaction (see Pugliese, 1994), not to a majority of the student population. Lack of observed interaction might also exacerbate problems with the acculturation of minority students involved in these types of learning environments.

Implication 3

This study's findings of student attitude and perceptions of individual interaction as significant predictors of satisfaction for both the computer-based and two-way audio/one-way video distance learning replicates and extends the findings of Garrison (1990) and Ritchie and Newby (1989) who found that students in traditional education courses experiencing higher levels of "engagement" or interaction have been shown to have more positive attitudes. These findings are also commensurate with Kruh and Murphy's (1990) suggestion that the more engaging a distance learning environment is, the more satisfactory its potential may also possibly be.

In accordance with these findings, educator cognizance and maintenance of student attitudes and the marketing of the distance learning medium to gain interest and acceptance by prospective students in an attempt to foster positive attitudes may be an important consideration for educators. Successful strategies may vary and should be tailored for various urban population components dependent upon their placement on a computer technology skills and familiarity continuum. These efforts coupled with pedagogical strategies that directly involve the individual student may bear consideration in regards to student satisfaction with the distance learning environment, whether it is computer-based or two-way audio/one-way video.

Implication 4

The level of positive student attitudes and satisfaction between the two distance learning environments in this study did not vary significantly. The evidence in this study suggests that for the present, the students involved in these environments are relatively equal in their expectations and attitude about their respective learning environments. As Zhang and Fulford (1994) so succinctly pointed out, the psychological perception of the learner is an important issue when considering the ability of technology to create an approximation of a real classroom. Zhang and Fulford further pointed out that students' perceptions tended to live up to their psychological preconceptions of what their learning environments would be like under the precepts of Salomon's (1984) Amount of Invested Mental Effort (AIME) model. The evidence in this study suggests that subjects in these two environments view the ability of each environment to meet their expectations about equally and the positive measurements recorded indicate that both environments are generally meeting those expectations.

Implication 5

Limited evidence provided in this study suggests that instructor and student perceptions of the learning environment vary in important ways. Instructors in the computer-based environment held more positive attitudes and were more satisfied with the environment than were their students. Computer-based instructors also perceived higher levels of observed interaction. Two-way audio/one-way video distance learning environment instructors varied significantly from their students only on the variable of satisfaction, in which their level was significantly higher.

Strategies to address and improve student perceptions of the level of overall interaction may prove useful for the computer-based distance learning environment educator. While there may be several confounding variables that were not addressed in this study for instructor satisfaction, the knowledge of both medium's general acceptability by educators involved in teaching through these methodological conduits of interaction may prove important in future media choice policies.

The findings in this study lend valence to the belief that educators and policy makers should strive to overcome the tendency to use emerging technology in the same manner as that which it is replacing. Newer distance learning environments, such as the computer-based environment, do in fact vary in important ways from their counterparts. University policy makers and educators should consider the pedagogical implications of varying interactivity. Curriculum development initiatives may want to consider ways to increase perceived observed interaction in computer-based environments and perceived individual interaction in televised environments. University technology centers need to be apprised and aware of changes in distance learning delivery methodologies in order to provide training and support to educators. Teacher competency with new technologies and the overcoming of inherent and often-times well founded distrust of technology may require policy makers at the university level to consider careful introduction and timing of technology changes within the university. Time management and pay decisions based on traditional classrooms or on earlier forms of distance learning may bear renewed consideration in the computer-based distance learning environment. Evidence in this study suggests educators should focus on the assessment and analysis of satisfaction as both an indicator of marketing trends and as an indicator of the success of acclimation training to by students to the environment.

Recommendations for Further Research

There is potential for numerous studies that may replicate or extend this study within the framework of higher education and distance learning. Three directions for further research are described below.

Direction 1

Extending and replicating the results of this study. Can similar results be obtained using different sample populations and different educational contexts? What are the effects of humanities, social science and art courses on the dependent variables? What other dependent variables can be combined to measure student perceptions? How do the findings of this study compare with web-based and traditional courses?

Replication will confirm or disconfirm the evidence presented in this study. Extension of this study can provide evidence of the study's validity across different populations and settings.

Direction 2

What are the actual events and interactions that occur in a computer-based and/ or two-way audio/one-way video distance learning environment that equate to higher perceptions of individual interaction and overall interaction on the part of the student learner? Can data gathered from the modified interaction analysis instrument developed in this study accurately and consistently collect what Moore (1992) defined as the essential components of distance learning interaction: learner-content interaction, learner-instructor interaction and learner-learner interaction? Do these events accurately predict and measure learner satisfaction, perceptions of individual interaction and overall interaction in the computer-based or two-way audio/one-way video environment?

Direction 3

The social aspects of learning are clearly an important motivating factor in obtaining an education. While computer-based learning may be sufficiently engaging at the individual level, does it lack a sense of observed interaction? Is there a sense of community, collaboration or group involvement missing from computer-based learning? How can these elements best be measured and compared with two-way audio/one-way video and asynchronous distance learning? What techniques or technological innovations would help to improve the overall sense of community and group participation in computer-based distance learning environments? As pure conjecture, would the inclusion of large-screen display monitors foster a greater sense of overall interaction in the computer-based classroom? Would greater use of survey tools, polling and remote site classroom technical monitors foster a greater communal effort?

Conclusion

Hillman, Ellis and Gunawardena (1994) introduced evidence that technology adds a fourth dimension to the definition of interaction, a dimension they deemed learner-interface interaction. The authors argue that this fourth type of interaction is a function of the system design and technology employed. This study suggested evidence of the effects of that learner-interface interaction through student perceptions of their particular distance learning environment's interactivity. A surprising finding of this study was the lack of statistically significant differences between student perceptions at an urban area's main site (co-located with the instructor) and student perceptions at the intra-urban remote sites (physically separate from the instructor) within a particular distance learning environment. These findings suggest that technology mediated distance learning can effectively broach an urban area's interactive distance and reach out to those who otherwise might not receive a particular educational opportunity.

The findings contained within this study suggest that computer-based distance learning is at least equivalent to the more common two-way audio/one-way video distance learning systems and may have a distinct advantage in personal engagement while lacking some of the social presence of the televised environment. A melding of the best aspects of both environments may be the necessary final step in making the distance learning environment an effective, viable and promising choice for urban educators and policy makers.

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Zhang, S. (1994). Are interaction time and psychological interactivity the same thing in the distance learning classroom? Educational Technology, 34, (4) 58-63.

APPENDIX A

SUBJECT ORIENTATION

My research examines learner perceptions of overall classroom interaction, learner perceptions of their individual interaction and satisfaction in computer-based and two-way television distance learning courses.

A major purpose of this research is to determine the role of interaction in two-way television and computer based distance learning courses. A second purpose is to classify classroom events in computer based distance learning courses to an individual or overall perceptual framework.

This study will not affect your grade or lesson content and is strictly voluntary.

Subjects for this study are students enrolled in two-way and computer based distance learning courses at both the main campus and remote sites that volunteer to participate.

A high volunteer rate is desired to enhance the validity of the study. Your participation in this study allows you to offer an important input into the nature of interactions in distance learning environments and to affect improvements in these educational environments. A high volunteer rate will help maintain the validity of the study results and enable findings more effective of academic change and improvement.

Volunteers will be allowed class time to complete questionnaires. There are three parts of the data collection process, an informed consent document, an initial demographic questionnaire, a survey and a final demographic questionnaire. Questionnaires will be given three times over the course of this semester. Mean completion time for completion of the informed consent documents is 3 minutes, for completion of the survey instrument is 6 minutes and for completion of both initial and final demographic instruments, 4 minutes, or 13 minutes total.

I will ask a volunteer from the remote site to assist me in handing out and collecting the survey documents.

Questions?

(Elicit remote volunteer and pass out the survey documents)

The first form in the survey package is a version of the standard ODU consent form that covers all types of human subject research conducted at Old Dominion University and has been approved by the university.

(Read the consent form)

(Questions)

Volunteers are asked to sign and date the consent forms. It would be very helpful if those who do not volunteer would describe their reasons for not volunteering on the last page of the consent form and to fill out the start of study questionnaire anonymously.

Witnesses are to sign and date consent forms.

(Wait for completion)

The second form is a start of study form to be filled out once. Please fill it out at this time.

(Wait for completion)

Please respond to the questions in the next survey portion independently; do not review previous questions once you have answered them. There are no correct or wrong answers. Please answer every question.

Enter the start and stop times in the top right hand corner

(Pilot study only - state start time)

Raise your hand if you have a question or need help in completing the questionnaire.

(Explanatory information regarding the study variables will be limited to the following:

a) Individual Interaction – Perceived individual involvement of each participant.

b) Overall Interaction – Perceived involvement of other members of the class.

c) Satisfaction – Perceived value and quality of instruction.

d) Two-way television distance learning:

Distance learning methodology where instructors and all or some students are separated by distance and connected via terrestrial or satellite-based two-way television and two-way audio technology. Remote site interactivity is conducted via television monitors and two-way audio channels located in classrooms at both main and remote sites. Audio and video are manipuable by both students and instructors. Video manipulation by students is limited to automated camera training on the student speaking. Open traditional classroom settings at both main and remote sites. Instruction is real-time without taped or technical delay.

e) Computer-based distance learning:

Distance learning methodology where instructors and all or some students are separated by distance and connected via terrestrial or satellite-based computer processor based technology and computer inter-networks. Remote site interactivity is conducted via computer monitors and networks. Joint manipulation of instructional technology tools is available to all students and instructors including individually manipuable screen-in-screen option selection, mutually viewable and manipuable whiteboards and notepads.

All classroom participants, including the instructor, participate via individual computer workstations with no group viewing available. Computer workstations have both inter and intra net connectivity including standard web retrieval capabilities.)

When everyone has finished the questionnaire I will collect them at the main site. Would my previous volunteer would collect them in the envelope provided and leave them _______.

Are there any final questions?

Thank you.

(Researcher note:

Course instructors are to be polled concerning their operation within the pedagogical limits of the following:

1. Traditional: formal or informal presentations of pre-determined curriculum content, related information, concepts or principles by faculty, guest speakers or students, and illustration (procedural presentations or event sequence demonstrations).

2. Verbal: Rendition of written documentation, text or materials. Group interaction whether ad-hoc or planned. Question and answer periods and social conversations.

3. Interactive Applications: Two-way television environment: Multimedia referencing (overhead projectors) or similar display tools and live camera feeds. Computer-based distance learning mediums encompass separate or parallel (ongoing) interactions for audio, imported video, electronic presentations, whiteboards, Web page displays, Web co-browsing and computer-driven simulations.

Those instructors falling outside these guidelines will not be utilized in the study.

Students not desiring to sign any form other than the informed consent document will be allowed to use a code or symbol. Failure to sign the informed consent documents or not being of legal age disqualifies the subject from participation).

APPENDIX B

INFORMED CONSENT DOCUMENT

Old Dominion University

Darden College of Education

INFORMED CONSENT DOCUMENT

TITLE OF RESEARCH: Comparative Student Perception and Interactional Event Analysis in an Urban Computer-Based Distance Education Environment.

INVESTIGATOR:

Michael S. Ireland, - Ph. D. Candidate, Darden College of Education, Old Dominion University, Norfolk, VA. 23452. Home: 1761 Prodan Lane, Virginia Beach, VA 23456. Tel: Home (757) 430-8528, FAX (757) 444-4194, Work (757) 444-1262. E-mail: ireland@vabch.com.

DESCRIPTION OF RESEARCH: This study is to examine the interactions that occur between learners and instructor in a computer-based distance education system.

EXCLUSIONARY CRITERIA: To the best of my knowledge, I am not aware of any prior knowledge, experience or physical limitations that would prohibit my participation in this study.

RISKS AND BENEFITS: The testing procedures I will undergo require the forfeiture of approximately ten minutes of classroom time. The identity of persons completing the survey form and in the analysis of classroom interactions will be protected. Analysis of the results will be public knowledge. Risks are minimal and all precautions will be taken to ensure confidentiality. I understand the main benefit to accrue from this study is the attainment of information relative to the effect of student perceptions of interaction and actual interactions in the classroom on remote computer based instruction.

COSTS AND PAYMENTS: I understand that my efforts in this study are voluntary, and I will not receive remuneration for my participation.

NEW INFORMATION: I understand that new information obtained during the course of this research that is directly related to my willingness to continue to participate in this study will be provided to me.

CONFIDENTIALITY: I understand that any information obtained about me from this research, including surveys and observations will be kept strictly confidential. I also understand that the data derived from this study could be used in reports, presentations, and publications, but that I will not be individually identified. I do understand, however, that my records may be subpoenaed by court order or may inspected by federal regulatory authorities.

WITHDRAWAL PRIVILEDGE: I understand that I am free to refuse to participate in this study or to withdraw at any time and that my decision to withdraw will not adversely affect my grade or standing in the university. I also realize that the investigators reserve the right to withdraw my participation at any time throughout this investigation if they observe any contraindication to my continued participation.

VOLUNTARY CONSENT: I certify that I read the preceding sections of this document, or it has been read to me; that I understand the contents; and that any questions I have pertaining to the research have been or will be answered Michael S. Ireland at (757) 430-8528. If I have any concerns, I can address them to the Darden College of Faculty Governance Research and Scholarship Committee. A copy of this informed consent will be given to me if I desire. My signature below indicated that I have freely agreed to participate in this investigation.

________________________________ ____________

Subject's Signature Date

________________________________ ____________

Parent or Guardian's Signature (if subject is under 18 Years of age) Date

________________________________ ____________

Witness's Signature Date

INVESTIGATOR'S STATEMENT I certify that I have explained to the subject whose signature appears above the nature and purpose of the potential benefits and possible risks associated with participation in this study. I have answered any questions that have been raised by the subject and have encouraged him/her to ask any additional questions during the course of this study.

________________________________ ____________

Investigator's Signature Date

APPENDIX C

PERCEPTIONS OF INTERACTION SURVEY

PERCEPTIONS OF INTERACTION SURVEY

Directions

1. Please darken in the number on the scale that most accurately corresponds to your answer

"Individual Interaction"

Perceived individual involvement of each participant.

During this class:

		Never					Often
*	How often did you answer questions asked by the instructor?	1	2	3	4	5	6
	How often did you volunteer your opinion?	1	2	3	4	5	6
*	How often did you ask a question?	1	2	3	4	5	6
*	How often did you participate in overall activities?	1	2	3	4	5	6
		Low					High
*	What level of interaction was there between you and the instructor?	1	2	3	4	5	6
*	What level of interaction was there between you and your classmates?	1	2	3	4	5	6

	Ineffective	Effective
* How well did the instructor motivate interaction with you?	1 2 3 4 5 6	

"Overall Interactions"

Perceived involvement of other members of the class.

	Low	High
* What level of interaction do you think occurred today?	1 2 3 4 5 6	
* What level of interaction was there between the instructor and the class?	1 2 3 4 5 6	
* What level of interaction was there between all other participants?	1 2 3 4 5 6	

	Ineffective	Effective
* How well did the instructor motivate interaction in general?	1 2 3 4 5 6	

	0%	100%
* What percentage of the time were the instructor and participants interacting?	1 2 3 4 5 6	

"Satisfaction"

Perceived value and quality of instruction.

	Negative					Positive
* How did the level of interaction make you feel?	1	2	3	4	5	6
* How do you feel about today's lesson as a whole?	1	2	3	4	5	6
	Low					High
* How would you rate the value of the question and answer portion of the session?	1	2	3	4	5	6
* How would you rate your knowledge of the content after the lesson?	1	2	3	4	5	6
	None of it					All of it
* How much of the material you learned today do you feel is valuable to you?	1	2	3	4	5	6

Demographic Information (Please Print)

Name: ____

Course: ______________________

Date of birth: __________________

*Race/Ethnicity: African-American*____ *Hispanic*____

*Caucasian*____ *Asian descent*____

Other (please explain): ____

Are you an international student attending Old Dominion University?

*Yes*____ *No*____

Sex: *M*____ *F*____

Standing: __ *Freshman* __ *Sophomore* __ *Junior*

__ *Senior* __ *Graduate*

Number of semester hours of previous experience in a Teletechnet, remote instruction or interactive course:

__ *0-3* __ *4-9* __ *10+ credit hours*

Did you take this survey at ODU's

__ *Main Campus*

__ *Graduate Center or other remote site*

Thank you! The survey administrator will collect this survey upon completion.

APPENDIX D

INITIAL DEMOGRAPHIC QUESTIONNAIRE

Location: ________
Course: ________
For Researcher Use Only

INITIAL DEMOGRAPHIC QUESTIONNAIRE (IDQ)

Directions: Please complete this questionnaire by entering your replies in the spaces provided.

1. What is your local mailing address, E-mail or telephone number? (This is so that I may follow up your survey questions if necessary)

____

2. What year were you born? _____

3. What is your sex? Male _____ Female _____

4. What is your race/ethnicity? African-American _____ Asian Descent _____

Caucasian _____ Hispanic _____

Other (please explain) _____

5. What is your present class standing? (Check one)

Freshman _____ Sophomore _____ Junior _____

Senior _____ Graduate _____ Other _____

Please answer questions 6&7 if you are presently enrolled in two-way television (TELETECHNET) courses.

And/or:

Answer questions 8&9 if you are presently enrolled in computer-based interactive remote instruction (IRI) courses.

TELETECHNET Students:

6. How many two-way television courses have you taken previous to this one? _____

7. How many two-way courses are you enrolled in at this time? _____

IRI Students:

8. How many computer-based interactive remote instruction courses have you taken previous to this one? _____

9. How many computer-based interactive remote instruction courses are you enrolled in at this time? _____

10. If you have taken or are presently taking both a two-way televised distance learning course such as TELETECHNET *and* a computer-based interactive remote instruction course such

as IRI:

Which do you prefer?

IRI _____ TELETECHNET _____

Neither _____ Does not apply to me _____

No opinion _____

11. What is your academic major? ______________________

12. Do you own a computer at home? Yes _____ No _____

13. Do you use a computer at work? Yes _____ No _____

14. How many hours per week do you spend on a computer? _____

APPENDIX E

Location: ________
Course: ________
For Researcher Use Only

FINAL DEMOGRAPHIC QUESTIONNAIRE

FINAL DEMOGRAPHIC QUESTIONNAIRE

Directions: Please complete this questionnaire by entering your replies in the spaces provided.

1. What course are you taking this survey in? ______________________________

2. What is your local mailing address, E-mail or telephone number? (This is so that I may follow up your survey questions if necessary)

____

3. During this semester, have you purchased a new (first time) computer?

Yes___ No___

4. If no, have you previously purchased and own a home computer? Yes___ No___

5. During this semester, have you obtained new (first time) Internet service?

Yes___ No___

6. If no, have you previously purchased an Internet service? Yes___ No___

7. Do you feel the level of interaction in your class was adequate? Yes___ No___

8. What were the main detractors from interaction in your class?

9. What were the main contributors to interaction in your class?

Thank you for your participation!

APPENDIX F

ASSESSMENT INSTRUMENT PROTOCOL

Introduction

Events occurring in a computer-based classroom environment delineated by expert panel review can possibly be compared to surveyed student perceptions of those interactions at the individual and group level. Knowledge of the two predictors of satisfaction suggested by the evidence in this study (student attitude and perceptions of individual interaction) can be compared with events occurring in classrooms that measure relatively high in these variables. When combined with information from instructor interviews, future investigators can then suggest activities, teaching strategies and teaching behaviors that might lead to higher ratings on these variables and therefore greater student satisfaction in the computer-based distance learning classroom.

Useful comparisons with these perceptions and same student satisfaction ratings have been found to be critical predictors of learning effectiveness (Fulford and Zhang, 1993). Adding actual valuations of observations and comparison between both computer-based and two-way audio/one-way video distance learning mediums may also allow the development of new ways of collecting information about the character of instruction within both distance learning environments.

IRI Event Assessment

Distance education systems include features intended to either reduce the costs of instruction or to improve the learning environment for both students and teachers. An outstanding example of computer-based distance learning utilized in this study was the Interactive Remote Instruction (IRI) environment. As described by Maly, Overstreet, Abdel-Wahab, & Gupta (1994) below, the IRI environment has made some strides with automated event analysis and automatic indexing of IRI sessions for selective replay.

During a classroom session, IRI's software programming can record computer-mediated activities. These activities can potentially include presentations and tools, (e.g., simulations) classroom discussions, (audio and video) and can provide timing information as to when these activities occurred. During a session, all individual audio, video and data streams are recorded along with timing points. This information is synthesized and made available as a set of web pages which students can review at their leisure or which can be recalled by the instructor for post-lesson group activities.

These recorded sessions may also find potential use in non-real time analysis of the events occurring in the classroom to give a better picture of the interactional character of the course under observation. Software coding such as that offered below may also be incorporated into the operating system of the computer-based distance learning system to allow real-time analysis either automatically or manually through human observer collection.

Assessment Instrument

To help define the actual events which may be significantly related to the perception variables measured in this study, an instrument to integrate a strong, highly recognized interaction analysis methodology, Flander's Interaction Analysis and to incorporate the type of interaction, the timeliness of the interaction, and the method of interaction recognized by Main and Riise (1994) was developed. Inclusion in the codification of the key issues of type, timeliness, and method encompasses the interactions that most substantially differentiate the computer-based distance learning environment from the standard classroom environment.

Recordable events as described above within Old Dominion University's Interactive Remote Instruction Environment were utilized in designing the instrument. These events are broadly analogous to events that occur in all computer-based distance learning systems and as such offer a useful baseline from which to develop the instrument. The events were broadly classified as: Student –Instructor, Instructor-Student, Student-Interface and Instructor-Interface.

An observer utilizes this instrument for data collection and summation, written for this study as a hypertext markup language (HTML) web page. This particular instrument categorizes events in accordance with the categories of the modified interaction analysis instrument developed in chapter two and presented in table six and provides time-based summaries of interactional event occurrences. Type classification can concur with assignment to the recordable event list. An observer utilizes the automated hypertext markup language code software during actual class observations or utilizing recordable event functions to record and provide summary printouts of the interactional character of the computer-based distance learning environment. The instrument may be modified to analyze other computer-based distance learning events or to collate the gathered data in any number of ways based upon the principles of the combined Flanders and Main and Riise methodology presented here.

Instrument Code

Partial instrument coding follows. Some CGI and web scripting is omitted for brevity.

Setup (Home) Page

```
<html>

<head>
<title>Home Page</title>
<meta name="GENERATOR" content="Microsoft FrontPage 3.0">
<meta name="Microsoft Theme" content="arcs 011">
<meta name="Microsoft Border" content="none, default">
<script LANGUAGE="JavaScript" FPTYPE="dynamicanimation">
<!--
 // If you want to change this script, you must also make the following
 // changes so that FrontPage will not overwrite your new script.
 // In the script tag, change type="dynamicanimation" to type="mydynamicanimation"
 // In the first script statement, change "dynamicanimation" to "mydynamicanimation"
 // Throughout the HTML content, change dynamicanimation= to mydynamicanimation=
 // Change function dynAnimation to function mydynAnimation
 // In the body tag, change onload="dynAnimation()" to onload="mydynAnimation()"
 dynamicanimAttr = "dynamicanimation"
 animateElements = new Array()
 currentElement = 0
 speed = 0
 stepsZoom = 8
 stepsWord = 8
 stepsFly = 12
 stepsSpiral = 16
 steps = stepsZoom
 step = 0
 outString = ""
 function dynAnimation()
 {
  var ms = navigator.appVersion.indexOf("MSIE")
  ie4 = (ms>0) && (parseInt(navigator.appVersion.substring(ms+5, ms+6)) >= 4)
  if(!ie4)
  {
   if((navigator.appName == "Netscape") &&
     (parseInt(navigator.appVersion.substring(0, 1)) >= 4))
   {
    for (index=document.layers.length-1; index >= 0; index--)
    {
      layer=document.layers[index]
      if (layer.left==10000)
        layer.left=0
    }
   }
   return
```

```
   }
   for (index=document.all.length-1; index >= document.body.sourceIndex; index--)
   {
    el = document.all[index]
    animation = el.getAttribute(dynamicanimAttr, false)
    if(null != animation)
    {
     if(animation == "dropWord" || animation == "flyTopRightWord" || animation ==
"flyBottomRightWord")
      {
       ih = el.innerHTML
       outString = ""
       i1 = 0
       iend = ih.length
       while(true)
       {
        i2 = startWord(ih, i1)
        if(i2 == -1)
         i2 = iend
        outWord(ih, i1, i2, false, "")
        if(i2 == iend)
         break
        i1 = i2
        i2 = endWord(ih, i1)
        if(i2 == -1)
         i2 = iend
        outWord(ih, i1, i2, true, animation)
        if(i2 == iend)
         break
        i1 = i2
       }
       document.all[index].innerHTML = outString
       document.all[index].style.posLeft = 0
       document.all[index].setAttribute(dynamicanimAttr, null)
      }
     if(animation == "zoomIn" || animation == "zoomOut")
      {
       ih = el.innerHTML
       outString = "<SPAN " + dynamicanimAttr + "=\"" + animation + "\"
style=\"position: relative; left: 10000;\">"
       outString += ih
       outString += "</SPAN>"
       document.all[index].innerHTML = outString
       document.all[index].style.posLeft = 0
       document.all[index].setAttribute(dynamicanimAttr, null)
      }
```

```
  }
 }
 i = 0
 for (index=document.body.sourceIndex; index < document.all.length; index++)
 {
  el = document.all[index]
  animation = el.getAttribute(dynamicanimAttr, false)
  if (null != animation)
  {
   if(animation == "flyLeft")
   {
    el.style.posLeft = 10000-offsetLeft(el)-el.offsetWidth
    el.style.posTop = 0
   }
   else if(animation == "flyRight")
   {
    el.style.posLeft = 10000-offsetLeft(el)+document.body.offsetWidth
    el.style.posTop = 0
   }
   else if(animation == "flyTop" || animation == "dropWord")
   {
    el.style.posLeft = 0
    el.style.posTop = document.body.scrollTop-offsetTop(el)-el.offsetHeight
   }
   else if(animation == "flyBottom")
   {
    el.style.posLeft = 0
    el.style.posTop = document.body.scrollTop-
offsetTop(el)+document.body.offsetHeight
   }
   else if(animation == "flyTopLeft")
   {
    el.style.posLeft = 10000-offsetLeft(el)-el.offsetWidth
    el.style.posTop = document.body.scrollTop-offsetTop(el)-el.offsetHeight
   }
   else if(animation == "flyTopRight" || animation == "flyTopRightWord")
   {
    el.style.posLeft = 10000-offsetLeft(el)+document.body.offsetWidth
    el.style.posTop = document.body.scrollTop-offsetTop(el)-el.offsetHeight
   }
   else if(animation == "flyBottomLeft")
   {
    el.style.posLeft = 10000-offsetLeft(el)-el.offsetWidth
    el.style.posTop = document.body.scrollTop-
offsetTop(el)+document.body.offsetHeight
   }
```

```
      else if(animation == "flyBottomRight" || animation == "flyBottomRightWord")
      {
       el.style.posLeft = 10000-offsetLeft(el)+document.body.offsetWidth
       el.style.posTop = document.body.scrollTop-
offsetTop(el)+document.body.offsetHeight
      }
      else if(animation == "spiral")
      {
       el.style.posLeft = 10000-offsetLeft(el)-el.offsetWidth
       el.style.posTop = document.body.scrollTop-offsetTop(el)-el.offsetHeight
      }
      else if(animation == "zoomIn")
      {
       el.style.posLeft = 10000
       el.style.posTop = 0
      }
      else if(animation == "zoomOut")
      {
       el.style.posLeft = 10000
       el.style.posTop = 0
      }
      else
      {
       el.style.posLeft = 10000-offsetLeft(el)-el.offsetWidth
       el.style.posTop = 0
      }
      el.initLeft = el.style.posLeft
      el.initTop = el.style.posTop
      animateElements[i++] = el
    }
  }
  window.setTimeout("animate();", speed)
}
function offsetLeft(el)
{
  x = el.offsetLeft
  for (e = el.offsetParent; e; e = e.offsetParent)
   x += e.offsetLeft;
  return x
}
function offsetTop(el)
{
  y = el.offsetTop
  for (e = el.offsetParent; e; e = e.offsetParent)
   y += e.offsetTop;
  return y
```

```
}
function startWord(ih, i)
{
 for(tag = false; i < ih.length; i++)
 {
  c = ih.charAt(i)
  if(c == '<')
   tag = true
  if(!tag)
   return i
  if(c == '>')
   tag = false
 }
 return -1
}
function endWord(ih, i)
{
 nonSpace = false
 space = false
 while(i < ih.length)
 {
  c = ih.charAt(i)
  if(c != ' ')
   nonSpace = true
  if(nonSpace && c == ' ')
   space = true
  if(c == '<')
   return i
  if(space && c != ' ')
   return i
  i++
 }
 return -1
}
function outWord(ih, i1, i2, dyn, anim)
{
 if(dyn)
  outString += "<SPAN " + dynamicanimAttr + "=\"" + anim + "\" style=\"position:
relative; left: 10000;\">"
 outString += ih.substring(i1, i2)
 if(dyn)
  outString += "</SPAN>"
}
function animate()
{
 el = animateElements[currentElement]
```

```
  animation = el.getAttribute(dynamicanimAttr, false)
  step++
  if(animation == "spiral")
  {
   steps = stepsSpiral
   v = step/steps
   rf = 1.0 - v
   t = v * 2.0*Math.PI
   rx = Math.max(Math.abs(el.initLeft), 200)
   ry = Math.max(Math.abs(el.initTop), 200)
   el.style.posLeft = Math.ceil(-rf*Math.cos(t)*rx)
   el.style.posTop  = Math.ceil(-rf*Math.sin(t)*ry)
  }
  else if(animation == "zoomIn")
  {
   steps = stepsZoom
   el.style.fontSize = Math.ceil(50+50*step/steps) + "%"
   el.style.posLeft = 0
  }
  else if(animation == "zoomOut")
  {
   steps = stepsZoom
   el.style.fontSize = Math.ceil(100+200*(steps-step)/steps) + "%"
   el.style.posLeft = 0
  }
  else
  {
   steps = stepsFly
   if(animation == "dropWord" || animation == "flyTopRightWord" || animation ==
"flyBottomRightWord")
     steps = stepsWord
   dl = el.initLeft / steps
   dt = el.initTop  / steps
   el.style.posLeft = el.style.posLeft - dl
   el.style.posTop = el.style.posTop - dt
  }
  if (step >= steps)
  {
   el.style.posLeft = 0
   el.style.posTop = 0
   currentElement++
   step = 0
  }
  if(currentElement < animateElements.length)
   window.setTimeout("animate();", speed)
}
```

```
//-->
</script></head>

<body onload="dynAnimation()">

<p><font face="7X13"
color="#0000FF"><big>        &nbs
p;            
; 
</big></font></p>

<p> </p>

<h1><big><font face="7X13" color="#0000FF">   
</font></big><font
color="#0000FF"
face="Alaska">          
COMPUTER-BASED  INTERACTIONAL</font></h1>

<h1><font color="#0000FF"
face="Alaska">          
   
        EVENT ANALYSIS
INSTRUMENT</font></h1>

<h3><font color="#0000FF"
face="Alaska">          
            
           
</font><font face="Alaska" color="#FF0000">STUDY DATA SECTION</font></h3>

<h4 dynamicanimation="flyBottom"
style="position: relative !important; left: 10000 !important"><font
face="Alaska"><small>         
;     
</small><font color="#000000">Enter the Following Information And Then Proceed To
The Data
Collection Section.</font></font></h4>
<div align="center"><center>

<table border="1" width="404" height="1" bgcolor="#C0C0C0">
  <tr>
    <td width="608" height="8">Course Nomenclature</td>
    <td width="381" height="8"><input type="text" name="T1" size="20"></td>
  </tr>
  <tr>
```

```
    <td width="608" height="31">Course Title

            
    
    </td>
    <td width="381" height="31"><input type="text" name="T2" size="20"></td>
  </tr>
  <tr>
    <td width="608" height="32">Instructor

            
       
    </td>
    <td width="381" height="32"><input type="text" name="T3" size="20"></td>
  </tr>
  <tr>
    <td width="608" height="24">Scheduled Convenings   </td>
    <td width="381" height="24"><input type="text" name="T4" size="20"></td>
  </tr>
  <tr>
    <td width="608" height="37">Observation Time Period</td>
    <td width="381" height="37"><input type="text" name="T5" size="20"></td>
  </tr>
  <tr>
    <td width="608" height="33">Amplifying Data</td>
    <td width="381" height="33"><input type="text" name="T1" size="20"></td>
  </tr>
  <tr>
    <td width="608" height="56"><input type="submit" value="Submit"
name="B1"></td>
    <td width="381" height="56"><input type="reset" value="Reset" name="B2"></td>
  </tr>
</table>
</center></div>

<p dynamicanimation="flyBottom"
style="position: relative !important; left: 10000 !important"><small><font
face="Alaska"> 
<font
color="#0000FF">         &nb
sp;  </font></font></small></p>

<p dynamicanimation="flyBottom"
style="position: relative !important; left: 10000 !important"> </p>

<p dynamicanimation="flyBottom"
```

```
style="position: relative !important; left: 10000 !important"> </p>

<p dynamicanimation="flyBottom"
style="position: relative !important; left: 10000 !important"> </p>

<p dynamicanimation="flyBottom"
style="position: relative !important; left: 10000 !important"> </p>

<form method="POST" action="--WEBBOT-SELF--">
  <!--webbot bot="SaveResults" startspan U-File="_private/form_results.txt"
  S-Format="TEXT/CSV" S-Label-Fields="TRUE" --><input TYPE="hidden"
NAME="VTI-GROUP" VALUE="0"><!--webbot bot="SaveResults" endspan --
><p> </p>
</form>

<h2 dynamicanimation="flyBottom"
style="position: relative !important; left: 10000 !important"><font color="#0000FF"
face="Alaska">          
      
</font></h2>

<p dynamicanimation="flyBottom"
style="position: relative !important; left: 10000 !important"> </p>

<p dynamicanimation="flyBottom"
style="position: relative !important; left: 10000 !important"> </p>

<form method="POST" action="--WEBBOT-SELF--">
  <!--webbot bot="SaveResults" startspan U-File="_private/form_results.txt"
  S-Format="TEXT/CSV" S-Label-Fields="TRUE" --><input TYPE="hidden"
NAME="VTI-GROUP" VALUE="1"><!--webbot bot="SaveResults" endspan --
><p> 
  </p>
</form>

<p dynamicanimation="flyBottom"
style="position: relative !important; left: 10000 !important"><font color="#0000FF"
face="Alaska">          
      
</font></p>

<p><font color="#0000FF"
face="Alaska">          
        
</font></p>
```

```
<p>           
</p>

<p>  </p>
</body>
</html>
```

Data Collection Section

```
<html>

<head><script language="JavaScript">
<!--
var d=new Array();
for(i=0;i<10;i++) {
 d[i]=new Image();
 d[i].src="images/dgt"+i+".gif";
}
var pm=new Image;
pm.src="images/dgtp.gif";
var am=new Image;
am.src="images/dgta.gif";
var dates,min,sec,hour;
var amPM="am";

function clock() {
 dates=new Date();
 hour=dates.getHours();
 min=dates.getMinutes();
 sec=dates.getSeconds();
 if(hour < 12) {
  amPM=am.src;
 }
 if(hour > 11) {
  amPM=pm.src;
  hour=hour-12;
 }
 if(hour == 0) {
  hour=12;
 }
 if(hour < 10) {
  document["tensHour"].src="images/dgtbl.gif";
  document["Hour"].src=d[hour].src;
```

```
 }
 if(hour > 9) {
  document["tensHour"].src=d[1].src;
  document["Hour"].src=d[hour-10].src;
 }
 if(min < 10) {
  document["tensMin"].src=d[0].src;
 }
 if(min > 9) {
  document["tensMin"].src=d[parseInt(min/10,10)].src;
 }
 document["Min"].src=d[min%10].src;
 if(sec < 10) {
  document["tensSec"].src=d[0].src;
 }
 if(sec > 9) {
  document["tensSec"].src=d[parseInt(sec/10,10)].src;
 }
 document["Sec"].src=d[sec%10].src;
 document["amPM"].src=amPM;
 setTimeout("clock();",100);
}
//-->
</script>
<script language="JavaScript">

    var enabled = 0;

function TOfunc() {

    TO = window.setTimeout( "TOfunc()", 1000 );

    var today = new Date();

    document.forms[0].elements[0].value = today.toString();

    }

</script>

<title>New Page 1</title>
</head>

<body " background="_themes/arcs/arctile.jpg">

<h1 align="center"><font color="#0000A0">DATA COLLECTION </font></h1>
```

```
<h1><font
color="#0000A0">         &n
bsp;           &nb
sp; 
    SECTION</font><br>
</h1>

<hr ALIGN="CENTER" SIZE="3">

<p><font
color="#0000A0">         &n
bsp;           &nb
sp;           &nbs
p;            
;            
            
            
         
</font></p>

<form method="POST" action="--WEBBOT-SELF--">
 <div align="center"><center><p><input type="text" name="disp" value size="25"
 onFocus="this.blur()"> <br>
 <input type="radio" name="rad" value="OFF" checked
 onClick="if( enabled ) {      clearTimeout( TO );      enabled = 0;    }"> OFF<input
 type="radio" name="rad" value="ON"
 onClick="    if( !enabled ) {      TO = setTimeout( 'TOfunc()', 1000 );      enabled = 1;
}">
 ON<br>
 </p>
 </center></div>
</form>

<hr ALIGN="CENTER" SIZE="3">

<p><br>
</p>
<div align="center"><center>

<table border="2" width="36%" bordercolor="#808080" height="641">
 <tr>
   <td width="20%" rowspan="3" height="21">Teacher Talk <em>Indirect
Influence</em></td>
   <td width="39%" height="19" align="center"><form method="POST" action="--
WEBBOT-SELF--">
```

```
      <!--webbot bot="SaveResults" startspan U-File="_private/form_results.txt"
      S-Format="TEXT/CSV" S-Label-Fields="TRUE" --><input TYPE="hidden"
NAME="VTI-GROUP" VALUE="0"><!--webbot bot="SaveResults" endspan --><div
      align="center"><center><p><input type="button" value="Accepts Feelings"
name="B1"></p>
      </center></div>
    </form>
    </td>
  </tr>
  <tr>
    <td width="41%" height="1" align="center"><form method="POST" action="--
WEBBOT-SELF--">
      <!--webbot bot="SaveResults" startspan U-File="_private/form_results.txt"
      S-Format="TEXT/CSV" S-Label-Fields="TRUE" --><input TYPE="hidden"
NAME="VTI-GROUP" VALUE="1"><!--webbot bot="SaveResults" endspan --
><p><input
      type="button" value="Praises or Encourages" name="B1"></p>
    </form>
    </td>
  </tr>
  <tr>
    <td width="41%" height="19" align="center"><form method="POST" action="--
WEBBOT-SELF--">
      <!--webbot bot="SaveResults" startspan U-File="_private/form_results.txt"
      S-Format="TEXT/CSV" S-Label-Fields="TRUE" --><input TYPE="hidden"
NAME="VTI-GROUP" VALUE="2"><!--webbot bot="SaveResults" endspan --
><p><input
      type="button" value="Accepts Or Uses Ideas" name="B1"></p>
    </form>
    </td>
  </tr>
  <tr>
    <td width="20%" rowspan="4" height="94">Teacher Talk <em>Direct
Influence</em></td>
    <td width="39%" height="19" align="center"><form method="POST" action="--
WEBBOT-SELF--">
      <!--webbot bot="SaveResults" startspan U-File="_private/form_results.txt"
      S-Format="TEXT/CSV" S-Label-Fields="TRUE" --><input TYPE="hidden"
NAME="VTI-GROUP" VALUE="3"><!--webbot bot="SaveResults" endspan --
><p><input
      type="button" value="Asks Questions"></p>
    </form>
    </td>
  </tr>
  <tr>
```

```
  <td width="41%" height="19" align="center"><form method="POST" action="--
WEBBOT-SELF--">
    <!--webbot bot="SaveResults" startspan U-File="_private/form_results.txt"
    S-Format="TEXT/CSV" S-Label-Fields="TRUE" --><input TYPE="hidden"
NAME="VTI-GROUP" VALUE="4"><!--webbot bot="SaveResults" endspan --
><p><input
    type="button" value="Lecturing" name="B1"></p>
  </form>
  </td>
 </tr>
 <tr>
  <td width="41%" height="19" align="center"><form method="POST" action="--
WEBBOT-SELF--">
    <!--webbot bot="SaveResults" startspan U-File="_private/form_results.txt"
    S-Format="TEXT/CSV" S-Label-Fields="TRUE" --><input TYPE="hidden"
NAME="VTI-GROUP" VALUE="5"><!--webbot bot="SaveResults" endspan --
><p><input
    type="button" value="Giving Directions" name="B1"></p>
  </form>
  </td>
 </tr>
 <tr>
  <td width="41%" height="19" align="center"><form method="POST" action="--
WEBBOT-SELF--">
    <!--webbot bot="SaveResults" startspan U-File="_private/form_results.txt"
    S-Format="TEXT/CSV" S-Label-Fields="TRUE" --><input TYPE="hidden"
NAME="VTI-GROUP" VALUE="6"><!--webbot bot="SaveResults" endspan --
><p><input
    type="button" value="Criticizing Authority" name="B1"></p>
  </form>
  </td>
 </tr>
 <tr>
  <td width="20%" rowspan="2" height="44">Student Talk</td>
  <td width="39%" height="19" align="center"><form method="POST" action="--
WEBBOT-SELF--">
    <!--webbot bot="SaveResults" startspan U-File="_private/form_results.txt"
    S-Format="TEXT/CSV" S-Label-Fields="TRUE" --><input TYPE="hidden"
NAME="VTI-GROUP" VALUE="7"><!--webbot bot="SaveResults" endspan --
><p><input
    type="button" value="Student Talk - Response" name="B1"></p>
  </form>
  </td>
 </tr>
 <tr>
```

```
  <td width="41%" height="19" align="center"><form method="POST" action="--
WEBBOT-SELF--">
    <!--webbot bot="SaveResults" startspan U-File="_private/form_results.txt"
    S-Format="TEXT/CSV" S-Label-Fields="TRUE" --><input TYPE="hidden"
NAME="VTI-GROUP" VALUE="8"><!--webbot bot="SaveResults" endspan --
><p><input
    type="button" value="Student Talk - Initiation" name="B1"></p>
  </form>
  </td>
 </tr>
 <tr>
  <td width="20%" height="38">Silence / Confusion</td>
  <td width="39%" height="38" align="center"><form method="POST" action="--
WEBBOT-SELF--">
    <!--webbot bot="SaveResults" startspan U-File="_private/form_results.txt"
    S-Format="TEXT/CSV" S-Label-Fields="TRUE" --><input TYPE="hidden"
NAME="VTI-GROUP" VALUE="9"><!--webbot bot="SaveResults" endspan --
><p><input
    type="button" value="None of the Above" name="B1"></p>
  </form>
  </td>
 </tr>
 <tr>
  <td width="20%" rowspan="3" height="88">Type</td>
  <td width="39%" height="19" align="center"><form method="POST" action="--
WEBBOT-SELF--">
    <!--webbot bot="SaveResults" startspan U-File="_private/form_results.txt"
    S-Format="TEXT/CSV" S-Label-Fields="TRUE" --><input TYPE="hidden"
NAME="VTI-GROUP" VALUE="10"><!--webbot bot="SaveResults" endspan --
><p><input
    type="button" value="Instructor-Student" name="B1"></p>
  </form>
  </td>
 </tr>
 <tr>
  <td width="26%" height="19" align="center"><form method="POST" action="--
WEBBOT-SELF--">
    <!--webbot bot="SaveResults" startspan U-File="_private/form_results.txt"
    S-Format="TEXT/CSV" S-Label-Fields="TRUE" --><input TYPE="hidden"
NAME="VTI-GROUP" VALUE="11"><!--webbot bot="SaveResults" endspan --
><p><input
    type="button" value="Student-Student" name="B1"></p>
  </form>
  </td>
 </tr>
 <tr>
```

```
   <td width="26%" height="38" align="center"><form method="POST" action="--
WEBBOT-SELF--">
     <!--webbot bot="SaveResults" startspan U-File="_private/form_results.txt"
     S-Format="TEXT/CSV" S-Label-Fields="TRUE" --><input TYPE="hidden"
NAME="VTI-GROUP" VALUE="12"><!--webbot bot="SaveResults" endspan --
><p><input
     type="button" value="Student-Lesson Material" name="B1"></p>
   </form>
   </td>
  </tr>
  <tr>
   <td width="20%" rowspan="9" height="257">Method Of Interaction</td>
   <td width="39%" height="19" align="center"><form method="POST" action="--
WEBBOT-SELF--">
     <!--webbot bot="SaveResults" startspan U-File="_private/form_results.txt"
     S-Format="TEXT/CSV" S-Label-Fields="TRUE" --><input TYPE="hidden"
NAME="VTI-GROUP" VALUE="13"><!--webbot bot="SaveResults" endspan --
><p><input
     type="button" value="Start A New IRI Tool" name="B1"></p>
   </form>
   </td>
  </tr>
  <tr>
   <td width="26%" height="19" align="center"><form method="POST" action="--
WEBBOT-SELF--">
     <!--webbot bot="SaveResults" startspan U-File="_private/form_results.txt"
     S-Format="TEXT/CSV" S-Label-Fields="TRUE" --><input TYPE="hidden"
NAME="VTI-GROUP" VALUE="14"><!--webbot bot="SaveResults" endspan --
><p><input
     type="button" value="Turn On Microphone" name="B1"></p>
   </form>
   </td>
  </tr>
  <tr>
   <td width="26%" height="38" align="center"><form method="POST" action="--
WEBBOT-SELF--">
     <!--webbot bot="SaveResults" startspan U-File="_private/form_results.txt"
     S-Format="TEXT/CSV" S-Label-Fields="TRUE" --><input TYPE="hidden"
NAME="VTI-GROUP" VALUE="15"><!--webbot bot="SaveResults" endspan --
><p><input
     type="button" value="Take Control Of Video Window" name="B1"></p>
   </form>
   </td>
  </tr>
  <tr>
```

```
   <td width="26%" height="38" align="center"><form method="POST" action="--
WEBBOT-SELF--">
     <!--webbot bot="SaveResults" startspan U-File="_private/form_results.txt"
     S-Format="TEXT/CSV" S-Label-Fields="TRUE" --><input TYPE="hidden"
NAME="VTI-GROUP" VALUE="16"><!--webbot bot="SaveResults" endspan --
><p><input
     type="button" value="Take Control Of A Shared Tool" name="B1"></p>
   </form>
   </td>
  </tr>
  <tr>
   <td width="26%" height="19" align="center"><form method="POST" action="--
WEBBOT-SELF--">
     <!--webbot bot="SaveResults" startspan U-File="_private/form_results.txt"
     S-Format="TEXT/CSV" S-Label-Fields="TRUE" --><input TYPE="hidden"
NAME="VTI-GROUP" VALUE="17"><!--webbot bot="SaveResults" endspan --
><p><input
     type="button" value="Slide Action" name="B1"></p>
   </form>
   </td>
  </tr>
  <tr>
   <td width="26%" height="19" align="center"><form method="POST" action="--
WEBBOT-SELF--">
     <!--webbot bot="SaveResults" startspan U-File="_private/form_results.txt"
     S-Format="TEXT/CSV" S-Label-Fields="TRUE" --><input TYPE="hidden"
NAME="VTI-GROUP" VALUE="18"><!--webbot bot="SaveResults" endspan --
><p><input
     type="button" value="Use White Board" name="B1"></p>
   </form>
   </td>
  </tr>
  <tr>
   <td width="26%" height="19" align="center"><form method="POST" action="--
WEBBOT-SELF--">
     <!--webbot bot="SaveResults" startspan U-File="_private/form_results.txt"
     S-Format="TEXT/CSV" S-Label-Fields="TRUE" --><input TYPE="hidden"
NAME="VTI-GROUP" VALUE="19"><!--webbot bot="SaveResults" endspan --
><p><input
     type="button" value="Use Survey Tool" name="B1"></p>
   </form>
   </td>
  </tr>
  <tr>
   <td width="26%" height="19" align="center"><form method="POST" action="--
WEBBOT-SELF--">
```

```
    <!--webbot bot="SaveResults" startspan U-File="_private/form_results.txt"
    S-Format="TEXT/CSV" S-Label-Fields="TRUE" --><input TYPE="hidden"
NAME="VTI-GROUP" VALUE="20"><!--webbot bot="SaveResults" endspan --
><p><input
    type="button" value="Document Camera" name="B1"></p>
   </form>
   </td>
  </tr>
  <tr>
   <td width="26%" height="19" align="center"><form method="POST" action="--
WEBBOT-SELF--">
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    S-Format="TEXT/CSV" S-Label-Fields="TRUE" --><input TYPE="hidden"
NAME="VTI-GROUP" VALUE="21"><!--webbot bot="SaveResults" endspan --
><p><input
    type="button" value="Note Pad" name="B1"></p>
   </form>
   </td>
  </tr>
</table>
</center></div>

<p>   </p>

<p>           &nb
sp;           &nbs
p;            
;            
  
            
            
   
   <a href="front.htm">[Study Data Section]</a></p>

<p>           &nb
sp;           &nbs
p; &nbspbsp;         &n
bsp;    
<a href="front.htm">[Data Analysis Section]</a></p>
</body>
</html>
```

Data Analysis page

```
<html>

<head>
<title>New Page 1</title>
</head>

<body stylesrc="http://ibm/mikesweb/front.htm">

<p> </p>

<h1>           &n
bsp;       
<font color="#0000A0">DATA ANALYSIS SECTION</font></h1>

<table border="1" width="50%">
  <tr>
    <td width="54%"><strong>Course Nomenclature</strong></td>
    <td width="46%"> </td>
  </tr>
  <tr>
    <td width="54%"><strong>Course Title</strong></td>
    <td width="46%"> </td>
  </tr>
  <tr>
    <td width="54%"><strong>Instructor</strong></td>
    <td width="46%"> </td>
  </tr>
  <tr>
    <td width="54%"><strong>Scheduled Convenings</strong></td>
    <td width="46%"> </td>
  </tr>
  <tr>
    <td width="54%"><strong>Observation Time Period</strong></td>
    <td width="46%"> </td>
  </tr>
  <tr>
    <td width="54%"><strong>Amplifying Data</strong></td>
    <td width="46%"> </td>
  </tr>
</table>

<h2><strong>          &
nbsp;           &n
```

```
bsp;           &nb
sp; 
   <font color="#0000A0">RESULTS</font>  </strong></h2>

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  <td width="39%" height="57"></td>
  <td width="9%" height="57"><strong>No of Ocurrences</strong></td>
  <td width="15%" height="57"><strong>Occurence Pct of Total</strong></td>
  <td width="10%" height="57"><strong>Avg Time</strong></td>
  <td width="10%" height="57"><strong>Total Time</strong></td>
  <td width="15%" height="57"><strong>Time Pct of Total</strong></td>
 </tr>
 <tr>
  <td width="26%" rowspan="3" height="69"><strong>Teacher Talk Indirect
Influence</strong></td>
  <td width="39%" height="19">Accepts Feelings</td>
  <td width="9%" height="19"><font color="#FFFFFF">.</font></td>
  <td width="15%" height="19"><font color="#FFFFFF">.</font></td>
  <td width="10%" height="19"></td>
  <td width="10%" height="19"></td>
  <td width="15%" height="19"></td>
 </tr>
 <tr>
  <td width="41%" height="19">Praises Or Encourages</td>
  <td width="18%" height="19"><font color="#FFFFFF">.</font></td>
  <td width="15%" height="19"></td>
  <td width="15%" height="19"></td>
  <td width="10%" height="19"></td>
  <td width="10%" height="19"></td>
 </tr>
 <tr>
  <td width="41%" height="19">Accepts or Uses Ideas</td>
  <td width="18%" height="19"><font color="#FFFFFF">.</font></td>
  <td width="15%" height="19"></td>
  <td width="15%" height="19"></td>
  <td width="10%" height="19"></td>
  <td width="10%" height="19"></td>
 </tr>
 <tr>
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Influence</strong></td>
  <td width="39%" height="19">Asks Quesiton</td>
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  <td width="15%" height="19"></td>
```

```
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<td width="10%" height="19"></td>
<td width="15%" height="19"></td>
</tr>
<tr>
<td width="41%" height="19">Lecturing</td>
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<tr>
<td width="41%" height="19">Giving Directions</td>
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<td width="10%" height="19"></td>
<td width="10%" height="19"></td>
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<tr>
<td width="41%" height="19">Criticizing Authority</td>
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<td width="10%" height="19"></td>
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<tr>
<td width="26%" rowspan="2" height="44"><strong>Student Talk</strong></td>
<td width="39%" height="19">Student Talk Dispense</td>
<td width="9%" height="19"></td>
<td width="15%" height="19"></td>
<td width="10%" height="19"></td>
<td width="10%" height="19"></td>
<td width="15%" height="19"></td>
</tr>
<tr>
<td width="41%" height="19">Student Talk Initiation</td>
<td width="18%" height="19"></td>
<td width="15%" height="19"></td>
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<td width="10%" height="19"></td>
<td width="10%" height="19"></td>
</tr>
<tr>
```

```
    <td width="26%" height="38"><strong>Silence Confusion</strong></td>
    <td width="39%" height="38">None Of the Above</td>
    <td width="9%" height="38"></td>
    <td width="15%" height="38"></td>
    <td width="10%" height="38"></td>
    <td width="10%" height="38"></td>
    <td width="15%" height="38"></td>
  </tr>
  <tr>
    <td width="26%" rowspan="3" height="88"><strong>Type</strong></td>
    <td width="39%" height="19">Instructor-Student</td>
    <td width="9%" height="19"></td>
    <td width="15%" height="19"></td>
    <td width="10%" height="19"></td>
    <td width="10%" height="19"></td>
    <td width="15%" height="19"></td>
  </tr>
  <tr>
    <td width="26%" height="19">Student-Student</td>
    <td width="39%" height="19"></td>
    <td width="9%" height="19"></td>
    <td width="15%" height="19"></td>
    <td width="10%" height="19"></td>
    <td width="10%" height="19"></td>
  </tr>
  <tr>
    <td width="26%" height="38">Student- Lesson Material</td>
    <td width="39%" height="38"></td>
    <td width="9%" height="38"></td>
    <td width="15%" height="38"></td>
    <td width="10%" height="38"></td>
    <td width="10%" height="38"></td>
  </tr>
  <tr>
    <td width="26%" rowspan="9" height="257"><strong>Method Of
Interaction</strong></td>
    <td width="39%" height="19">Start A New IRI Tool</td>
    <td width="9%" height="19"></td>
    <td width="15%" height="19"></td>
    <td width="10%" height="19"></td>
    <td width="10%" height="19"></td>
    <td width="15%" height="19"></td>
  </tr>
  <tr>
    <td width="26%" height="19">Turn on Microphone</td>
    <td width="39%" height="19"></td>
```

```
<td width="9%" height="19"></td>
<td width="15%" height="19"></td>
<td width="10%" height="19"></td>
<td width="10%" height="19"></td>
</tr>
<tr>
<td width="26%" height="38">Take Control Of Video Window</td>
<td width="39%" height="38"></td>
<td width="9%" height="38"></td>
<td width="15%" height="38"></td>
<td width="10%" height="38"></td>
<td width="10%" height="38"></td>
</tr>
<tr>
<td width="26%" height="38">Take Control Of Shared Tool</td>
<td width="39%" height="38"></td>
<td width="9%" height="38"></td>
<td width="15%" height="38"></td>
<td width="10%" height="38"></td>
<td width="10%" height="38"></td>
</tr>
<tr>
<td width="26%" height="19">Slide Action</td>
<td width="39%" height="19"></td>
<td width="9%" height="19"></td>
<td width="15%" height="19"></td>
<td width="10%" height="19"></td>
<td width="10%" height="19"></td>
</tr>
<tr>
<td width="26%" height="19">Use White Board</td>
<td width="39%" height="19"></td>
<td width="9%" height="19"></td>
<td width="15%" height="19"></td>
<td width="10%" height="19"></td>
<td width="10%" height="19"></td>
</tr>
<tr>
<a href="front.htm">[Study Data Section]</a></p>
</body>
</html>
```

Browser Previews

The following pages contain browser previews of the actual instrument pages.

COMPUTER-BASED INTERACTIONAL EVENT ANALYSIS INSTRUMENT

STUDY DATA SECTION

Enter the Following Information And Then Proceed To The Data Collection Section.

Course Nomenclature	
Course Title	
Instructor	
Scheduled Convenings	
Observation Time Period	
Amplifying Data	

DATA COLLECTION SECTION

Fri Nov 19 10:03:30 EST 1

OFF ON

Teacher Talk *Indirect Influence*	[redacted]
	[redacted]
	[redacted]
Teacher Talk *Direct Influence*	[redacted]
	[redacted]
	[redacted]
	[redacted]
Student Talk	[redacted]
	[redacted]
Silence / Confusion	[redacted]

Type	[redacted]
	[redacted]
	[redacted]
Method Of Interaction	[redacted]
	[redacted]
	[redacted]
	[redacted]
	[redacted]
	[redacted]
	[redacted]
	[redacted]
	[redacted]

[Study Data Section]

[Data Analysis Section]

DATA ANALYSIS SECTION

Course Nomenclature	
Course Title	
Instructor	
Scheduled Convenings	
Observation Time Period	
Amplifying Data	

RESULTS

		No of Ocurrences	Occurence Pct of Total	Avg Time	Total Time	Time Pct of Total
Teacher Talk Indirect Influence	Accepts Feelings	.	.			
	Praises Or Encourages	.				
	Accepts or Uses Ideas	.				
Teacher Talk Direct Influence	Asks Quesiton	.				
	Lecturing	.				
	Giving Directions	.				
	Criticizing Authority	.				
Student Talk	Student Talk Dispense					
	Student Talk Initiation					
Silence Confusion	None Of the Above					
Type	Instructor-Student					
	Student-Student					
	Student- Lesson Material					

Method Of Interaction	Start A New IRI Tool	
	Turn on Microphone	
	Take Control Of Video Window	
	Take Control Of Shared Tool	
	Slide Action	
	Use White Board	
	Use Survey Tool	
	Document Camera	
	Giving Directions	

[Study Data Section]

APPENDIX G

INSTRUCTOR INTERACTIVITY SURVEY

INSTRUCTOR INTERACTIVITY SURVEY

Directions

1. Please darken in the number on the scale that most accurately corresponds to your answer

	Never					Often
Throughout your experience as an instructor:						
* How often do you ask questions of the students?	1	2	3	4	5	6
During this class:						
* How often did you ask questions of the students?	1	2	3	4	5	6
Throughout your experience as an instructor:						
* How often do students ask you questions?	1	2	3	4	5	6
During this class:						
* How often did students ask you questions? of the students?	1	2	3	4	5	6

	Never					Often
Throughout your experience as an instructor:						
* How often do students volunteer their opinion?	1	2	3	4	5	6
During this class:						

* How often did students volunteer their opinion?	1 2 3 4 5 6
	Low High
Throughout your experience as an instructor:	
* What level of interaction is there between you and the student?	1 2 3 4 5 6
During this class:	
* What level of interaction was there between you and the student?	1 2 3 4 5 6
Throughout your experience as an instructor:	
* What level of interaction is there among the students themselves?	1 2 3 4 5 6
During this class:	
* What level of interaction was there among the students?	1 2 3 4 5 6
	Low High
* Overall, what level of interaction do you think occurred today?	1 2 3 4 5 6
	0% 100%
Throughout your experience as an instructor:	
* What percentage of the time do you and participants in your class spend interacting?	1 2 3 4 5 6
During this class:	

* What percentage of the time did you 1 2 3 4 5 6

and participants in your class spend interacting?

Negative Positive

During this class:

* How did the level of interaction make 1 2 3 4 5 6

you feel?

* How do you feel about today's lesson 1 2 3 4 5 6

as a whole?

The following is a general model of pedagogical forms:

1. Content Presentation: Formal or informal presentations of pre-determined curriculum content, related information, concepts or principles by faculty, guest speakers or students, and illustration (procedural presentations or event sequence demonstrations).

2. Verbal Techniques: Rendition of written documentation, text or materials. Group interaction whether ad-hoc or planned. Question and answer periods and social conversations.

3. Interactive Application Techniques: Two-way television environment: Multimedia referencing (overhead projectors) or similar display tools and live camera feeds. Computer-based distance learning mediums encompass separate or parallel (ongoing) interactions for audio, imported video, electronic presentations, whiteboards, Web page displays, Web co-browsing, and computer-driven simulations.

Do you feel your personal pedagogy differs greatly from this model?

_____ Yes _____ No

If yes, would you briefly describe below in what way?

Demographic Information (Please Print)

Name: ____

Course: ______________________

Date of birth: __________________

*Race/Ethnicity: African-American*____ *Hispanic*____

*Caucasian*____ *Asian descent*____

Other (please explain): ____

*Number of years teaching experience:*____________________

*Number of months/years of Two-way television/two-way audio distance learning teaching experience:*_______

*Number of months/years of computer-based distance learning teaching experience:*_______

Sex: *M*___ *F*___

Did you take this survey at ODU's

__ *Main Campus*

__ *Graduate Center or other remote site*

Thank you!

The survey administrator will collect this survey upon completion.

VITA

Michael Shawn Ireland was born in Emporia, Kansas and raised in the Kansas City area. He enlisted into the United States Navy as an electronics technician in December of 1980. He earned an Associate of Science degree from the State University of New York in September 1986 and Associates in Arts degree from the University of Maryland in August 1988. In August of 1991 he earned a Bachelor of Science degree from the University of Maryland and in December of 1992 completed graduate studies with Troy State University earning a Master of Science degree.

In 1994 he was commissioned as an Electronics Material Officer. His significant military assignments include the USS Orion, La Maddelena, Sardegna, USS L.Y. Spear, Norfolk, Virginia, Headquarters Landsoutheast Izmir, Turkey, and USS Guam, Norfolk, Virginia. Lieutenant Ireland has conducted numerous peacekeeping deployments to Europe, the Mediterranean, the Middle East and Africa and is currently serving as the Combat Systems Coordinator and Electronic Systems Officer aboard the guided missile destroyer, USS Barry in Norfolk, Virginia.

Lieutenant Ireland resides in Virginia Beach, Virginia with his wife Tijen and daughter Ashley.