CHARACTERISTICS LEADING TO STUDENT SUCCESS: A STUDY OF ONLINE LEARNING ENVIRONMENTS

by

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ABSTRACT
CHARACTERISTICS LEADING TO STUDENT SUCCESS:
A STUDY OF ONLINE LEARNING ENVIRONMENTS

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This exploratory study examined the effect of multi-tasking ability and graphics versus text preference, as well as history of technology usage on high school student performance in an online environment. The study's objective was to explore, through the collection of data, the questions derived from review of the current research literature that examined online learning environments in the K-12 community. The goal was to identify trends that emerged from analysis, rather than in prior findings, for the generation of hypotheses grounded in the data that warrant further study. Students who had successfully completed an online high school course through SUPERNet Virtual School were compared with students who had begun such a course, but not completed it, to determine if a variance between the history of digital device usage, information presentation preference, or multi-media processing skills between course completers and non-completers could be identified. The purpose of the study was to inform, through its findings, both content and process of virtual course delivery in an effort to provide course offerings that meet the needs of a broader range of learners.

Students randomly selected, representing 75 completers and 75 non-completers, were sent requests for inclusion in the study. Positive respondents included 23 completers

and 13 non-completer. This convenience sample total of 36 students was sent a packet of three surveys designed to measure media literacy preferences, multi-tasking ability, and technology usage traits. Twenty- three students, 14 completers and 9 non-completers returned completed packets, representing a 64% return rate. ANOVA performed on technology history and multi-task data and used descriptively indicated frequent digital gaming and usage beginning at an earlier age by non-completers and greater multi-tasking proficiency by completers. Chi-square tests on graphics preference data showed small areas of differences between the two groups. Stem-and-leaf plots were further utilized to illuminate trends. This study identified areas of interest that warrant a larger study under a more controlled environment.

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Dedication

I dedicate this final product to my family, my amazing husband, Brad Crawford, who after 20+ years remains the “wind beneath my wings” and “my only love”; and my children, Rik, Tavia, and Charlie who never cease to amaze and delight me. Not to be forgotten are my mom and dad, Jo and Charlie Dean who bred then nurtured my values and convictions and my little sister, Ann, who, had she not jumped head first into the pool of the terminal degree, I probably would not have gone in after her! Also, not to be forgotten, my mother-in-law and late father-in-law, Willie and Gene Crawford, who have made me a part of their family since the day I married into it. You ALL are my inspiration.

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Chapter 1

INTRODUCTION

Tremendous innovation in communication technologies over the past 12 years has significantly impacted all levels of education. The Children's Partnership's 2005 Report, *Measuring Digital Opportunity for America's Children: Where We Stand and Where We Go From Here,* reported that although in 1994, only 3% of America's public school "instructional rooms" had Internet connectivity, by 2003 that number had grown to 93% (Lazarus, Wainer, & Lipper, 2005, p. 2). Connectivity at home increased dramatically during the same time period. In 1994, only 36% of school age children had access to personal computers at home, and only 15% of homes were installed with modems. Those numbers grew to 77% and 68% respectively by 2003 (Lazarus et al.). Gary Marx (2006), futurist, identified 16 trends that will have huge implications for the future of education. The fourth entry on the list of trends states, "Technology will increase the speed of communication and the pace of advancement or decline" (Marx, 2006, p. 17). Although Marx did not contend to know precisely the full ramifications technological advances will have on society, he did profess,

> Those schools and colleges, communities, businesses, and countries that make appropriate use of technology to help unleash the genius of their people will likely move forward at an unprecedented rate. Those that do not will likely fall backward at the same dizzying pace. (Marx, p.17)

The initial chapter of this study explains the study background, states the problem, provides an overview of the method utilized, and describes its professional significance. Finally, the chapter defines pertinent terms, outlines limitations and delimitations of the study, and summarizes the implications sought.

Background

Online learning and virtual schools, defined as "learning programs that offer formal instruction, not merely instructional resources or content" (Smith, Clark, & Blomeyer, 2005, p. 4), exploded with the growth in broadband connectivity. Online delivery offers multiple advantages for reaching the educationally underserved. Students who are isolated by location, such as those in rural areas or those who cannot attend traditional school settings due to health issues, can access virtual instructors without the need to travel. Remote locations unable to attract local highly qualified instructors may obtain access to such educators through digital means. "The first impetus to the growth in K-12 distance education was an interest in expanding educational options and providing equal opportunities for all learners" (Smith et al., p. 8). Research by Barker and Wendel (2001) has shown that virtual students have developed improved problem-solving and independent learning skills over and above their peers receiving instruction through traditional delivery.

> Academic advantages over traditional classroom instruction were demonstrated by students in Mexico's Telesecundaria program, who were "substantially more likely than other groups to pass a final 9th grade examination" administered by the state (Calderoni, 1998, p.6); by students taking a chemistry by satellite course (Dees, 1994); and by students learning reading and math via interactive radio instruction. (Yasin & Luberisse, 1998, as cited in Cavanaugh, Gillan, Kromrey, Hess, & Blomeyer, 2004, p. 5)

Potential disadvantages such as students feeling isolated or limited in their ability to interact with the teacher or other students were discovered as well. Heavy reliance on text in most online offerings posed challenges for those students with language limitations or other learning styles. Course limitations were observed as the arts and

physical activity classes were seldom offered in a digital format (Cavanaugh et al., 2004). "Virtual school students in comparison to CS [conventional school] students, are inclined to experience less improvement in the academic and communication skills of listening and speaking" (Barker & Wendel, 2001, p. ix). Concerns over funding and policy decisions have the potential to increase rather than narrow educational gaps (Blomeyer, 2002). The findings of no significant difference in student performance in courses delivered by distance compared to traditional studies in Russell's (1999) landmark study, and later in another such study by Bernard, Abrami, Lou, and Borokhovski (2004), elicited a dual argument in response to the same findings. Although one camp insisted that a finding of no significant difference indicated a lack of benefit from the use of technology, therefore establishing no justification for the added expenditure, the reverse argument held that if students could be equally served academically through technology, the broadened opportunities with its implementation justified the costs.

Student academic success in virtual formats remained a primary concern for educational policy leaders. Many of the initial findings centered on post-secondary programs. Though such studies provided insights, differences in educational maturity between children and adults were not addressed. Although adult learners are motivated by internal factors, making online delivery an excellent resource for that population, youth generally derive their motivation from external sources (Knowles, 1990). With the growth of virtual high schools, additional resources have appeared.

> Many studies of K-12 distance education have been published, but a small proportion of them are controlled, systematic, empirical comparisons that fit the definition of "scientific," as it is defined by the U. S. Department of Education and described at the What Works Clearinghouse website, http://www.w-w-c.org. (Cavanaugh et al., 2004, p. 8).

However, in the past 3 years, organizations such as Learning Point Associates, North Central Regional Educational Laboratory (NCREL), WestEd, as well as others, have published scientifically based research focused on K-12 online delivery. Studies focused on the K-12 students, such as the meta-analysis by Cavanaugh et al. (2004), and the K-12 research synthesis by Smith et al. (2005), found differences based around educational independence, autonomy, and locus of control issues that suggested the need to examine the two populations, adults and youth, independently.

A large portion of today's K-12 learners was introduced to technology virtually from the cradle. Baby Einstein (the Baby Einstein Company, LLC) and other computer generated sensory programs geared at the very young have been widely available for several years. Though Prensky (2001) has not contributed heavily to research, his understandings and definitions of K-12 students hit the mark.

> At the turn of the millennium, the median age of the U. S. workforce is 39. …This means that half of all corporate employees were born after 1961. The oldest of this group were 7 years old when men landed on the moon; most were not even born. Most have never used a rotary dial telephone, never known a time when music wasn't totally portable or digital, never lived without hundreds of thousands of video images a day, never known a world without some kind of computer. (Prensky, 2001a, Ch. 02, p. 2)

Electronic gaming, either by desktop computer, television-connected unit, or handheld device has exploded in recent years. The United States consumer, in 2001, invested in excess of $6 billion on gaming (Dickey, 2005). Multiple studies; such as those by Blumberg and Sokol (2004), Calvert, Rideout, Woolard, Barr, and Strouse (2005), and Green and Bavelier (2003); concerning individuals who have grown up gaming have discovered that the practice may alter cognitive areas such as visual attention, problem solving strategies, and spatial skills that impact learning.

The challenge for today's educational leaders is to integrate the research indicating cognitive changes in today's student with that of K-12 online learning in order to fully maximize technological advances and to support higher levels of student success. The potential for online delivery to close the access gaps in K-12 education does exist.

> Among the benefits of distance education for school-age children are increases in enrollment or time in school as education programs reach underserved regions, broader educational opportunity for students who are unable to attend traditional schools, access to resources and instructors not locally available, and increases in student-teacher communication. (Cavanaugh et al., 2004, p. 5)

However, if quality, rigor, and retention suffer, the gains may be minimal at best. Emphasis on implementation of research recommendations during course creation and delivery ensure the provision of quality course offerings to students. This study, in recognition of the educational challenges of equity of access to a quality education, attempts to provide some direction in bridging these gaps.

Statement of the Problem

Small, rural, and underserved K-12 schools often lack the ability to adequately staff and deliver a full and rigorous high school curriculum as dictated by the federal No Child Left Behind Act of 2001. This disparity creates unequal footing as students from underserved institutions compete for entry to the same colleges, military positions, and job placements as those from wealthier, better-located schools. Technological advances in the past 10 years have virtually closed the access gaps to school districts throughout the United States. This could lead to addressing equity issues.

This study isolated two differences in learning style suggested by Prensky (2001), parallel processing ability, as measured herein by multi-tasking skill, and preference for graphics-first over text presentation. Prensky believed that today's learner has been

impacted by his/her early and prolonged exposure to technology, particularly video gaming. Research publications by Blumberg and Sokol (2004), Brown (2000), Calvert et al. (2005), Gee (2005), Green and Bavelier (2003), Greenfield, DeWinstanley, Kilpatrick, and Kaye (1994), Mayer and Moreno (1998), and Subrahmanyam and Greenfield (1994) have supported Prensky's notion.

This study was designed to explore whether these variances in today's learner contribute to a significant difference between those students who successfully complete online coursework and those who do not in order to lay a foundation for further studies in the area of K-12 online learning. The two questions used to explore possible variances were:

1. Is the amount of exposure to digital devices and deliveries such as video gaming, cell phone usage, Internet usage, and instant messaging altering the way students think?
2. Is there a measurable skill-based trait or media literacy preference that can predict student success in an online environment?

Purpose and Objectives of the Study

Reports on completion rates for online courses vary widely by program. Reported rates range from "less than 50% to 90% as reported at a recent conference of statewide online program administrators" (Kalmon, 2003, p. 1). A 90% completion rate demonstrates a positive resource worth an investment of time and money, a less than 50% rate may leave stakeholders questioning the soundness of a decision to proceed. Knowledge of how to maximize completion rates from the initial design of programming is an important aspect of online success.

Identifying students who are good candidates for an online environment is one method employed to improve completion rates. Roblyer and Marshall's study (2002–2003), developed an instrument for determining student success in virtual courses, called

the Educational Success Prediction Instrument (ESPRI), and then evaluated its precision. The ESPRI was shown to accurately identify successful and unsuccessful online students prior to their taking the course. The study found the only significant difference in personal characteristics such as age and gender to be in the number of hours students worked outside of school. All other significant determiners revolved around attitudes about personal academic ability along with organizational and self-esteem attitudes (Roblyer & Marshall, 2002–2003). "Online learning programs frequently target students who are self-motivated, self-disciplined, and college bound" (Kalmon, 2003, p. 4). The purpose of this study was to explore whether measurable skills and media literacy preferences other than self-identified psychological traits could predict successful online learners. This study also sought to explore whether a relationship existed between multi-tasking ability, preference for graphics-first presentation, or level of previous technology usage and successful completion of an online high school course. These more skills-based traits and media literacy preferences might identify students who would benefit from online opportunities but might not score well on an instrument such as ESPRI.

> . . .if online learning is going to enhance the equity of educational opportunity, it must serve a broader student population-"average" students, students on alternative paths, those who have limited English proficiency or physical or emotional disabilities, and students who have left school altogether. Otherwise, online learning is just another gifted and talented add-on, not a strategy for providing a meaningful extension of the educational experience. (Kalmon, pp. 4-5)

The study's objective was to explore, through the collection of data, the questions derived from review of the current research literature that examined online learning environments in the K-12 community. The goal was to identify trends that emerged from analysis for future generation of hypotheses grounded in the data, rather than in prior

findings, that warrant further study. To examine the study questions, the following objectives were addressed:

1. To determine if there is a significant difference between students who successfully complete (receive credit for) an online high school course and those who do not in their preference for graphics or text-first presentations.
2. To determine if there is a significant difference between students who successfully complete (receive credit for) an online high school course and those who do not in their ability to parallel process information as measured by multi-tasking accuracy.
3. To determine if there is a significant difference between students who successfully complete (receive credit for) an online high school course and those who do not in their previous technology usage.

Professional Significance

Electronic delivery of instruction can provide additional offerings for students underserved by their educational geographic or economic circumstance. Since research has indicated today's learner has been impacted by early and prolonged exposure to technology, particularly video gaming, consideration of new strengths should be incorporated into online instruction.

> The millennial generation has always had access to technology. Surrounded by computers and portable video games, students born between 1982 and 2000 spend more time surfing the web, building websites, communicating through instant messaging, and writing blogs than they do watching television. (Pape, 2005, p. 12)

This study seeks to discover a measurable way to determine skill sets and media literacy preferences common to this generation that will predict success in an online environment. The ability to identify the appropriate skills for success online by

nontraditional learners who may not be prospering in a conventional setting opens the door to expanded access and equity. Utilizing technology to serve only the self-motivated and high achieving does not expand access or address equity issues. More importantly, such implementation only serves to widen the divide between the haves and have-nots. Skill strengths should then be built upon in digital platforms to support academic achievement. Equity will be achieved when both access and quality are uniform. Instructional strategies meeting the needs of today's learner delivered virtually could potentially bridge multiple deficits and gaps in the educational system.

Method

Limited prior studies were uncovered in the literature comparing online students who successfully completed coursework with online students who did not successfully complete a virtually delivered course. This exploratory study utilized analysis of variance and chi-square Phi value calculations to examine the relationship between completion and non-completion of an online course and previous technology experience, parallel-thinking as measured by multi-tasking ability, or a primary preference for graphics or text. The goal was to explore the data collected for emergent trends that identified possible areas for future concentrated and controlled studies.

Course completion served as the factor variable. Two groups of subjects, those who had successfully completed an online SUPERNet high school course between the spring of 2004 and the spring of 2006 and those who had attempted such courses but not finished, completed surveys. The surveys were designed to measure the dependent variables. A set of questions asked respondents to rank previous technology experience on a Likert scale. An additional set of questions offered graphic and text-based presentation of the same material and asked for respondent preference. A third survey, designed to measure lateral-processing or multi-tasking ability used multiple inputs of information on a single computer screen then quizzed students on the accuracy of their

acquisition of the information. Prensky (2001), author of *Digital Game-Based Learning*, suggested that in order to truly engage today's learner who has been raised on video inputs, learning must focus on the learner, not the content. "The issue is that most of our educators, coming from a previous generation and set of experiences, generally do not understand the new generation's need or learning methods" (Prensky, 2001b, Ch. 03, p. 18). This study is designed in anticipation of clarification of a minute portion of this concern in order to provide a doorway to further research.

Exploratory research provides an important contribution to the body of knowledge in many disciplines. Although not generally resulting in results generalizable to the larger population, exploratory studies can significantly impact the direction of research particularly in new or ill-defined arenas. Studies conducted on a small scale offer the ability for theories to emerge grounded in collected data, indicating a need for further controlled study. Such research may help to control study costs by illuminating areas of interest and eliminating deficient topics (Joppe, 2006).

Definitions

The following definitions of course levels are presented as defined in the 2005 *Growing by Degrees* study (Allen & Seaman).

Traditional or face-to-face course –none of the content is provided online.

Web facilitated course –online content comprises 1-29% of the delivery.

Hybrid or blended course –online content comprises 30-79% of the delivery.

Online course –80% or more of the course is delivered online (Allen & Seaman, 2005).

Additional definitions for this study are as follows:

Breeze™–a Macromedia product that appears as a Microsoft PowerPoint ™ plugin and allows the creation of online presentations and quizzes. The Breeze system used in this study is licensed by Texas A&M University-Commerce.

Completers –for the purpose of this study, a completer is defined as a student who took a

SUPERNet Virtual High School course between the spring of 2004 and spring of 2006 and received a grade and/or credit for at least one semester.

Exploratory Research Study –research performed when a problem is ill defined. Exploratory studies often help determine the best methodologies to be utilized for future studies or may determine that further research is not warranted. It may assist the researcher in generating hypotheses for further study. Exploratory studies are usually not generalizable to the larger population (Joppe, 2006).

Grounded Theory Approach –the practice of deriving theories or hypotheses inductively from data gathered, with the purpose of checking those theories in later research (Gall, Borg, & Gall, 1995; Straus & Corbin, 1990).

Lateral thinking –also referred to as parallel processing, or random access thinking- the ability to attend to and process more than one thing at a time. One illustration of this is hyperlinking on the web. Rather than following a thought in a step-by-step manner, one may jump from related topic to related topic in random order. The level of skill for this ability is measured in this study by the ability to multi-task.

Non-completers –for the purpose of this study, a non-completer is defined as a student who registered for a SUPERNet Virtual High School course between the spring of 2004 and spring of 2006, completed online orientation, but dropped or withdrew from the course before receiving a grade.

Virtual school –"educational organizations that offer K-12 courses through Internet- or Web-based methods" (Clark, 2001, p. i).

Limitations and Delimitations

This study requested participation from a random sample of 150 high school students limited to one program in East Texas and to those who enrolled in an online course over a 2-year period between the spring semester of 2004 and the spring semester of 2006. Due to the age of the population and confidentiality levels of the participants,

the study sample frame was small and therefore impeded generalizability to larger or more diverse populations. The study may be limited by additional factors. The researcher served in the capacity of program manager during this time period. Direct involvement of the researcher in program design and management could have resulted in unintended biases within the study. Every precaution was taken to alleviate this situation. Course offerings also changed over the period of the study, increasing from the availability of only one course, Health, in the fall of 2002, to 14 courses by the spring of 2006. Lessons learned over the 4-year period of operation concerning working with high school students in online delivery of instruction informed practice throughout the period and should also be considered as a delimitation. Online delivery procedures improved throughout the period as did the manner in which students were recorded in the database. Initially, any student who registered for a course was entered into the database. After the summer of 2003, students were required to complete an online orientation process before being allowed access to course materials. Any student who registered but did not complete the required orientation was deleted from the database. Therefore, after the summer of 2003, any student listed as a non-completer actually had begun a minimum of a few lessons of course material. Most of the study population attended small, rural campuses.

Data are also limited by the lack of ability to tie demographic information directly to study respondents. Though general demographic information of the group as a whole was available, efforts to maintain subject anonymity precluded the ability to connect specific survey responses to specific subjects. The importance of maintaining the privacy of individual minor students, particularly when the sample size was small and limited by geographic setting, outweighed the value of the data lost.

The multi-tasking multi-media presentation created for use in this study was designed to be delivered via the Internet to a computer screen. A “plan B” videotaped recording was offered to students who might have difficulty with access or bandwidth

issues in viewing the piece; therefore, respondents may have viewed this portion of the packet under only similar conditions.

Overview

This study reviewed the literature, presenting the history of virtual schools and their impact on the K-12 educational community. The advantages, disadvantages, and challenges of delivering course content via distances were explored. Literature that indicated new literacy emphasis in the information age was presented. These readings raised questions about the effect of constant digital inputs on this generation's cognitive strengths as opposed to their instructor's information presentation styles. The review concluded with a look at attempts to predict student success in an online environment. Based upon the information reported, this study then attempted to explore questions that could lead to hypotheses for further study into whether or not there a variance between students who were successful in an online environment and those who were not successful could be identified. The study sought to find measurable, skills-based and media literacy factors as opposed to self-reported personality characteristics that could account for recognizable differences. The results were intended to inform both virtual course content and processes, as well as student recruitment and retention to online environments.

Summary

This chapter introduced the reader to growing interest in virtual or online instruction at the K-12 level. The study's efforts to inform and improve practice in online delivery and the professional significance of attention to equity of access as opportunities expand were discussed. The method of this study was outlined and key terms were defined. Limitations created by the study design were delimited and an overview of the remaining chapters was presented.

Chapter 2 reviews current literature addressing online course delivery as well as virtual schooling. Chapter 3 outlines the method employed within this study including explanations of the subjects, instrumentation, data gathering and data analysis. Chapter 4 presents the data and discusses findings. Chapter 5 concludes with a discussion of the findings and implications for further study.

Chapter 2

REVIEW OF LITERATURE

Introduction

Today's educational administrators and educational policy makers are faced with growing needs and shrinking resources to meet those needs. They must constantly seek opportunities to maximize fiscal, physical and human assets. Rapid technology innovations offer the potential to stretch resources over distances and provide previously unattainable resources. Virtual delivery offers the opportunity to reach remote areas and audiences of varying sizes with the same quality of course offerings. Technology opens the door to either narrowing or broadening the educational gaps between rich and poor, rural and urban.

> The Measuring Stick analysis of 40 quantitative indicators from respected national data sources shows that these potential benefits are starting to reach large numbers of children and young adults. But are they being delivered to all children? The Measuring Stick also documents a disturbing gap between low-income, ethnic minority, and disabled children and their peers in terms of reaping the benefits of digital opportunity. (Lazarus, Wainer, & Lipper, 2005, p. 6)

Online educational opportunities such as those provided in a virtual school environment hold promise for the future. "Through online courses and virtual school that serve both students and teachers, we can shift our focus from the three R's to an education system that builds skills in the three C's; content, collaboration and community" (Pape, 2005, p. 13). It is important that educational leaders become well informed about the potential benefits and drawbacks of such offerings. Issues of funding and policy concerns must be thoroughly examined to guarantee equitable and fiscally sound implementation. Further, student achievement, the ultimate goal for all educational

leaders, must be in the forefront of the decision-making process in the virtual classroom. Policy makers and instructional leaders alike must consult the research illuminating today's learner, their varied learning styles brought about by early and prolonged exposure to a technological age and the link with successful student learning. They must investigate the findings of the skills required for the "new literacy" (Brown, 2000, p. 14) and ensure that any educational offerings address current needs. The volume of information is exploding, "…the amount of published information on the Internet doubles every 54 days, we cannot continue to focus on an [traditional] educational system that primarily delivers information to students" (Pape, 2005, p. 12). No longer may school policy makers sit idly by as technology happens to them, they must take the lead in seeking and implementing educational opportunities focused on bridging the divides between students and leveling the playing field for all. "The administrator should be a planner, motivator, promoter, and supporter in the process to ensure quality online education" (Yang & Cornelious, 2004, p. 855). Knowing the differences in learners is crucial for administrators in order to promote successful learning for all students.

Background

Distance education, defined by Kaplan-Leiserson (as cited in Blomeyer, 2002), as teachers and students being separated by time, place or both, has been around in various forms as long as American education itself. In 1989, Nipper described distance education in three "generations" and Keegan updated his description in 1996 (as cited in Bernard, Abrami, Lou, & Borokhovski, 2004). Nipper's first generation included print-based correspondence type courses. The second-generation of distance education, its origination attributed to the Open University's establishment in 1969, expanded the print medium with the integration of a broadcast component via either audio, video recordings or both. Third-generation delivery included teleconferencing and hyperlinked Internet content. In 2001, Taylor added a fourth-generation that included the any time, any place,

Internet based delivery and a fifth-generation that added the elements of interactivity and learner control (as cited in Bernard, Abrami, et al.). E-learning, defined as a course delivery mechanism that requires some form of computer usage (Blomeyer, 2002) first became popular on college campuses and within industry for training purposes. With the explosive development of media rich Internet content in the early 21st century, e-learning became an affordable and accessible option (Fulton, 2002). Allen and Seaman (2005), in their third annual report on the progress of online offerings in higher education, found growth in the numbers of online students outpacing that of traditional enrollment growth in post-secondary institutions overall. "The online enrollment growth rate of 18.2% is over ten times that projected by the National Center for Education Statistics for the entire post-secondary student population" (p. 15). Pressure to properly prepare secondary students to take full advantage of these burgeoning post-secondary opportunities created a need for a mechanism to teach online skills. Virtual schools, "…educational organizations that offer K-12 courses through Internet or Web-based methods" (Clark, 2001, p. i) began to appear.

Virtual School History

Exponential increase in Internet access has fueled explosive growth of virtual schools. The nation's first public virtual school, originally called Concord Virtual High School began operation in 1996, funded through a $7.5 million, five year federal Challenge Grant (Blomeyer, 2002). At that time, only 14% of all classrooms in the United States had Internet access; by 1999 the number had increased to 63% (Web-based Commission, 2000). According to the National Center for Education Statistics, by 2000, 98% of U.S. public schools had Internet access, including 77% of the rooms where direct instruction occurred (as cited in Blomeyer, 2002; National Association of State Boards of Education (NASBE), 2001). Several types of entities sponsored the delivery of virtual courses. As of The Virtual School Report's Summer 2004 newsletter, eight virtual

schools were serving students in more than one state and 15 more were operated by state agencies. Seven universities, 36 districts or local education agencies, and 90 cyber charter schools served K-12 students. This list was not exhaustive, as many smaller entities delivering online instruction did not attract national attention and were therefore not reported. More recent studies by Watson, and Setzer and Lewis, noted increasing national interest in online delivery (as cited in Smith, Clark, & Blomeyer, 2005). At least 20 states provided virtual course offerings and 26 states recorded state level policies addressing student participation in online coursework.

Clark (2001), undertook a study of state-level virtual high schools in March 2000. Information received from this endeavor pointed to a need to examine a broader spectrum of virtual offerings beyond only state sanctioned programs. In August of 2001, Clark revisited his March 2000 investigation. Online surveys that polled an expert panel consisting of virtual school leaders from 33 programs of various types along with their profiles, were explored. Results indicated that K-12 virtual schools chiefly addressed high school students, yet 51% of those surveyed in 2000 also offered courses to junior high school students, and 25% served the entire K-12 spectrum. It is difficult to ascertain exact numbers, but data extrapolations estimated 40,000-50,000, K-12 students were enrolled in a virtual school during the 2001–2002 school year. The Education Commission of the States reported The Southern Education Board's estimate of 2002–2003 online K-12 student enrollments to be 100,000 (Connections Academy, 2004). The November 2005 study, *A Synthesis of New Research on K-12 Online Learning*, of which Clark was a part, reported, "Based on a national survey of school districts, the U. S. Department of Education [Setzer & Lewis, 2005] estimated 328,000 public school enrollments in online or video-based distance education courses in 2002–2003" (Smith, Clark, & Blomeyer, 2005, p. 5).

Advantages of Online Learning

Numerous potential advantages are provided by virtual schools. Online courses can close accessibility gaps for such groups as rural and homebound students (Blomeyer, 2002). Online courses offer… *"any time, any place, any pace"* (Web-based Education Commission, 2000, p. 1) educational experiences, extend resources to underserved areas, add multimedia dimensions to increase the number of learning styles addressed, and serve to network both people and assets. Online students experienced greater empowerment of communication due to the multiple methods utilized and the relative obscuring of identities (Connections Academy, 2004). A 2001 study of nine secondary schools in Canada, three traditional campuses and six online schools conducted during the 1998-2000 school years, compared data encompassing a wide variety of topics. During year one of the study, data collection through survey analysis, focused on satisfaction levels of all members of the school community. Year two collections expanded the focus to include additional student characteristic and achievement data, as well as general information on the challenges, such as budgeting and policy issues, facing virtual schooling. The analysis indicated increased abilities of virtual students in skills such as critical thinking, problem solving and independent performance, though noted less improvement in speaking and listening skills (Barker & Wendel, 2001).

Virtual schools vary in their missions. Some seek to expand course offerings that will provide challenging high-level curriculum for college bound or high achieving students, some seek to serve gifted students whereas others address struggling or special needs students. Some schools exist to provide additional resources for rural areas, and some serve students from overcrowded and under staffed urban centers, whereas others may desire to provide top-notch teachers for students. Still others hope to reach students who never graduated but now wish to complete a K-12 education (Clark, 2001).

Disadvantages of Online Learning

Concerns about the social development of children and the limitations for certain course offerings appeared as disadvantages to online instruction. Interactions, both student-to-teacher and student-to-student, may be limited in online delivery by both individuals and available technology. Courses that require activity, such as music or physical education, require a large level of creativity in order to present course materials adequately without face-to-face instructors. Further, most e-learning environments remain heavily text-based, requiring a significant amount of individualized reading in order to ascertain the content (Cavanaugh, Gillan, Kromrey, Hess, & Blomeyer, 2004).

Critics of virtual schools argue that proponents' motives are to eventually replace all brick and mortar schools with less expensive cyber schools. Although use of distance learning capabilities can increase the reach of highly qualified teachers, it does not negate the need for onsite educators. Teachers will need to fill new roles but will not be replaced by computers (NASBE, 2001). Looking at learning rather than schools is an important paradigm shift required in order to maximize the power of technology. Students will always need the social and physical aspects of school, but learning no longer need be constrained by school buildings or schedules (NASBE, 2001). Clark (2001) conducted an online survey of 44 regionally accredited or state-approved K-12 virtual schools during July and August 2001. Personalized e-mail was utilized to initially request participation in the online survey. Follow-up phone requests resulted in a 75% overall response rate. Survey results found that the majority of virtual school students utilized their access to online resources to expand their accessibility to course offerings within the regular school day. From this study it was gleaned that most students did not utilize virtual courses as a replacement for attendance at a traditional school (Clark, 2001).

Key Components of Virtual Schools

Clark's initial 2000 study identified the key components for virtual schools as funding, technology, curriculum, teaching, student services, assessment, policy and administration, along with marketing and public relations. Also included as separate components in the 2000 study, but dropped in the later 2001 study were professional development, and equity and access. By 2001, Clark saw equity and access as integral parts of all the other virtual school components. Professional development was seen as separate in 2001 only in its need to support teachers in the acquisition of skills with regard to particular delivery methods. Challenges to widespread availability of online course delivery existed within all components. Sixty percent of survey respondents reported funding issues as a barrier to virtual school success. These barriers included the costs of initial funding for technology purchases and course development and staffing. Of the participants, 50% mentioned technology as a barrier, whereas 40% pointed to other factors, such as quality of staff, promotion of virtual schooling, and the building of support and collaboration (Clark, 2001). This study clearly acknowledged the need to focus research efforts toward finding solutions to unanswered questions in the areas of instructional and course quality, student achievement, assessment, funding, and policy, so that equity of access to this valuable and burgeoning resource could be achieved.

The Children's Partnership released a new study, *Measuring Digital Opportunity for America's Children: Where We Stand and Where We Go From Here*, in June of 2005 (Lazarus, Wainer, & Lipper). A survey tool deemed "The Digital Measuring Stick" assessed 40 indicators to determine technology's impact on America's children. The study found 77% of children, ages 7-17, have a computer in their home, 68% of those are connected to the Internet, up from 36% and 15% respectively in 1994. An overwhelming 93% of instructional classrooms were connected to the Internet, up from 3% in 1994. The study further found that heightened information technology access had provided

improvements in not only the educational arena, but "…improved health, economic opportunity, and community and civic participation" (p. 6). Despite marked improved access, increased gaps between groups of students were found to be emerging as well. Students from economically deprived and minority populations, as well as students with disabilities, were still limited in their ability to reap the benefits of broadened access.

Funding for Virtual Schools

Funding of virtual schools is often cited as the largest barrier to expansion. However, determining the true costs associated with e-learning is often difficult (Curtain, 2002). Costs of virtual schooling are front-loaded as acquisition of equipment and course development expenses in the beginning stages can be significant. The question of whether to purchase packaged courseware or create it within the district or institution is fraught with funding decisions. Technical support, development and delivery resources are required in some form whether course curricula and instruction are written and delivered in-house or contracted out (Pape, 2004). Some costs may be masked by the utilization of existing staff to create coursework *on the side*. For example, the cost of substitute teachers required to relieve course developers allowing time to create materials should be considered an initial cost, but may be overlooked (Blomeyer, 2002). In the short term, savings in personnel and development costs may be realized through contracted services arrangements, over time cost savings may be realized through ownership of content and delivery systems (Pape, 2004).

The range of cost per student for delivery of online courses in 2005 was determined to vary nationwide from $4,200–$10,000 (Solomon, 2005). Funding models most often used for distribution of state funds to local districts involved a particular formula based upon average daily attendance (ADA). Students participating in online course options do not necessarily have to be on school property in order to receive delivery of coursework. Therefore, these students may or may not credit a school with

their attendance while participating in virtual classes. This method of support pits school districts, homeschoolers, and the private sector in competition for the same state dollars. The confusion can cause a budgeting nightmare as budget planning is impacted by increased student attendance options (Solomon).

Several sources of funding for virtual schools are reported in the literature. State funding, federal grants, and charged tuition are among the most common. Seventy-three percent of respondents to Clark's survey charged students at least some tuition, in combination with some other funding source. During the 2000–2001 school year, respondents collectively reported receipt of $957,566 from non-tuition sources and $1,207,795 during 2001–2002 (Clark, 2001). Schools that were state sponsored generally paid for course creation, administration, and salaries. Florida Virtual School, the nation's largest, had an annual operating budget of $16 million (Fulton, 2002). Some states served as brokers for course providers, funneling approval of all delivery through a governing body. Consortia of districts or individual districts have utilized grant funds or membership models to deliver online courses to group members. Additionally, some states have allowed the formation of cyber charter schools. Most of these charter schools are funded by funding trusts or built up through fees charged, and generally offer full delivery, not individual courses (Fulton, 2002).

Virtual schools offer a possibility for profitable commercial venture creating a market for the for-profit cyber school (Blomeyer, 2002). America spends $7 billion a year on technology for schools, a sizable chunk of money to attract entrepreneurs. These charter schools began by targeting the homeschool population. Because they are businesses, they often have no educational accountability to state or local governing bodies (NASBE, 2001). Public entities have responded by offering local options. As schools have rushed to provide access quickly for their students through the power of online delivery, they have often left the door open for technology providers to dictate

what drives education. Tantalized by their hard sell approaches of prepackaged products, schools have often failed to put long-range strategic plans in place for hardware and software, thereby limiting expansion (NASBE, 2001). The result is disjointed implementation of individual programs without united, well-planned efforts within and between educational communities.

Policy Concerns

Though online learning holds great promise for expanded educational value, current trends of fractured implementation indicate policy development happening largely absent of state education policy leaders who have not yet established a dialog among themselves (Blomeyer, 2002). The current trend of head-strong acquisition without clear policy leadership from the education sector could cause more harm than good (Blomeyer). Equity and quality are the two areas that most often suffer from a policy vacuum (NASBE, 2001). Equity of access is still an issue. Though student-to-networked-computer ratios improved in poor schools from 17 to 1 in 1999, to 9 to 1 in 2000, the ratio still lagged behind the more affluent school ratios of 6 to 1. Further, access outside of school, particularly in rural and high poverty areas, still showed serious gaps (Clark, 2001). Most recently, The Children's Partnership's *Digital Opportunity Measuring Stick* showed the gap sustained. Deficits to access in the home, a factor that heavily impacts student access to online delivery outside of school, persisted. In 2003, only 7% of 7-17 year olds' households with annual incomes under $15,000 had broadband access, only 29% had access to some form of the Internet, and only 45% had a computer. Similar households where annual family incomes were greater than $75,000 possessed 51% broadband access, 93% Internet access, and 96% computer access (Lazarus, Wainer, & Lipper, 2005).

Fulton's 2002 policy study examined virtual school policies based around six public education principles widely accepted as national goals. According to the study,

public education should: (a) prepare citizens for life beyond school; (b) build a shared culture; (c) be free and accessible; (d) be non-discriminatory; (e) be accountable to the public; and (f) be neutral with regard to religion (Fulton, 2002). Individual online schools have adopted measures to accommodate these principles. Monte Vista Online Academy provides computers and Internet access for their virtual students. The Federal Accessibility Standards describe requirements to insure that persons with disabilities can access course content adequately. These specifications are being met through the utilization of online tools, such as "Bobby", that can check a website for accessibility. Maryland, in addressing the non-discrimination issue, prioritized students with the greatest needs as first in line for available courses. Course development was geared to areas of greatest need as well. West Virginia maintained public accountability for quality by serving as a clearinghouse for all vendors. Quality requirements must first be met before access to West Virginia public schools was granted. In an effort to assure that schools continue to build a shared culture, Florida Virtual School limited the number of courses any student also enrolled in traditional coursework could take to two per semester (Fulton, 2002).

The individual efforts to project basic principles of American public education into the burgeoning movement of virtual schools, as well as other areas of technology implementation, remain just that; individual. In contrast, a decade-long study of West Virginia's focused implementation of a technology-based student improvement program produced significant academic gains (Mann, Shakeshaft, Becker, Kottkamp, & Solmon, 1999). The project gave limited software choices to schools statewide that targeted identified student weaknesses, ensured ample access, and focused on training of teachers. These three measures…"account for 11% of the variance in basic skills gain scores at more than a 0.001 confidence level (n=502)" (p. 30). Talbot Bielefeldt (2005) reviewed Thomas Fuchs and Ludger Woessmann's study of the Programme for International

Student Assessment (PISA) that reported no significant student educational gains through computer access. Fuch and Woessman analyzed year 2000 data gathered from 96,855 15 year-old students from 31 countries questioned in reading, math, science, family background, school, and computer usage characteristics (as cited in Bielefeldt). The study found a mixed relationship between technology usage and improved academic success. Although no significant relationship was found between academic subjects and in-school computer usage, a negative relationship was indicated between computer usage at home and academic achievement. Internet and educational software use at home showed a slightly positive effect, but the same usage at school indicated only minimal positive effects (Bielefeldt, 2005). The findings ignited debate on the impact of technology usage, both in and out of school, on academic success. Many investigators reviewed the study's data in an attempt to clarify Fuch and Woessman's findings. Bielefedt's report of multiple reexaminations of the original study found that significant educational gains could be found in programs when focused implementation allowed for control of conditions. Results of such studies should lead administrators to question if policy decisions driving online implementations impact student achievement results more strongly than indicated on the surface.

Beyond the relentless drive of technology business to push schools in to quick decisions devoid of careful planning, several other current policies have impeded online learning. "Seat time" requirements, student/teacher limitations, scheduling, attendance policies, and prescribed coursework based on age and grade level classifications all place limitations that may now be obsolete. Other policies that may need revisiting include graduation requirements, and teacher contracted time. As parents gain greater access to teachers through technology so that family communication can be a part of a teacher's regular activities, educator planning times may need to be revisited (NASBE, 2001). Accreditation of schools and certification of teachers, usually a state-level process, can

hamper efforts of virtual schools to serve students from multiple states. North Central Association of Colleges and Schools (NCACS), a multi-state accrediting agency may hold one type of solution to facilitate cross-state service. Such cross-state organizations can offer both teacher certification and high school accreditation that is recognized regardless of state boundaries (Clark, 2001).

Twenty-year-old copyright laws created during the broadcast media heyday allow for educational use of intellectual property within a physical classroom, but remain unclear on fair-use regulations for the virtual classroom (Web-based Education Commission, 2000). Procurement procedures that slow the selection process and prevent schools from keeping up with the latest updates hinder hardware and software purchases. Clear guidelines on such issues as credit, attendance, student and teacher expectations and responsibilities, and when and where courses will be available to students should be addressed in initial implementation of virtual programs in order to avoid future conflict (Pape, 2004).

Acceptance of the need for policy changes to accommodate online training delivery happened more quickly in the business sector. Driven largely by the astronomical cost savings that can be realized in industry, many companies are quickly shifting the majority of their employee training to the online environment. As the workplace has become more complex, the cycle of product rotation shortened, and company acquisitions increased, maintaining a well-trained workforce required a significant portion of a company's budget. The provision of online training not only impacted travel expenses, but also provided workers with greater personal empowerment over the pace of their skill acquisitions (Fitcher, 2002). Cisco Systems, an early adopter of e-learning for employee training, transformed from a company providing 90% of their staff training in the classroom, to providing 80% online in one year (Hammond, 2001). Contrary to the belief of critics, the e-learning approach did not isolate the employees of

Cisco. The 10,000 member sales force that spanned 150 countries were linked together into study groups and mentorship arrangements. Previously, the cost to bring this team together for a week set Cisco back $24 million (Hammond, 2001). The motivators for adopting change vary greatly between business and education. Though the rapid adoption of online learning has proved successful in business, it has been slow to catch hold in education. Although business is heavily driven by economic decisions, education's economics are often uncertain. Major technology acquisitions require long term planning and budgeting to be beneficial. Companies control their own budgets, as well as their own economic destiny. Planning can take the form of well-structured sequential acquisition.

Education's financial fate, conversely, often rests in the hands of legislatures unfamiliar with true instructional needs. The cyclical budgeting process is uncertain as the ideologies of each legislative session hinge on current trends. This ambivalence often leaves educators unwilling to commit to the training and structural changes that would be necessary to adopt such a huge paradigm shift (Prensky, 2001). Fear that the next legislative session will undo their predecessors' decisions stifles systemic change. Twenty-four percent of Erate funds, rebates dedicated to schools for technology acquisition and Internet use, went unused in the first two years due to budgeting timetable restraints (NASBE, 2001).

Many of education's policies and practices today continue to be based upon the original goals of upholding the institution. Regulations aimed at teacher-centered control of learners of similar ages moving at the same pace to eject a finished product at exactly age eighteen continue though delivery methods have outgrown the need for such restrictions. State controlled education policies are hampering the global classroom (Web-based Education Commission, 2000). A year-long review by a Congressional committee headed by Senator Bob Kerrey and Representative Johnny Isakson resulted in

recommendations for a nationwide effort to embrace e-learning, similar to that of the science movement during Sputnik. The committee believed that the impediments to equity of access of education's latest powerful tool would require a national approach to resolve. Their recommendations included the following:

1. Broadband access everywhere
2. Professional development to support teachers of e-learning
3. Funded research to review how people learn on the Internet
4. Quality, affordable online content
5. Review of regulations that serve to impede full utilization of e-learning
6. Protection of users' privacy rights
7. Investigation into new and old funding models that can sustain e-learning
8. Contributions by each level of government-
    a. Federal- regulations that assist rather than impede
    b. State- increased collaboration
    c. Communities and businesses- partnering to provide opportunities that are cost effective and creative in nature

(Web-based Education Commission, 2000, pp. iii–iv)

Leadership through Educational Research

Through the testimony provided to the 2000 hearings of the National Web-based Education Commission, a recommendation for focused, directional research to investigate how people learn on the Internet emerged. The shortcomings of educational inquiry to date have minimized the ability for utilization of findings to improve instruction. The Commission found there to be three issues with research methodologies into online learning to date; (a) funding levels did not allow for coordinated study, (b) research lacked connection between educational exploration and improved practice and, (c) accessibility of conclusions in a format that is applicable for practitioners was

lacking. Though research budgets in fields such as medicine encompass approximately 6% of the funding levels, education's research budget amounted to approximately 0.1% of the funding level (Web-based Commission, 2000). The landmark PCAST study of 1997 (Panel on Educational Technology of the President's Committee of Advisors on Science and Technology) called for expenditures of at least 0.5% of the funding level for educational research, though these recommendations were not heeded (Web-based Commission, 2000). Lack of coordination between the policy makers who set objectives for online delivery and evaluators who measure its progress has created the inability for results to inform practice (Cavanaugh et al., 2004).

Instructional Content and Quality

Focused attention to content and quality issues is required to improve current offerings as well as to adequately defend virtual learning as a valid solution for the K-12 learner. Quality content and instruction is paramount in education regardless of the delivery method. Clark's expert panel indicated a variety of course types, staffing patterns, and development mechanisms contributed to current online offerings. Respondents indicated that 90.9% offered courses from the regular high school curriculum, 72.7% offered remedial, 20% Advanced Placement (AP), 16% dual credit, and 7% High School diploma courses (Clark, 2001). Of the respondents, 20% utilized K-12 instructors who taught in the virtual school as a part of their regular teaching duties, 38% of respondents utilized K-12 instructors who held a supplemental contract to teach online, 28% supported full time virtual school educators, 6% supported part-time teachers, and 16% used some other form of staffing not specifically identified. Clark found that 12% of those surveyed used courses developed totally externally, 39% those developed internally, and 49% a mixture of external and internal development.

A 1999 study (Yamashiro & Zucker) reviewed 12 randomly selected Virtual High School (previously Concord Virtual School) "netcourses" from 18 offerings that met

study criterion for longevity of existence. An expert-developed quality rubric projected 19 standards within four broad categories. An identified 12% unsatisfactory quality rate raises concern that expansion of online offerings would produce an unacceptable quality rate if close content scrutiny were not applied. Focusing on content, the results found one course to be "of serious concern," nine to be of "satisfactory quality," and 13 to be of "high quality" (Yamashiro and Zucker, 1999, p. iii).

Though researchers such as Booker, and O'Connor, laud the ability of online learning to provide interactive, constructivist opportunities for students the reality of these formats predominating most online delivery is still not apparent (as cited in Brennan, 2002). In a 2002 study, Partlow and Gibbs employed Delphi methodology to ascertain "indicators of constructivist principles" (Partlow & Gibbs, 2002, p. 291) that would contribute to online delivery. Three rounds of online questioning narrowed 110 indicators in 10 categories down to a list of 13 indicators in six categories that received an average score greater than 4.5 on a five-point scale. Identified categories included tasks that were project-based, collaborative in nature, required higher-order thinking skills, were safe, authentic, and assessed the learning. Providing opportunities for interactivity and compelling students to partake of those chances may be two separate challenges. A 2005 study by Andrew Zucker of The Concord Consortium attempted to entice greater participation in online interactions through awarding additional grade points for frequency and quality of submissions. Though the study was limited by inconsistent application of the research design, results indicated limited success in improved interaction when additional points were awarded. Of the participating students however, 77% did acknowledge the importance of student interaction to the quality of their online experience (Smith, Clark, & Blomeyer, 2005).

Many studies published in the late 1990s and early 21st century reflected data gathered from institutions of higher education, as they were the first to provide

web-based course offerings. Much of this early available literature addressing course quality was derived from student satisfaction surveys. One such study utilized online solicitation of 500 students and over 50 educators, all participants in online course delivery, regarding quality. The primary positive factor in student responses was flexibility. Seventy-one percent of student respondents felt their online experience was of quality, 18% did not note that it was quality, and 11% did not respond. Factors that contributed to student assessment of quality included the teacher, the material, the assessment and feedback of that assessment, their personal learning styles, and having a face to face component (Cashion & Palmieri, 2002). Multiple studies confirmed both student and instructor preference for a mixed-mode delivery of online content that included at least minimal in-person interaction (Blomeyer, 2002; Brennan, 2002; Curtain, 2002).

Appropriate preparation of both students and teachers for the challenges of online course creation and delivery appeared linked to overall appeal. The largest detractor to student satisfaction with e-learning was difficulty with technology . Teachers indicated an orientation program for students might minimize some of the negative aspects inherent in virtual delivery. It was further suggested that such a program should introduce students to both the technology and the learning style required for online delivery. It should further identify available support mechanisms, and familiarize students with a means to balance the flexibility of time and place and the need to structure and manage that flexibility (Cashion & Palmieri, 2002).

More recent studies have utilized a validated assessment tool, *What Is Happening in This Classroom* (WIHIC) with high school students to assess satisfaction in online classes. The WIHIC was developed in 1996 by Fraser, McRobbie, and Fisher to capture the more student-centered aspects of contemporary classrooms that previous instrumentation failed to address. Using a Likert scale, students are asked to respond to

the frequency of practice within the classroom in seven areas: “student cohesiveness, teacher support, involvement, investigation, task orientation, cooperation, and equity” (Aldredge & Fraser, 1997, pp. 2–3). Hughes, McLeod Brown, Maeda, and Choi’s 2005 comparison of four virtual and three traditional Algebra I courses found distinctive areas of strength for each format (as cited in Smith, Clark, & Blomeyer, 2005). Students in the classroom setting indicated a higher level of student-to-student interaction and collaboration whereas students in the online environment reported greater teacher support (Smith et al.). A study by Ferdig, DiPietro, and Papanastasiou (as cited in Smith et al.) used the same WIHIC instrument and uncovered similar conclusions. Over a 6-month period, five classes that were offered both face-to-face and online from two high schools were surveyed. Differences were recorded in the student cohesiveness and cooperation indicators. Traditional students indicated greater satisfaction with student-to-student “collegiality” than did online students (Smith et al., p. 37).

With lengthier utilization at the college level, studies of post secondary course quality are more prevalent. Marked differences in the way adults and children learn, and in their experiences and cognitive abilities, limit the degree to which post-secondary studies can inform decisions for the K-12 community (Smith, Clark, & Blomeyer, 2005). Knowles, noted andragogy expert, reported that although adult learners have a self-concept of self-directedness, young learners tend to hold a much more dependent view of self (Knowles, 1990). A pilot study from University of Texas Pan American, for example, attempted to discover a correlation between various course features and student achievement. Utilizing three courses taught simultaneously by the same three professors in both an online and offline environment (for a total of six sections), student grades were tracked. Due to the wide variations in presentation style of each professor, relationships were impossible to adequately decipher (Llanes, 2002). The study demonstrated the difficulty in deducing correlations even using adult learners who can more accurately

self-identify learning needs than can younger students. Therefore, conclusions reached about K-12 course quality through studies of post-secondary students would be suspect.

Distance Education versus Traditional Delivery

Beginning in the mid 1980's, researchers conducted comparison studies between courses delivered in traditional classrooms and those delivered via various modes of distance technologies. In 1983, Clark questioned whether study of a delivery mechanism could be separated from the full package of mode, content, and pedagogy (as cited in Bernard, Brauer, Abrami, & Surkes, 2004). In one of the broadest meta-analyses of the time, Dr. Thomas L. Russell conducted a 1999 study that found that delivery of instruction via technology had little affect on student achievement. He asserted no significant difference (Russell, 1999) between the two mediums. In response, Bernard and colleagues, (2004) claimed the Russell study lacked rigor.

> On the basis of compiling evidence in the form of fragmented annotations (e.g., "…no significant difference was found…") of all of the studies that could be located and contrasting this evidence with the much smaller number of "significant difference studies" (which could be either positive or negative), Russell declared that there is no compelling evidence to refute Clark's original 1983 claim that a delivery medium contributes little if anything to the outcomes of planned instruction and that, by extension, there is no advantage in favor of technology-delivered DE [distance education]. (Bernard, Abrami, Lou, & Borokhovski, 2004, p. 380)

In an effort to impose a more controlled study, Bernard, Abrami, Lou, and Borokhovski (2004) set clearly defined standards for study inclusion within a meta-analyses, then addressed the question of difference between distance and traditional delivery. The study looked at not only the difference issue, but the extent of measurable difference as well. Study selection criterion included publications published between

1985 and 2002 that compared distance education, defined as courses that included radio, television, or satellite delivery along with an interactive component such as e-mail, phone or a combination thereof, or web-based or interactive video based delivery presented with separation by distance from the instructor, with traditionally delivered settings. The studies must have examined individual courses rather than programs, contain experimental and control groups, and included an achievement, attitude or course retention measure that was comparable between the two groups. Though all levels of learner, kindergarten through adult were accepted, the level had to be identifiable (Bernard, Abrami, et al.). The final analysis included 232 studies with 688 outcomes reviewed. Though average overall effect size discovered through the more controlled analysis remained near zero, wide variability among outcomes was uncovered. The achievement outcome indicated, "…a very small and significant effect favoring DE conditions ($g+$= 0.0128) in terms of overall achievement outcomes (k = 318)" (Bernard, Abrami, et al., p. 395). The attitude outcome showed a small negative effect for distance delivery, ($g+$ = -0.0812) with the same for the retention outcome ($g+$ = -0.0573). The most troubling element of the study found that 55.73% of codable measures overall were missing (Bernard, Abrami, et al.). Though in conclusion, Bernard's controlled study concurred with the earlier Russell findings, more questions than answers were raised about the confidence of conclusions reached with regard to distance education.

Recently, several studies have been undertaken that focused on high school student academic achievement in an online environment as compared to that of students in a similar traditional course. Between 2004 and 2005, two meta-analyses were published in answer to calls for increased rigor in research pertaining to K-12 virtual schools. Responding to NCREL's request for proposals in the fall of 2004, Smith, Clark, and Blomeyer, synthesized the findings of eight projects. The request called for randomized designs with valid and reliable instrumentation and quantitative methods.

Learning Point Associates published another meta-analysis by Cavanaugh, Gillan, Kromrey, Hess, and Blomeyer (2004). Analysis included 14 web-based programs. Inclusion in the study required measurements to compare online students with traditional students, and measurements that were quantitative in nature and presented in a manner that would allow for calculation of an effect size. Though more informative than studies on adult learners, one must view such data critically. Several of the included studies (i.e., Cavanaugh, Bosnick, Hess, Scott, & Gillan; Ferdig, DiPietro, & Papanastasion; Zucker; as cited in Smith et al., 2005) rely on the voluntary submission of survey or assessment instruments by online students in comparison with those instruments collected from traditional settings where teachers are more likely to compel submission. With this limitation in mind, the studies have produced similar results worthy of examination.

The studies of high school students again commonly found no significant difference between academic achievement in online learning environments when compared with students in a comparable traditional setting. Ferdig, DiPietro, and Papanastasiou's 2005 study (as cited in Smith et al., 2005) examined five courses from two high schools that were offered both in a face-to-face format and online. The classes included the math content areas of Algebra I and Algebra II, Geometry, and Personal Finance, as well as a Health course. The study included a total of 410 students, 342 in a traditional setting and 68 online. Student academic success, predictability of that success as measured by the Educational Success Prediction Instrument (ESPRI) and student satisfaction as measured by the WIHIC instrument, was collected over a 6-month period. Although 248 classroom students returned the WIHIC survey, only 18 online students completed it. "Findings indicated that there were no significant differences between overall results of combined face-to-face versus combined achievement scores" (Smith et al., p. 36). Review of academic scores alone showed online students with slightly higher achievement.

The Cavanaugh, Gillan, Kromrey, Hess, and Blomeyer (2004) meta-analysis examined 14 studies with 116 outcomes, using the dependent variable student outcome. A pre-post test method was used to determine student achievement. The study was delimited to previous investigations published between 1999 and 2004 where the online component was defined as at least 50% of the content delivered online and away from the instructor, with a measurable effect size with an N of two or more, and the outcome measured by student achievement. Post test scoring of traditional versus the distance learning group showed –0.28 mean effect size with a 95% confidence range of –0.116 to +0.060. Factors tested included age of student, types of programs and the schools offering them, roles of participants, setting variables, frequency, pace and timing of instruction, and experience level of participants. "No factors were found to be related to significant positive or negative effects" (Cavanaugh et al., 2004, p. 4).

A 2005 study of academic success by Kleiman, Carey, Bonifaz, Haistead, and O'Dwyer (as cited in Smith et al., 2005) examined the concept of increased access to highly qualified teachers through use of technology. The study classrooms consisted of two teachers, one certified math teacher who supported students in an online environment while simultaneously serving as a mentor to the classroom instructor, and an instructor who was not certified in math. Eighth, ninth, and tenth grade Algebra I students from 31 schools representing 16 districts participated in the study during the 2004-2005 school year. Of the 31 schools, 16 offered the online class, and 15 served as control groups. A total of 37 teachers comprised of ten online, 13 traditional classroom teachers, three teachers who taught both online and in the traditional classroom, and 11 within the control group participated. There were 257 online students. Academic advancement review found greater progress from pre to post-test scores ($p=0.024$) for online students and greater overall ending scores ($p=0.051$) for the same group (Smith et al., 2005).

The 2004 Cavanaugh, Gillan, Kromrey, Hess, and Blomeyer meta-analysis concluded that a finding of no significant difference between online and traditional instruction, along with the knowledge that course quality is most greatly impacted by teacher competency, demonstrated that every measure should be undertaken to ensure proper teacher preparation to instruct in an online environment. Kleiman's investigation, when examining teacher behaviors, found that when teachers spent more time in small group and individual assessment with students, a component present by design in online environments, student achievement improved (Smith, Clark, & Blomeyer, 2005). Good teachers can make good online teachers with the right training (Blomeyer, 2002). Educators believed the skills needed for teaching online included some technical skills but also the ability to develop curriculum for electronic delivery, the ability to manage time and equipment, and the ability to determine student progress accurately and respond accordingly (Brennan, 2002). Furthermore, awareness that it can take 50-150 hours of preparation on the part of instructors to produce one hour of online material for students is essential (Blomeyer, 2002). Notably, those testifying before the 2000 Congressional Commission on Web-based studies indicated that although 90% of necessary professional development in industry is provided on company time, only 39% of educators received their training on school time (Web-based Education Commission, 2000), suggesting that training efforts may not be supported to the fullest for online delivery.

A 2005 study by Dickson, of Michigan Virtual University for the Michigan Virtual High School, attempted to design ways in which data generated by student academic performance in online environments could be utilized to improve course quality. Most development of virtual high school programs is not undertaken with the emphasis on evaluation from the planning stage. Therefore, most data gathering is done

in an after-the-fact manner that promotes molding study parameters to available data and limits reliability. One of the difficulties identified with studies that compare online student performance to that of students in a traditional setting is that random assignment to groups is virtually impossible. The current nature of online delivery provides generally a self-select mechanism that skews randomness. The Dickson study began with consolidation of five years of student data gathered by Michigan Virtual High School into a single database. Initial analysis looked at trends in student enrollment by time and location. Secondly, examination by content area was undertaken. Work with the data suggested that often startup programs concerned with initial operations do not appropriately plan ahead for the types of data needed to truly inform practice. The shortfall leaves instructors ill-prepared to make significant adjustments that result in immediate course improvements. Teachers prepared to properly monitor measures that impact achievement could more effectively control outcomes. Dickson found student participation in all aspects of the online program to be a strong predictor of a student's final grade. Course participation is an aspect of online delivery that can be closely monitored and affected by the instructor. Further, wide variability of the types of students taking online courses led to questioned reliability when comparing average final course grades between virtual and traditional deliveries of the same course. Dickson suggested that analysis of individual student progress in both an online and a traditional system might yield more accurate data. Planned data collection and analysis by practitioners offers the best opportunity for improved course quality (Dickson, 2005).

Learning Styles

Technology based delivery methods have the potential to address multiple student learning styles. "The typewriter prized one particular kind of intelligence, but with the Web, we suddenly have a medium that honors multiple forms of intelligence-abstract, textual, visual, musical, social, and kinesthetic" (Brown, 2000, p. 12). Some such styles

show a greater propensity for success than others. Students who consider themselves to be *reflectors* according to Honey and Mumford's Learning Styles Questionnaire, tend to prefer the online delivery method of instruction. Although these students tend to be introverted within a regular classroom, the extended time allowed for reflection with the online environment is conducive to their more extroverted participation. Access to materials well in advance of discussions allowed these students more preparation time that in turn afforded them more reflection before a response was required (Downing & Chim, 2004).

Further, some content areas can be more successfully delivered online than can others. A meta-analysis of 19 experimental and quasi-experimental studies conducted between 1980 and 1998 examined student achievement affected by distance delivery to K-12 students. Published, as well as unpublished sources, were reviewed with preference given to those that used random sampling. Study criterion required that included projects contain a determinable effect size. Fifty-nine studies were initially selected but 40 eliminated. Two doctoral students coded the 19 studies that remained for publication for methodological, technological and ecological characteristics, and analytical results, with 85% interrater reliability. Student content achievement was the dependent variable. Seven areas; general studies, math, language arts, science, social studies, computer science, foreign language was reviewed. Achievement measures were grouped as developed by the teacher, developed by the researcher, or other, and used either pre-test-post-test or post-test only administration. Independent variables included length, frequency, design of instruction, and delivery method of the distance experience. Students were also coded as to school grade level and ability level. The study showed a 0.147 effect size improvement in student achievement affected by distance education in all subject areas with the exception of foreign language. Only one of the studies examined by Cavanaugh included web-based content, and 68% used two-way interactive video (Cavanaugh, 2001).

New Literacy and New Learning

"In the view of Robert McClintock, Frank Moretti, and Luyen Chou, the evolution of, and transformations in, teaching and learning goes hand-in hand with the evolution of technology" (Prensky, 2001b, Ch. 03, p.7). Learning evolved over time from a *follow-me* endeavor that began with the caveman, through oral, then written language. With the invention of the printing press, multiple copies of the same material allowed groups of people to study documents together, hence the beginning of formal education. "Book-based learning favors logical exposition and presentation" (Prensky, Ch. 03, p. 8). The standard fare in schools consisted of reading or discussing written material then testing a student's knowledge of the content. Yet, with the evolution of the computer, an aspect of interactivity was added that made written language less prevailing. "Linear organization was supplemented with random-access (hypertext) organization. Passive media, such as books and TV, were supplemented with active ones, such as interactive games and the Internet" (Prensky, Ch. 03, p. 9).

Literacy in the 20th century evolved from emphasis on text. During this timeframe the typewriter was the high tech instrument of choice. Today, with the advent of easily accessible and portable multimedia devices, literacy has taken on a totally new meaning. Beyond text, today's learner must be competent in image and screen navigation in order to be fully literate (Brown, 2000). Twenty-first century literacy demands the ability to use technology, including visuals and audio segments, to enhance personal learning and communicate with others over digital devices (Looney, 2005). The North Central Regional Educational Laboratory (NCREL) researched online reading comprehension as a different skill than that of traditional print comprehension. Online reading comprehension encompassed the ability to navigate to locate information, and to evaluate, synthesize, and then communicate findings in new formats. The study evaluated seventh grade science students who were divided into four treatment groups and provided

with varying levels of Internet instruction integrated into the science content. A control group receiving no Internet training was included. Students completed the Degrees of Reading Power (DRP), an assessment of traditional reading comprehension in January. They were again assessed in this manner in June, but were also given the Online Reading Comprehension Assessment with Instant Messaging (ORCA-IM) or the ORCA-Blog. Results indicated significant positive differences between the ORCA scores in all three treatment groups over the control group. Yet, no significant correlation was found between traditional reading comprehension and online reading comprehension regardless of treatment group (Leu, Castek, Hartman, Coiro, & Henry, 2005). The findings indicated a difference in the skills needed to be literate in today's high tech environment and those required in the text-based world.

Recent cognitive research has shown new understanding of the way memory functions. Multiple studies, such as Mayer and Moreno's (1998) investigation on split-attention have demonstrated that memory has both a visual and an auditory component. In this particular study, two groups of college students were presented identical information on how lightening forms; one with visual animation supported by on-screen text, the other with animation supported by an audio track. Participants were then given three tests of information acquisition that measured matching, retention, and transfer. In all three assessments, the group with both visual and audio tracks showed improved memory, with effect sizes ranging from 0.55 on matching to 1.75 on transfer. A second trial used information about braking a car and produced similar conclusions with effect sizes from 0.49 on retention and 0.94 on transfer indicating that multi-media presentations with both visual and auditory components can improve retention (Mayer & Moreno, 1998).

Differences in Today's Learners

The repeated findings of no significant difference between online and traditional course offerings in the broad spectrum demand a need to discover indicators to inform when online offerings provide educational benefit for students. Not every student benefits from e-learning. As evidenced by initial research into new literacies, a different skill set is required for competency online.

Today's learner has changed. He/She did not grow up at the foot of the family radio, hanging on every word of a storyteller's oration, nor did most of today's teachers. Unlike most current teachers, today's learner did not even spend a good portion of his/her childhood glued to the television as Sesame Street and Mr. Rogers taught letters and morals; information disseminated in a constant linear stream changing focus in short segments to retain the learner's attention. Rather, today's learner has and continues to spend many of their out of school hours in a digital world composed of cell phones, MP3 players, computers, and video games.

A 2003 survey of 1,065 U.S. parents requested information concerning computer usage of 6-month to 6-year olds. Using a "…list-assisted random-digit dialing methodology" (Calvert, Rideout, Woolard, Barr, & Strouse, 2005, p. 594), parents were contacted by phone and interviewed by Princeton Research Associates representatives. The oldest or the youngest child in the family, who was between the ages of 6 months and 6 years, was the participant. Questions were asked from a set of interview questions generated during a two-day conference on children and media exposure. Approximately 6% of the sample was made up of parents of 6 month olds, with 12%–15% of the remaining parent participants answered for children falling into each age category 1–6. The study found that computer usage generally began at the parent's lap by age two and by age three children could control the mouse, load a CD, and turn on the computer (Calvert et al.).

Computers, DVD players, cell phones, game consoles, and iPODs (Apple Computer) are the norm in students' pre and post school day. Choices abound within the video game world and hold real consequences that affect the player's fate within the game. Constant input requires fast thinking, instant reflex actions, and simultaneous attention to multiple stimuli. A chat session on the Internet may involve multiple buddies, each participating in different conversations in separate open windows. Written, not oral language is premium, though the convention it follows is not the King's English. The thumb is today's most useful digit, as the speed with which it texts may determine which gentleman earns the company of his lady faire. Prensky (2001a) has dubbed today's learners as "digital natives" whereas their teachers earn only the title of "digital immigrants" (Ch.02, p. 10).

Prensky further claimed that "digital natives" exposure to technology from an early age has caused their brains to be wired differently. Information is processed in a random access manner, rather than a linear one. Similar to research on the web, today's students would prefer to follow thoughts in multiple directions rather than be fed a constant unidirectional message. The United States National Research Council found in a 2-year study that today's learner required a level of control of their learning in order to make needed transfers of information (Huffaker & Calvert, 2003). Their preferred speed Prensky (2001a) has deemed "twitch speed" (Ch. 02, pp. 14–15) which means hit it hard and fast and proceed. Additionally, "digital natives" prefer graphics-first with text to support unclear content rather than the "digital immigrant" method of illustrations to augment text (Prensky, 2001a). The idea that information is fluid and informed by multiple inputs that may be updated instantaneously when discovery occurs is not a foreign concept to 21st century learners. Brown dubbed today's learners "bricoleurs" (Brown, 2000, p. 14) evolving from a term first used by Claude Levi-Strauss. Bricoleaurs have the ability to take some small piece of information and then use it to create

something meaningful for themselves. He further found that today's adolescents have moved their preferences for knowledge acquisition from passive to active, from linear to lateral, and from becoming unresponsive when they do not understand to "lurking then trying" (Brown, 2000).

Perhaps most importantly, "digital natives" are network builders. With access to anyone, anytime at the end of a computer, cell phone, or Blackberry (Research in Motion Limited), today's students are better at building a community of learners without knowing they are doing it, than teachers who have experienced multiple inservice trainings on the subject. Brown cited a quadrant of knowledge; *tacit*, or information on *how*, versus *explicit*, or information on *what*, and individual versus group knowledge. The central meeting of the four quadrants constitutes a community of learning (Brown, 2000).

Gaming's Impact on Learning

Calvert's study of 6-month to 6-year-olds suggested that when young children spent time with the computer, it most often involved game play (Calvert, Rideout, Woolard, Barr, & Strouse, 2005). Though "digital immigrants" may profess gaming to be a waste of time, James Paul Gee demonstrated that good games contain multiple elements of current learning theory. "The new science of learning, as advocated by the National Research Council and the National Academy of Science, recognizes the importance of allowing children to take control of their own learning experiences [Bransford, Brown & Cocking, 1999]" (Huffaker & Calvert, 2003, pp. 325-6). The terms "active learning," the learner taking an active role in the learning process, "metacognition," defined as the student monitors and regulates their own learning, and "transfer of knowledge" as learners apply information learned to multiple settings and tasks, are now a part of the educational vernacular (Huffaker & Calvert). Digital gaming builds all of these elements into play. Game players are encouraged to place themselves within the action, to be producers rather than consumers, to take risks, solve problems, think systemically and

laterally, and perform to reach competency. Good games provide the opportunity to self-select levels of difficulty, get additional information on demand and reward levels of solutions (Gee, 2005). Most importantly, multiple studies have demonstrated that the influence of video game play has altered the way individuals learn.

Research into such areas as internal locus of control, problem solving strategies, visual and divided attention, and spatial abilities has demonstrated the impact of action video gaming on cognitive abilities. A study of second through fifth grade boys and girls examined the strategies employed when learning to play video games. The study included students from a middle-class school district in New York City. A group of 46 second graders and 58 fifth graders ranging in age from 6.9–10.3 years of age took part. The children were initially questioned as to their frequency of game play, their familiarity with the Sega Game Gear and the Sonic the Hedgehog II being utilized, as well as the strategies they normally utilized when learning a new game. Students were then observed while playing by raters who coded strategies employed for internally or externally motivated. Similar coding of the verbal responses given by the student prior to play was recorded. Though the study originally hypothesized gender differences would favor girls' use of external controls during novel play, the study instead found differences between age groups. "The proportion of fifth graders who referred to internally based strategies was significantly greater than that for second graders, $z=-3.73$, $p< 0.05$" (Blumberg & Sokol, 2004, p.155). The researchers found that older children and children who described themselves as frequent video game players tended to rely on internal strategies such as reading instructions or trial and error rather than external strategies such as asking for help or watching someone else play, when learning a new game than did younger children and those that did not play video games. The most frequently used internal strategy was trial and error.

When college student expert gamers and novices were tested against one another on tasks that required divided visual attention, the experts showed faster scores at levels where differences were noted (Greenfield, Dewinstanley, Kilpatrick, & Kaye, 1994). Two different trials were undertaken. In the first test, sixteen undergraduate, male University of California Los Angeles (UCLA) students, eight considered to be video game experts and eight video game novices, were selected to participate in the study after undergoing a screening process. Initially, students viewed a computer screen under controlled conditions where a target appeared either to the right, left, or both locations briefly and they were asked to quickly respond as to its location via a button. The target appeared in varying percentages under two different conditions; the first it appeared 80% of the time in one location, 10% in the other location, and 10% in both. Under the second condition it appeared 45% of the time in each location, and 10% in both. "…video game experts' RTs (reaction time) were significantly faster than video game novices' RT for the 80% location and the 10% location, $t(14) = -2.07$, $p<0.025$, and $t(14) = -2.18$, $p<0.025$, respectively. There was no difference between experts and novices in the even probability location" (p. 112). In experiment two, novices spent some time practicing gaming between pre and post testing. Forty male students, experienced and non-experienced gamers were equally divided between two groups and randomly assigned. An experimental group was allowed five hours of video game practice prior to undertaking the same procedure as in experiment one, and the control group did not practice. Change in performance was the focus of the analysis in this experiment. The experimental group did show improvement between pre and post testing when the target appeared in the least likely location (10%). The findings indicated that strategies employed by video game players may transfer to other areas of cognition that require split attention.

Another study of visual attention performed on college students used multiple tasks to compare habitual gamers and novices. Four tests of visual attention that utilized a visual distractor designed to exhaust the capability to accurately attend were presented to a group of video game players and a group of non-players. Subjects included 18–23 year old males. Gamers were defined as individuals who had played video games at minimum one hour a day, four days a week for the last six months. Players outscored non-players in visual attention capacity, speed of processing, and task-switching ability. As in the Greenfield study, an additional test using both male and female subjects was undertaken to determine if practice with video games one hour a day for 10 consecutive days would improve responses. The experimental group was trained on *Medal of Honor* (JJ Entertainment Networks), an action video game requiring visual attention to multiple fields that switch rapidly. A control group was trained on *Tetris* (Pajitrov), a game that requires a motor response, but the visual attention deals with only one object at a time. Test for *enumeration*, *useful-field-of-view*, and *attentional blink* were performed after training (p. 536). "Notably, action-game training led to greater performance improvement than did the control game on all three experimental tasks." "…action-video-game playing pushes the limits of three rather different aspects of visual attention. It leads to detectable effects on new tasks and at untrained locations after only 10 days of training" (p. 536).

A group of 61 fifth grade students were tested for the impact on spatial skills in dealing with objects in motion, before and after practice with two types of interventions. Students were divided into an experimental group consisting of 15 boys and 15 girls, and a control group of 13 boys and 18 girls. The children were students at a West Hollywood, California, private school. The control group practiced using a computer word game, *Conjecture* (1986) that required no spatial skills. A second group practiced with an action video game, *Marble Madness* (Harvey, 1986) that required movement of a marble

through a maze. Students were then assessed for both static and dynamic spatial ability with pre and post-tests. “Video game practice, but not practice on a computerized word game, led to significant improvement in dynamic spatial skills, an improvement that was concentrated in those subjects who started out with relatively poor spatial performance” (Subrahmanyam & Greenfield, 1994, p. 26). New learning theories, new literacy, and new types of learners that research has confirmed are cognitively impacted by their digital experiences, require today’s educational leaders to revisit the way education is delivered.

Predicting Success Online

Completion rates for virtual courses are an ongoing concern.

> No national statistics exist yet about how many students complete distance programs or courses, but anecdotal evidence and studies by individual institutions suggest that course-completion and program-retention rates are generally lower in distance-education courses than in their face-to-face counterparts. (Carr, 2000, pp. 1–2)

Though once again, most of the available data is from post-secondary institutions with a longer period of implementation from which to draw, the figures are informative. The LeCroy Center, the telecommunications portion of the Dallas Community College System, reported an 11% to 15% difference in the retention rates of online courses versus their traditional counterparts. Tyler Junior College noted a 35% completion rate for online courses as opposed to a 71% rate for traditional courses during the same time period. UCLA reported that in the initial stages of offering online courses, their completion rates were approximately 50%-60%, but over time those have increased to 87% (Carr, 2000, pp. 2-3).

Predicting virtual school success has most often been accomplished through self-report surveys of characteristics. Recently, a survey prediction tool was developed and

administered by researchers at Concordia University for the purpose of predicting student online success. Their instrument was comprised of 38 items broken into four categories, *general beliefs about DE, confidence in prerequisite skills, self-direction and initiative*, and *desire for interaction* (Bernard, Brauer, Abrami, & Surkes, 2004, p. 31). The questionnaire was administered as a pre and post evaluative measure to 167 undergraduate students during the fall 2002 through the summer 2003 terms. Student grade point averages and final course grades were also reported to researchers. "The results were significant, F=4.01 (4, 132), p<0.01. In total, the predictors accounted for 8.0% of the variance in Course Grade" (Bernard, Brauer, et al., p. 37). Their findings showed a correlation with eventual success in the online environment to a student's general beliefs about distance education and their perception of their own ability to be self-directed, yet the most significant predictor was overall grade point average.

A similar instrument was developed to focus on high school students. The Educational Success Prediction Instrument (ESPI) was developed through review of literature of successful online high school students as well as through direct observation of online high school instructors. The instrument consisted of 70 items addressing a statement of a personal quality that called for a response on a seven-point Likert scale ranging from *strongly agree* to *strongly disagree*. The instrument asked students to report on their personal beliefs about their achievement, self-esteem, risk-taking, technology, organization and self-regulation skills. The survey was completed by 135 students and final course grades were reported for 96 of these. Successful completion of the course was considered to be a final grade of a C or better. Of the 96 students with final reported grades, 75 met with success whereas 21 received a grade of D or F. Upon analysis with ESPRI factors used as independent variables and final course grade as the dependent variable, the instrument accurately selected students who eventually passed an online course with 100% accuracy and those who failed or did not complete with 95% accuracy.

(Roblyer & Marshall, 2003). Utilization of the ESPRI tool in the 2005 DiPietro and Papanastasiou study found 100% successful or unsuccessful grade prediction of 202 online high school students from 18 courses (as cited in Smith, Clark, & Blomeyer, 2005).

Although both instruments reported highly accurate ability to predict online success, the elements measured rely heavily on attitudinal characteristics common in highly motivated students who are generally successful with educational endeavors. The clarifying point is whether students who do not score well on such instruments are, or would be, discouraged from attempting online coursework. Dickson, in his review of 5 years of data from Michigan's Virtual High School suggested further research was needed, "…on the relationship of the virtual high school to the students' regular school, including such things as comparative success in the two learning environments, mentor's decision making when encouraging students to enroll in virtual courses, and so on" (Dickson, 2005, p. 60). Current research into cognitive impacts on early digital exposure may open the door for the development of new measures that include addressing cognitive ability along with learning style preferences to predict virtual school success.

Summary

The Digital Opportunity Measuring Stick 2005 confirms that the majority of America's high school students are "digital natives" (Lazarus, Wainer, & Lipper, 2005). Research has demonstrated that these students come to school in need of skills in new forms of literacy, possessing different strengths in cognitive ability than their predecessors, and finding motivation in different forms than the pre-digital student. Instructed by teachers who, for the majority, spent their childhoods engulfed in television programs that fed information for consumption rather than interaction, information delivery is just that; delivery. Absent the choices and short snippets that lead to further discovery, the least engaging part of a student's day is often the time spent at school.

Virtual, multimedia, and e-learning mechanisms offer the potential to bridge the gap between today's new learner and their instructors. Yet, "digital immigrants" comprise the majority of today's educational policy makers. It is incumbent upon today's leaders to inform themselves with the latest research into the educational potential technology encompasses, and incorporate that new knowledge into policy and curricular decisions in order to help fill in the access gap.

Chapter 3 presents the methods used in this study to gather and analyze data in an effort to uncover trends that can be further explored to distinguish between high school students who successfully complete online courses and those who do not. The study investigated the participants' current usage of digital devices as well as the age at which they first began using technology. Participants were also asked to respond to material presented in both a text-based and pictorial format and to indicate their preferred presentation style. Thirdly, students viewed a multi-media, split-screen presentation and recorded their ability to respond to questions regarding its content. Results gathered from a group of students who successfully completed an online course and a group that did not finish online coursework were compared using analysis of variance (ANOVA) and chi-square Phi calculations. Areas of interest were displayed in a stem-and-leaf format to illuminate trends that emerged indicating areas for future study.

Chapter 3

METHOD

Technology has the potential to level the educational access gap by providing courses designed by highly qualified teachers to students that lack opportunity for such exposure. It is essential that educators determine the factors that will allow students to meet with success in such delivery systems in order to eliminate the potential for creating a new type of gap.

Prensky, founder of *Games 2 Train*, suggested that students today do not process information in the same manner as previous generations due to frequent interactions from a very early age with digital devices, particularly video gaming. He has coined the phrase "digital natives" to refer to the digital generation and "digital immigrants" to refer to those who learned to use digital devices as they aged (Lazarus, Wainer, & Lipper, 2005). Prensky (2001) contends that today's student, with his/her brain wired for speed, parallel processing, and on demand access will learn best in a gaming mode.

Some measurement tools for determining student success in an online environment have proven remarkably accurate. The ESPRI (Educational Success Prediction Instrument) has been utilized with virtual high school students. In a 2003 study by Roblyer and Marshall, this instrument predicted those who passed with 100% accuracy and those who did not with 95% accuracy. Yet, the instrument relies on self-report of personal character issues such as belief in one's academic ability, organizational skills, technology skills, and internal motivation (Roblyer & Marshall, 2003). Self-report measures, although instructive, hold the potential for inaccuracies. "In some instances, to attain his or her goals, a person might be motivated to 'fake good'; in other instances, he or she might be motivated to 'fake bad' " (Johnson & Christensen, 2004, p. 149). The traits measured in the ESPRI instrument identify successful independent learners in any format. Though independence is crucial to online success, examining these traits alone

may indicate that the current structure of online classes is missing a population of potentially successful virtual students by design. Measures based upon technological skills and media literacy preferences that demonstrate potential online success could provide schools with a pool of students that could be trained to be independent learners online. Utilizing study data to find ways to match student online skills with appropriate presentation formats that engage and motivate students is one goal of this type of exploratory research.

This study was designed to explore data gathered from online students in an effort to uncover trends that may point toward differences between high school students who successfully complete online coursework and those who do not complete online coursework. Since some research to date indicates little or no significant differences between the groups, determining such a factor may hold the key to moving online high school course delivery to the next level. Students who had participated in online coursework through SUPERNet Virtual School were divided into two groups, those who had completed a course online and those who had started coursework but failed to finish. Two questions were utilized to focus on areas that research has indicated may produce variances:

1. Is the amount of exposure to digital devices and deliveries such as video gaming, cell phone usage, Internet usage, and instant messaging altering the way students think?
2. Is there a measurable skill-based trait or media literacy preference that can predict student success in an online environment?

Organization Background

SUPERNet Virtual School was established in response to concerns of the SUPERNet member districts regarding their high school graduates. Anecdotal evidence cited in the grant application that eventually funded the establishment of SUPERNet

Virtual School indicated that although many districts were successful in getting students admitted to colleges and universities, many pupils were coming home prior to successful college graduation. Many of the students, when questioned, felt that they were unprepared to compete with students graduating from larger, more urban high schools. The advisory board of SUPERNet Consortium hypothesized that several factors contributed to the students' feelings. Smaller districts were unable to consistently staff rigorous and advanced courses especially in the areas of math, science, and foreign language. Lack of experience with technology for academic purposes was also seen as a problem for many SUPERNet students as colleges and universities moved more and more aspects of their programming online.

In the summer of 2002, SUPERNet purchased a Geometry course from Florida Virtual School and enrolled 40 students. The course was developed by a Florida teacher and monitored by a local teacher. The course was hosted on an offsite server and technical support was provided by yet another out of state provider. Though the program was moderately successful in terms of completion rate, approximately 65%, and the study was included in the Texas Virtual School Pilot Project (Texas Education Agency, 2002), the initial offering pointed to several concerns. Courses not developed by the instructor held the potential that material was designed in a format contradictory to the teacher's natural style. Hosting of the course by a third party provider meant that students and the instructor were at the mercy of the host company for technical support. In the case of the first summer, the technical support company was located in a state in a different time zone than the school's state, with the author of the course in a third time zone. Detailed records were not kept on these initial students as after the first semester, SUPERNet began the process of creating and hosting their own courses.

During the fall of 2002, a Health course was created and offered to students. Health remained the only offering through summer 2003. A group of teachers were trained in

course creation and presentation in an online environment during the summer of 2003. Beginning in the fall of 2003, Advanced Placement (AP) U.S. History, Biology, Business Computer Information Systems (BCIS), English III AP, English I, and Physics were added to the course offerings. In the spring of 2004, Spanish, Algebra I, and World History began to have students enrolled, and in spring of 2005, English IV was offered, mostly for seniors that needed to recover credit to graduate. In the summer of 2005 courses in Integrated Physics and Chemistry (IPC) and Spanish II were opened. In the fall of 2005, Algebra II was added.

Student profiles were maintained within a Microsoft Access™ database that included demographic, course completion, and course grade data on each student. The manner in which students were recorded as completers or non-completers changed after the first year of delivery of the first SUPERNet hosted course, Health. Experience with the Florida purchased course demonstrated that many students would enroll in an online course thinking that it was an easy way to a high grade with little work. Once into the course, students found that not only was it not easy, a high grade was not guaranteed. A significant number of students dropped officially or simply discontinued their efforts without notification. This resulted in a lot of effort generated by the registrar and instructors that did not result in student completion. Therefore, an online orientation requiring several submissions of mini lessons before a student remained in the database became a requirement. Therefore, beginning with the fall of 2004, any student who registered but did not complete the online orientation was deleted from the database. Once a student completed online orientation and entered a course for the first time, they were recorded as a student. Those who did not complete the course and receive a grade by the end of a period of time allowed by their individual district were considered non-completers.

Design of the Study

Today's "digital natives" approach the learning environment from a different perspective than their "digital immigrant" counterparts (Prensky, 2001). This exploratory study examined whether two of the differences enumerated by Prensky impact students' tendency to complete an online course. Today's learners tend to think in a more lateral, random, or parallel rather than linear manner. The hyperlinked web environment has led students to expect to follow the search for information across multiple related topics while tying it all back to the initial inquiry. A preference for graphics presentation first with text support for unclear denotations also describes today's learner. These two qualities, along with a measure of past technology usage, were reviewed for their impact on course completion.

This study utilized three survey instruments designed by the researcher to gather information from students about technology usage history, preference for graphics presentation of information, and multi-tasking ability. The instruments were juried for understandability and ease of use by a panel of technology experts. Instrumentation was then piloted by a group of students similar in age and geographic location as those students included in the study, but who were not eligible participants. Modification identified during the jury and pilot phases were compiled and applied to the survey documents before the surveys were administered. The survey designed to measure multi-tasking ability was checked for reliability from the collected pilot data utilizing a split-half procedure.

The first study question was addressed by collecting documentation of each student's technology usage history. A survey inquiring of students which digital devices they used, how often, and for what purpose was utilized (see Appendix A for complete survey). Participants were also requested to disclose the age at which they first began to use computers and other digital devices.

This study's second question was investigated through two instruments designed to find measurable technological skills and media literacy preference. Asking a teenager to self-evaluate their ability to parallel process or think laterally would likely yield more questions than valid data. A request for an evaluation of his/her ability to use the cell phone while performing other tasks, messaging multiple friends simultaneously, or listening to an iPOD (Apple Computer) while drafting a research paper might produce a more usable measure. The measurable skill most resembling the desired characteristic is multi-tasking ability. Delbridge (2001) defined multi-tasking as, "accomplishing multiple-task goals in the same general time period by engaging in frequent switches between individual tasks" (p.1). Delbridge reported several historical ways in which multi-tasking has been assessed. Dual-task performance activities require the subject to spread their attention across two tasks simultaneously. Accuracy on both tasks is then measured. Task-switching starts the respondent on one task then periodically cues a switch to a secondary task. In 1971, Gopher and Kahneman created a task to measure this ability through auditory tasks in which the subject received varying inputs in each ear and was asked to monitor one of the two on an ongoing basis, but periodically requested to switch to the other ear. Measurements of process loss as well as reaction time to accurately switch to the new task gauged the level of ability (as cited in Delbridge, 2001).

Creativity that allows the researcher to go beyond the conventional to uncover new relationships is an important part of the exploration toward the emergence of grounded theory (Straus & Corbin, 1990). Previous measures of multi-tasking based upon auditory commands did not attempt to measure the skills required in today's multi-media environment. The researcher, with assistance from the Information Technology Department of Texas A&M University-Commerce, designed the survey for this study to measure multi-tasking ability through multi-media segments that mimicked presentations seen on many television news presentations where multiple inputs tantalize the viewer

simultaneously. It required the participants to attend to three frames on a computer screen, all with a visual component; one input also contained an audio component. Ability to monitor all three parameters was measured through a ten-question assessment of content retention.

The second instrument used to investigate measurable skills-based and media literacy traits, targeted the literacy aspect. Many of the opportunities currently provided to students through digital delivery remain heavily text-based (Cavanaugh, Gillan, Kromrey, Hess, & Blomeyer, 2004). Though SUPERNet Virtual School courses have made multiple efforts to improve interactivity and virtual experiences with such offerings as science and math laboratory simulations, anecdotally, approximately 80% of the content is delivered through text. An assessment of media literacy preference as measured by student election of a graphics or text-based presentation style was included in this study to see if this learning style correlated with whether or not a student was successful in a text-heavy environment.

This exploratory study was designed to determine if trends emerged from collected data that pointed to identifiable significant differences, other than motivational characteristics, that existed between students who successfully completed an online course and those who did not complete an online course. One-way analysis of variance, (ANOVA) was selected to identify areas that pointed toward differences between completers and non-completers of online courses for the two measures, technology usage and multi-tasking ability. These two instruments utilized scale or ordinal variables. A chi-square test was performed on the graphics preference data. The chi-square test was more appropriately used for that instrument's nominal data (Norusis, 2004). Factors that emerged as possible indicators of difference were then charted using a stem-and-leaf plot to illuminate trends of interest. Gall, Borg, and Gall, (1995) encouraged the use of the stem-and-leaf plot, particularly in exploratory analysis of data. This data configuration

has the advantages of providing a shape to scores that can point toward patterns and help to target outliers.

Subjects

The subjects were selected from a group of students who registered for an online course delivered through SUPERNet Virtual School between the spring of 2004 and the spring of 2006. SUPERNet Virtual School served students who attended one of the schools within member districts of SUPERNet Consortium. Seventeen districts made up the SUPERNet Consortium and ranged in sizes indicated by the University Interscholastic League's "A" level classifications based on high school enrollment (smaller A classification indicated a smaller school). The members included two 1A, five 2A, five 3A, four 4A, and one 5A, mostly rural districts. One nearby 2A high school was allowed to utilize the virtual school on a minimal basis. Students were required to obtain permission from their district of attendance in order to register for a Virtual School course. The signature of both the district counselor and a parent was required at the time of registration. SUPERNet Virtual High School did not issue course credit. Credit was issued by the school district the student currently attended.

Instrumentation Development

The involvement of minors in research studies requires that every measure be taken to insure that no harm physical, mental, or emotional, be inflicted upon participants. The National Cancer Institute includes children among the list of *vulnerable populations* "…persons who are relatively or absolutely incapable of protecting their own interests" (National Cancer Institute, 2006, Vulnerable Populations section, p. 1). "Adequate measures must be developed to protect children's privacy and to ensure that the participation does not stigmatize them in the present or future" (Vulnerable Populations section, p. 2). Therefore, the instruments developed for use in this study were designed in a survey format that

in no way tied the respondent to the response. Although anonymity of participants was strongly protected through these measures, the resulting data could not be correlated to participant demographic data.

All of the instruments were designed using Microsoft PowerPoint™ . The multi-task media presentations were created in Macromedia's *Breeze* ™ system. Texas A&M University-Commerce faculty members utilize this program for online presentation of course material. The system allows the instructor granted access as a user to create both presentations through Microsoft PowerPoint ™ and quizzes or surveys that collect respondent data. The material may then be setup so that it can be accessed by anyone who is granted the directions to a particular site location, or it can be restricted to users who must login with a username and password in order to complete the surveys or quizzes. The former case was selected for this study in order to maintain student anonymity.

Each instrument was designed and then juried by a group of three technology directors from SUPERNet school districts to determine ease of usability. Sixteen high school students ranging in age from 14 to 17, and ranging in technological ability, participated in a pilot study to further illuminate areas of concern with the documents before their distribution. Revisions were made in response to the pilot findings to improve the quality of data requested.

The first instrument used to measure technology usage history asked students to rank their level of usage of such devices as cellular phones and the computer on a five point Likert scale that included the choices *never, once in a while, monthly, weekly*, and *daily*. Information concerning the tasks for which the devices were used was also collected. The resulting instrument was utilized for the study (see Appendix A).

The second instrument was designed to explore whether participants prefer to obtain their written information in graphic or text-based format. Each slide presented information in both of the mentioned formats; one marked A and the other marked B, followed by a slide asking students which one they preferred. Material varied from a simple sign such as "No Dogs Allowed" as compared to a picture of a dog with a crossed circle over it, to a full set of multi-step directions about how to perform a specific task (see Appendix B for complete survey). Surveys completed by the 16 students piloting the project indicated score distributions ranging from a 47% to 93% preference for graphics presentation that indicated variances in preference were being observed by the instrument (Johnson & Christensen, 2004).

The final survey was designed to measure student multi-tasking ability. Three separate multimedia presentations that provided a split-screen delivery of multiple content inputs were uploaded for presentation online through the *Breeze*™ system. Each presentation included three screens playing simultaneously, a video with an audio track, a PowerPoint ™ presentation that progressed without student interaction, and a text scroll across the bottom (see Appendix C for image of presentation). The content of the three frames was unrelated. A videotape containing the presentation was also created as a "plan B" option for students who might have difficulty accessing the online content. Student ability to multi-task was evaluated using a 10-question quiz over each presentation to determine content acquisition and retention. The first three questions on each quiz pertained to the video frame, the second three to the PowerPoint ™ frame and the remaining four to the scrolling information (see Appendix D for complete survey). The quiz was scored for accuracy per question type. The resulting data showed a variance between respondents and questions

that is necessary for the survey to be deemed valid. The instrument was then checked for reliability using a split-half technique (Johnson & Christensen, 2004).

Data Gathering

SUPERNet Virtual School's database was the collective property of the 17 entities associated with the project. Permission was requested from every superintendent whose district participated in the virtual school to contact the parents of district students. Superintendents were assured that the survey instruments utilized did not ask identifying information and that student identity would be protected. They were also instructed that parents could elect not to have their students participate if they so desired and that they could withdraw at any time even if initial permission was granted. All participating district superintendents returned written approval to contact district parents for permission for their students to participate in the study.

Student data were recorded within the Microsoft Access™ database in a dynamic manner with regards to course status. Those who had completed a course were indicated by their final course grade, those who failed to complete or dropped a course were marked as dropped, and those who were actively working were indicated as "open." The Microsoft Access™ database that contained a listing of all students who attempted coursework through SUPERNet Virtual School was utilized to obtain the names and addresses of possible study participants. A query was created within Access ™ to divide students into two groups, those who had enrolled for a course between the spring of 2004 and the spring of 2006 but had dropped or failed to complete the course, and those who had enrolled during the same time frame but had completed the coursework and obtained a grade. Students with courses still in progress at the beginning of the summer semester 2006 were not included in the participant list unless they had

already completed or dropped a previous course. No grade requirement was used in order to determine successful completion. The non-completers group consisted of 174 students in the eligible population, and 301 formed the eligible completers group. Each list was uploaded into a Microsoft Excel™ document and ordered by date of enrollment. The lists were then numbered from 1 to 174 and 301 respectively with that number being assigned to the participant. Research Randomizer (Urbaniak & Plous, 1997), an online tool designed to assist researchers by producing a prescribed amount of random numbers from an inputted range, was used to select 75 students from each group to request participation in the study. Initial mailing of requests for participation and informed consent were sent to the parents of selected students from each group on June 16, 2006.

Documents were run on colored paper for ease of completer and non-completer group identification for the investigator, though participant confidentiality was strictly guarded at all times. Requests for participation and informed consent documents were run on blue paper for students in the completers group and green paper for those in the non-completers group. The request for participation (see Appendix E for document) required consent by the parent of any student under the age of 18 as well as assent by the student regardless of his or her age. A stamped self-addressed envelope was enclosed with the permission documents for ease of return. Requests for participation were returned to the researcher with positive responses from 36 students. The sample represented 23 completers and 13 non-completers.

Packets were created that contained the three paper surveys and a copy of the videotaped version of the multi-task media presentations. The survey instruments were printed on colored paper in order to separate the completers and non-completers. When consent forms were returned to the researcher, completers

were mailed surveys printed on light blue paper, and non-completers were mailed surveys on light green paper. Students were also provided with the web address and instructed to use the high-speed connection option and view that portion online if available. The taped version was seen as a "plan B" alternative. A letter of appreciation and instructions in how to complete and return the surveys was also included on the appropriately colored paper with each packet (see Appendix F for instruction letter). Students were instructed not to place any identifying information in the return packet. The surveys and video were sent via priority mail with a stamped priority mail envelope included for return mailing.

Returned surveys were numbered and clipped together so that continuity of results between questionnaires could be maintained. The packets were immediately separated from their mailing envelopes to eliminate any chance of connecting surveys with senders. Color coding of survey instruments provided a clear distinction as to group membership without the need for other identifying information. Two additional postcards were sent to all participants between the initial packet mailing date and September 15th requesting completion of the surveys. Since there was no way to identify students who had been mailed or completed packets, postcards were sent to all students who had returned informed consent. Fourteen completers and nine non-completers returned packets, representing a 64% rate of return.

Data Analysis

The data was analyzed utilizing one-way analysis of variance (ANOVA) with SPSS for the technology history and multi-task instruments, and chi-square tests with Phi statistic calculation for the graphics preference instrument. The null hypothesis noting that there was no significant difference between completers and non-completers was assumed. The finding of no significant difference corresponded with the results of multiple previous studies (Bernard, Abrami, Lou, & Borokhovski, 2004).

Analysis of variance requires that certain assumptions about the data be met:

1. data is from independent, random samples
2. data is normally distributed
3. data contains equality of population variance (Norusis, 2004, p. 301)

The design of the study insured independent, random samples. Analysis of variance is a robust test that can withstand variations in the normality assumption therefore little weight was placed upon this requirement. Levene's homogeneity-of-variance test was performed using SPSS on resulting data to determine equality of variance before analysis was undertaken (Norusis). Levene's statistics indicated levels manageable for ANOVA's robust procedure. Stem-and-leaf plots of factors where ANOVA results pointed toward areas of interest were drawn to further descriptively view the data for trends that led to hypothesis generation for further research endeavors.

Summary

Three instruments were designed by the researcher, juried, and piloted for the purpose of collecting information on student technology usage history, preference for graphics or text-based information presentations, and multi-tasking ability. Students who had participated in the SUPERNet Virtual School program between the spring of 2004 and spring of 2006 were divided into those who had completed an online course and those who had started but failed to complete a course. Permission was requested and received from school superintendents to recruit participants by contacting their parents for informed consent.

A convenience sample of 36 volunteers, 23 completers and 13 non-completers, was sent complete survey packets. Study data were collected from June through September 2006. A response rate of 64% of survey packets completed resulted in data from 14 completers and 9 non-completers.

Chapter 4

PRESENTATION OF DATA

This chapter first describes the available demographic data on the students who responded to requests for study participation. The data are then presented in an effort to determine if emergent trends point toward identifiable difference between those students who completed an online course and those who had begun the online course but failed to complete similarly delivered content. Analysis focuses on the research objectives of notable differences in technology usage history, measurable skills-based traits, namely the ability to multi-task, and media literacy preferences measured as an election of a graphics presentation style over a text-based offering.

Participant Demographics

Critical attention given to protecting subject anonymity limited the complete identification of the demographic make-up of the final study sample. Informed consent and assent documents were returned identifying students. Survey documents were then mailed using color-coded paper to determine group assignment but with no other identifying information. Informed consent documents were returned by 36 students. This created a convenience sample of 23 completers and 13 non-completers. Survey packets were filled out and returned by 14 completers and 9 non-completers, a return rate of 64%. Though not possible to determine which 23 of the 36 participants who returned informed consent documents were included in the study data, students ranged in age from 13-20 and attended high school in rural east Texas.

Findings

The study's objective was to explore, through the collection of data, the questions derived from review of the current research literature that examined online learning environments in the K-12 community. The goal was to identify trends that emerged from

analysis for the generation of hypotheses grounded in the data that warrant further study. To address the study questions, the following objectives were addressed:

1. To determine if there is a significant difference between students who successfully complete (receive credit for) an online high school course and those who do not in their preference for graphics or text first presentations.
2. To determine if there is a significant difference between students who successfully complete (receive credit for) an online high school course and those who do not in their ability to parallel process information as measured by multi-tasking accuracy.
3. To determine if there is a significant difference between students who successfully complete (receive credit for) an online high school course and those who do not in their previous technology usage.

Exploration of data in search of differences between students who completed an online high school course and those who began but did not complete the endeavor, examined data collected based upon the two study questions generated from review of pertinent literature.

Question 1

The first question analyzed was: *Is the amount of exposure to digital devices and deliveries such as video gaming, cell phone usage, Internet usage, and instant messaging altering the way students think?* This question was addressed through the first survey (see Appendix A). Students used a Likert scale ranging from *daily* on the high end to *never* on the low end, to indicate the amount of time spent using cellular phones, computers, video games, and music players such as MP3s. The particular uses of the devices were also addressed. The questions were designed to investigate whether students utilized the technologies for structured purposes such as schoolwork, or for entertainment purposes such as gaming and socializing. Students were asked to indicate when they first began to

use digital devices in terms of four age ranges, *under 4 years of age, 5-8 years, 9-12 years* or when they were *older than 12*. One-way analysis of variance (ANOVA) was performed on the technology usage data. The score was determined by assigning of values to the parameters of the Likert scale: 1=*never*, 2=*once in a while*, 3=*monthly*, 4=*weekly*, 5=*daily*. Similar assignments were made to the age of commencement of use data: 1=*older than 12*, 2=*9-12 years*, 3=*5-8 years*, 4=*under 4 years*; higher values were given to the younger a student began their technology usage. When *F* statistic of ANOVA was greater than 1.0, the area was viewed as an area of interest for further analysis.

Age of digital usage commencement data was reviewed through ANOVA calculations. With an alpha level of <0.05, F=1.150, p=0.296. This finding indicated a trend toward non-completers beginning the use of technology at an earlier age than completers. Table 1 displays these results.

Table 1

Age Use of Digital Devices Began

	older than 12	9-12 years	5-8 years	Under 4 years
Completers *	7	2	3	1
Non-completers	2	2	4	1

(*1 responder left the question blank)

Examination of the technology usage data analyzed by item yielded three areas of interest. Video game usage for completers versus non-completers showed F=3.576, p=0.073 with an alpha level of <0.05 (see Table 2). Use of a cellular phone for other purposes than placing a call found, with an alpha of <0.05, F=2.644, p=0.119, but this area showed a Levene statistic that did not indicate that the homogeneity of variance requirement was met for this measure. Though the

results indicated no notable difference between completers and non-completers in their use of Internet searching, when students were asked to indicate the frequency of their Internet usage on school-related tasks, a larger *F* value again emerged. Completers more often used Internet searching as a tool to assist with school assignments than did non-completers (*F*=2.009, *p*=.171, alpha < 0.05).

Table 2

ANOVA Results of Student Technology Usage by Item

(alpha < 0.05) (df = 22)	F	Sig
Video Game Usage	3.576	0.073
Cell Phone Usage	0.438	0.515
Text Messaging	0.000	0.985
Instant Messaging	0.100	0.755
Internet Searching	0.337	0.568
Internet Searching for School	2.009	0.171
Messaging Multiple Friends	0.782	0.386
MP3 Music Downloads	0.169	0.685
Cell Use for Other Than Calls	2.644	0.119
Age Technology Usage Began	1.150	0.296

The two areas of interest indicated by ANOVA data, video game usage and Internet searching for school were plotted using a stem-and-leaf graph (Figures 1 and 2). This structure allows the opportunity for patterns found in the distribution of individual scores to be revealed that might otherwise be overlooked through statistical calculations alone (Gall, Borg, & Gall, 1995). A stem-and-leaf graph displays individual scores by splitting data point values into two parts, the stem and the leaf. The leaf generally consists of the last digit of the data value with the stem consisting of the remaining digits to the left. The

stem values are graphed down the center of the plot with a solid line separating the stems from the leaves. Each individual data point is then placed horizontally along the graph so that scores that fall between the unit range separating the stems appear on the same horizontal line. Each leaf represents an individual score. The value of each score may be calculated by placing each leaf, to the right of its stem and multiplying by the unit given. When two groups of data are compared, a back to back plot is utilized where a single stem is shared by both groups of data.

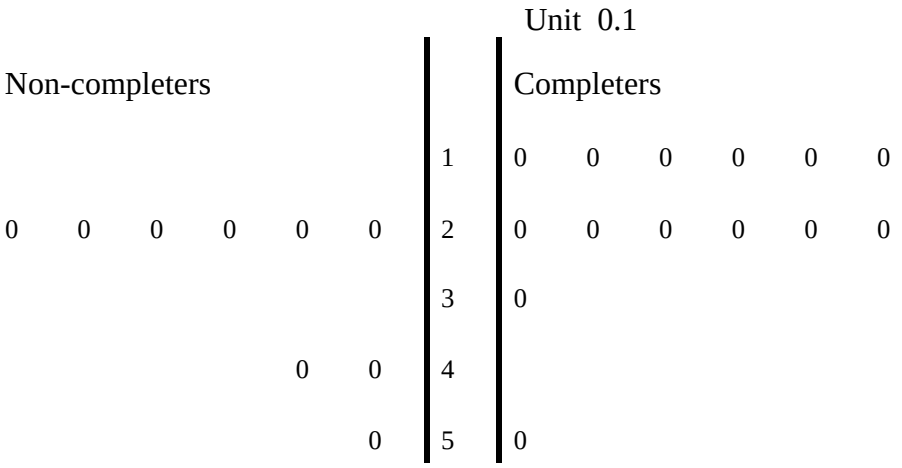

Figure 1. Video Game Usage. Distribution of individual scores, ranging from 1-*never* to 5-*daily*, show an absence of non-completers in the *never* category for video game usage. Most completers answered that they played video games either *never* or *once in a while* and only one completer that answered with more frequency than *monthly*.

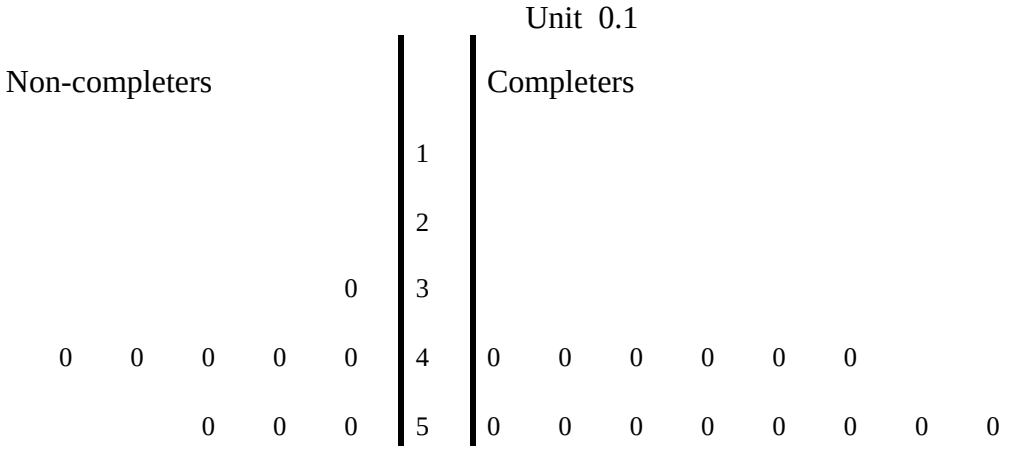

Figure 2. Internet Usage for School. Distributions of completers and non-completers with regard to Internet searching for school tasks demonstrated the majority of completers answered *daily* use with all completers in either the *daily* or *weekly* categories. Non-completers more often chose *weekly* than *daily* with one falling to *monthly* frequency.

The stem-and-leaf plots drawn to display the technology usage history data used the Likert scale number as the stem of each individual data point with a 0 for the leaf. Placing each leaf to the left of its stem and multiplying by the unit, 0.1, provided the appropriate Likert number. The numbers indicated a selection of frequency with 1 identifying *never*, 2 *once in a while*, 3 *monthly*, 4 *weekly*, and 5 *daily* usage. In examination of Figures 1 and 2, the areas where data points were absent were more illuminating than the points where the data existed. With regard to video game usage (Figure 1), there were zero non-completers who indicated that they had never played a video game. However, approximately 48% of all completers indicated that they had never participated in video game play. Although one-third of the respondents from the non-completer group responded that they played video games daily or weekly, only one completer, representing about 7% of the total completer respondents, indicated daily or weekly levels of frequency with regard to playing video games.

Upon examination of the individual responses with regard to the use of the Internet for the purpose of performing school related tasks (Figure 2), once again the areas lacking respondents provided the greatest amount of interest. Among completers there were no respondents who indicated usage less frequently than weekly with more than half of the respondents reporting daily usage of the Internet for school purposes. Non-completers, reporting a preponderance of daily or weekly participation, more often reported weekly than daily usage. Only one-third of the non-completer respondents indicated daily Internet usage for school related tasks and one respondent indicated only monthly frequency.

Question 2

The second question examined in an effort to find differences between completers and non-completers of online courses was: *Is there a measurable skill-based trait or media literacy preference that can predict student success in an online environment?*

Two surveys were utilized to address the question. The first looked at student preference for graphics presentation of content material. Students were shown information presented in two ways, one with a graphic image and the other with comparable text. Initial questions showed simple signage and the remaining questions presented increasingly complex sets of directions to complete tasks such as cooking macaroni, assembling devices, or performing exercises.

A chi-square test was utilized to explore the independence of the results obtained between completers and non-completers on each of the graphics preference questions. The Phi coefficient was calculated for each question (Table 3). Phi is a measure of association that allows a correction for sample size. It ranges in value for zero to one, where one indicates a perfect association and zero indicates no association (Norusis, 2004). Greater independence between the two variables, Phi closer to zero, indicated a

difference between the two study groups in two instances. The presentation of macaroni directions produced a significant Phi score (Table 3). All non-completer respondents indicated a preference for text-based presentation of this material. The other question that resulted in a significant Phi was the explanation of how to clear a paper jam from a fax machine. While all but one non-completer preferred this information in a text-based format, half of completers desired the graphic format. Though both questions contained multi-step directions for the performance of a task, so did several of the other stimuli presented, leaving no clear distinction between these two questions and the others that would provide an explanation for the variances.

Table 3

Phi Statistic for Graphics Presentation N=23

Input	Phi
Restroom Sign	.964
No Dogs Sign	.940
Lightbulb Change	.964
Macaroni Prep	.022
Coin Sort	.624
Cut Flower Preservation	.825
TV Assembly	.235
Printer Cartridge Replacement	.907
Ab Lounge Exercise	.526
Paper Jam Correction	.027

An additional measure designed to address the second study question tested the ability of students to multi-task with regards to multimedia presentation of material.

Participants were provided with three segments of media that contained split frame presentation of three different inputs. One frame showed a video with both audio and video components on one topic. Another frame immediately to the left of the video displayed a PowerPoint™ presentation on an unrelated topic that advanced on a timed progression and contained both graphics and text representations. The third frame scrolled the full width of window below both of the other two frames and contained only text information on a third, unrelated subject. Students were asked to view the presentation then answer ten questions pertaining to the information.

Reliability of the multi-tasking survey instrument was tested from pilot results using a split-half procedure (Johnson & Christensen, 2004). Questions 1–3 of each of the three tests pertained to the information presented in the video frame, questions 4–6 addressed the PowerPoint™ frame, and questions 7–10 questioned recall on the scrolled material. The instruments were split by randomly selecting four video questions and four PowerPoint ™ questions from each of the tests for each half, eliminating one of each type of question. Both halves included at least one question from each of the three quizzes. The scroll questions were divided evenly, two from each instrument in each half of the split. Data gathered through the *Breeze*™ system could not be separated or identified by individual respondent supporting confidentiality. Each question was reported only as the total number of respondents selecting each item, A–D, for each question. The percent of correct answers for each question was calculated and entered into SPSS in the appropriate half of the test. A two-tailed correlation was then run on the data. Pearson's correlation between the two halves of the instrument resulted in $r = 0.761$. Table 4 displays analysis of variance (ANOVA) data on the percentage of correct answers for each question type per each test.

Table 4

Student Media Multi-Tasking Ability

(alpha < 0.05) (df = 22)	F	Sig
Percent video questions answered correctly	0.509	0.483
Percent ppt questions answered correctly	1.742	0.201
Percent scroll questions answered correctly	1.561	0.225

Examination of data by question type per individual quiz further illuminated areas of variance. Students, overall, seemed to have a difficult time with the questions over the PowerPoint™ section of presentation two. The segment contained a large amount of written information about preparing for college. The slides were crowded with text and contained limited graphical clues to the content. The mean correct response for completers was 1.43 and for non-completers 1.56 out of a possible 3. The other section that showed significantly poor scores for both groups was the video segment of quiz 3. The mean correct out of a possible 3 for the video portion of question 3 for completers was 1.36 and for non-completers 1.33. Since the other two video segments resulted in some of the highest levels of accuracy, completers 2.71 and non-completers 2.33 out of 3.0 on quiz 1, 2.79 and 2.67 out of 3 respectively on quiz 2, the most reasonable assumption for the drop in student accuracy was technical difficulties with the presentation.

Stem-and-leaf plots of average overall accuracy scores across the three presentations for each participant more clearly revealed trends. Acquisition of information on the video portion of the three media presentations was assessed with the first three questions on each instrument. A total of nine questions measured student accuracy of responses to questions about this information. Similarly, nine questions measured the ability of students to gather and retain information presented in the PowerPoint™ segments. The evaluation instruments contained a total of 12 questions

over the scrolling text segments. Each portion of the questionnaire was scored separately with the percentage of correct responses recorded in the graph. Incorrect responses to the video and PowerPoint™ segments deducted approximately 11 points from the student's score, although incorrect responses to the scrolling segment debited approximately eight points. Figures 3, 4, and 5 present the individual scores of each portion of the multi-tasking instrument. The last digit of the percentage score for each individual student served as the leaf, with the remainder of the percentage represented the stem. Once again, as with the digital usage information, absence of distributions in certain areas provided the most informative descriptions. Each plot is described as it is presented.

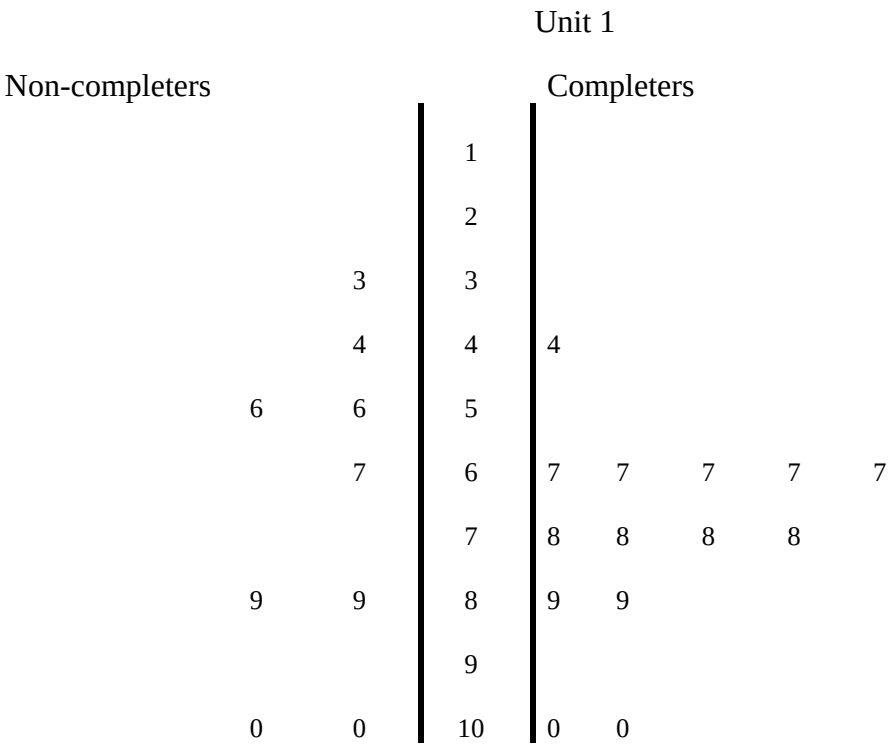

Figure 3. Average Scores on Video Segments. Distribution of individual accuracy scores for the video segments of the multi-tasking activity show a greater number of non-completers at the extremes.

Whereas the ANOVA showed a very close match between completers and non-completers on the video segments of the multi-task instrument, the stem-and-leaf plot revealed some areas of interest not recognizable when scores are compressed into calculations. Completers scored better overall on the video portion of the multi-media presentation. Only one completer scored below the 67% mark while almost half of the non-completers scored 56% or below. Both completers and non-completers had four respondents that missed either one or fewer questions on this portion of the instrument, representing a larger percentage of the non-completers at the higher end of the distribution than for the completers. More completers fell toward the middle of the distribution, whereas non-completers tended to fall to either extreme. The video section of the multi-media presentation was the portion that contained both an audio and a visual input for students and therefore it presumably represented the portion to which the acquisition of content would be acquired most readily. The variance that showed non-completers tending toward one extreme or the other could be indicative of a distraction level with multiple simultaneous inputs that caused some students difficulty. Such an issue, if known, could be easily addressed in online course creation.

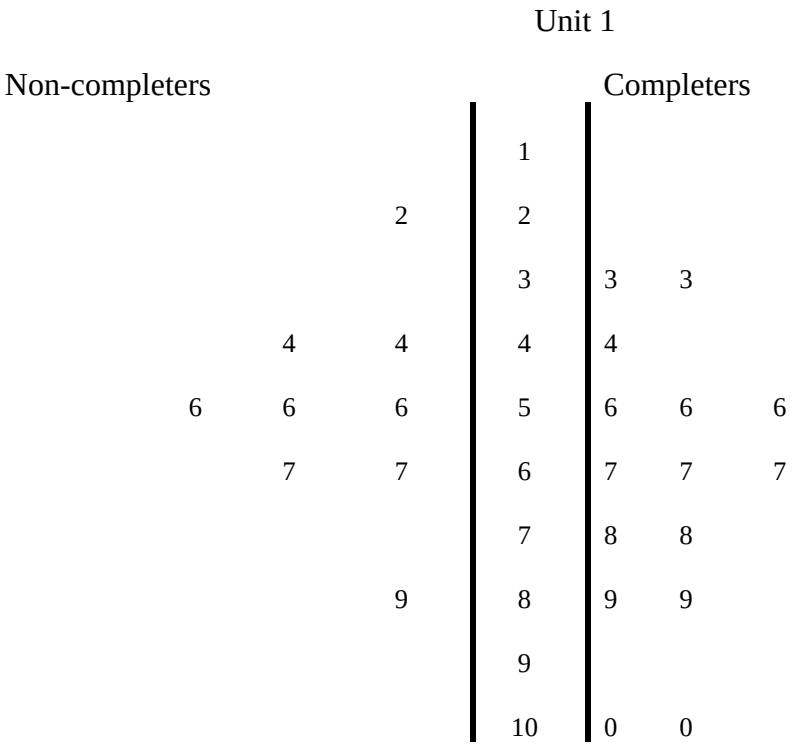

Figure 4. Average Scores on PowerPoint™ Segments. Distribution of accuracy scores on the PowerPoint™ portion of the multi-tasking activities demonstrated differences at score extremes.

The ANOVA data demonstrated the largest difference between completers and non-completers on the PowerPoint™ section of the multi-task instrument. Although completers did not score below 33%, non-completers failed to score above 89%. Though the variances between the extremes were larger on this measure than on the previous input type, the scores clustered more tightly around the middle. A greater percentage of completers broke away from the cluster to the higher end than did the non-completers. Just under half of the completers scored above the pack whereas only one non-completer accomplished the higher score. This portion of the media input contained both text and

graphics representations and required attention to both mediums to fully understand the material.

Unit 1

Non-completers			Completers		
	0	0	0		
	7	1			
	5	2	5		
		3			
		4			
	8	5	0		
7	7	6	7	7	7
	5	7	5	5	
	3	8	3	3	
	2	9	2	2	
		10	0	0	

Figure 5. Average Scores on Scrolling Segments. Although non-completers more often scored at the two lowest score levels, completers more often scored at the two highest.

Once again, ANOVA calculations indicated some differences between completers and non-completers on the scrolling text portion of the multi-tasking instrument. The all text segment indicated a distribution of scores very similar to the one produced by the PowerPoint™ segment. Both of these two segments did not contain an audio portion. No non-completers received a perfect score on this segment whereas two completers accurately answered all of the questions. Though about the same percentage of both

completers and non-completers scored on either side of the middle on this measure as they did on the previous measure, those that scored lower missed more questions. The significantly larger percentage of all students who scored lower on the two portions of the presentation that relied solely on visual input with no audio track may indicate that today's learner needs visual instruction to be supported by audio input as well. The abundance of music videos consumed by today's youth could contribute to this learning style.

Summary

Tendencies or trends indicating differences between completers and non-completers of online courses were detected in varying degrees on all three measures utilized in this study. Differences were noted in areas of technology usage, graphics preference, and multi-tasking ability. Technology usage history data indicated that non-completers played video games more frequently than completers. Completers more often used Internet searching for school assignments. Although graphics preference data indicated a greater preference for graphics presentation by completers than non-completers, no explanation for the difference could be readily detected from the data. Multi-tasking ability trend differences were identified between completers and non-completers with completers better able to accurately multi-process multiple media inputs in each of the three types of formats. The tendency toward a greater percentage non-completers to fall below the median score levels on all multi-task instruments may indicate some areas that could be addressed within online course creation.

Chapter 5 revisits the statement of the problem for this study, its objectives and the study method. It discusses the findings in detail and recommends hypotheses for further research that emerged from this exploration.

Chapter 5

SUMMARY AND DISCUSSION

The final chapter of this dissertation will serve as a review of the overall study. A restatement of the problem and review of method will precede the summary and discussion of results. Implications for further study will also be addressed.

Statement of the Problem

Distance education at the high school level offers the opportunity for equity of access to highly qualified teachers and programming to underserved students and remote locations (Cavanaugh, Gillan, Kromrey, Hess, & Blomeyer, 2004). Examination of the aspects of this relatively new form of content delivery is essential to ensure that quality and rigor are maintained, and student success is maximized.

The novelty of the design of this study prescribed exploratory research. Though the literature abounds with studies comparing online learners with traditional face-to-face students (Bernard, Abrami, Lou, & Borokhovski, 2004; Cavanaugh et al., 2004; Smith, Clark, & Blomeyer, 2005), limited work compares online students with each other to determine differences between those who succeed and those who do not. Further, efforts to find skills-based traits that could explain student completion differences are few. Exploratory research serves as a method to utilize data in an effort to allow trends to emerge inductively, allowing for the construction of hypotheses that warrant further study (Joppe, 2006).

Review of the Method

This exploratory study attempted to uncover differences between high school students who had successfully completed an online course and those who had attempted, but not finished, a similar class. Participants completed three surveys designed to explore technology usage history along with the more media literacy and skill related elements of preference for graphic presentation of information and multi-tasking ability. Analysis of

variance (ANOVA) and chi-square calculations were applied, using SPSS, to the resulting data to identify differences between the two groups. The Phi statistic was calculated for chi-square data to determine relative association of nominal variables and to address small participant numbers within the study. Stem-and-leaf plots were presented to reveal individual data in order to highlight and further explain tendencies and trends calculated through a descriptive statistical process.

Review of Study Objectives

The study's aim was to explore, through the collection of data, the questions derived from review of the current research literature that examined online learning environments in the K-12 community. The goal was to identify tendencies and trends that emerging from analysis for the generation of hypotheses grounded in the data, rather than in prior findings, that warrant further study. To address the study questions, the following objectives were utilized:

1. To determine if there is a significant difference between students who successfully complete (receive credit for) an online high school course and those who do not in their preference for graphics or text first presentations.
2. To determine if there is a significant difference between students who successfully complete (receive credit for) an online high school course and those who do not in their ability to parallel process information as measured by multi-tasking accuracy.
3. To determine if there is a significant difference between students who successfully complete (receive credit for) an online high school course and those who do not in their previous technology usage.

Summary of the Results

Results of data analyses are discussed according to the research question.

Question 1

Is the amount of exposure to digital devices and deliveries such as video gaming, cell phone usage, Internet usage, and instant messaging altering the way students think?

The technology usage history questionnaire indicated areas of possible differences between completers and non-completers in their use of video games and their use of the Internet for school related tasks. Although completers more often reported using the Internet to search for school related topics more frequently than did non-completers, non-completers reported they engaged in video gaming more often than did completers. Prior research (Gee, 2005; Brown, 2000) has indicated that the high level of participant engagement associated with multimedia gaming creates high interest levels that could compel course completion if it were integrated into the design. Current online course offerings do not generally contain the elements of engagement. Completers, by the indication that they use technology for schoolwork more frequently, seemingly have recognized the value of the application of technology as a tool, and use this application for gain in their real-world activities. Anecdotally, the reason most often reported by high school counselors to virtual high school teachers for students dropping a course and becoming non-completers has been that the course was not what students had expected. This could be due to the fast-paced gaming practice and approach desired by the new learning style noted by such researchers as Gee (2005) and Brown (2000). Students accustomed to the high level of engagement and interactivity of video games and less prone to see technology as a tool for task completion, probably find the still largely traditional presentation of course material in the online courses utilized for this study less palatable than they expected.

Question 2

Is there a measurable skill-based trait or media literacy preference that can predict student success in an online environment? Examination of the two survey results

intended to target skill differences between online course completers and non-completers revealed tendencies or trends toward identifiable differences. Literature would suggest that a preference for graphics presentation of material in all students might be found (Prensky, 2001), yet the data did not support this conclusion. A slight preference for graphics presentation was indicated by completers, when broken down by question, the results were intriguing and might warrant further investigation to determine if students' preference for graphics is task dependent. The two inputs that produced the smallest Phi value and therefore more likely indicated a significant difference between the two groups were the macaroni preparation directions and the paper jam directions. Both presentations involved step-by-step directions of how to complete a task. Several other inputs including sorting coins in a coin machine, preserving cut flowers, performing an exercise on an abdominal lounge, assembling a television monitor, and replacing a printer cartridge also provided multi-step directions but did not generate the differences. Perhaps the differences emerged because of all the directional inputs, high school students would be most likely to cook macaroni and remove a paper jammed in a fax machine than they would be to perform any of the other presented tasks. These two particular tasks are useful to students on a daily basis and therefore could indicate a preference for useful information in graphics form. This information could be directly applied to course content during creation. Since there appeared to be some deviation, these findings also bear further examination.

Small differences were indicated in the direction of completers in the multi-tasking survey. Completers were better able to accurately process and retain information presented through multiple frames simultaneously. The least area of difference between completers and non-completers was in their ability to process and retain information presented in a video format. Both an audio and video track constituted this input allowing participants two opportunities to glean the information through visual and

auditory stimulation. Difference levels widened in the ability of completers and non-completers to process the information presented via PowerPoint™ presentation and scrolled information. The PowerPoint™ input included only a visual track through both graphics and written text. The scrolled input included only text-based material that moved at a speed that could not be controlled by the participant. Further research should be conducted to uncover whether the tendencies and trends identified by this small-scale study would hold true on a larger scale. Indications that an audio track along with a video track would be helpful to students, as well as the possibility that a distraction factor may impact student success when visual fields become overloaded could be considered during course design. The multi-tasking skill may be one that can be cultivated through exposure and practice with video gaming. Green and Bavelier (2003); and Greenfield, DeWinstanley, Kilpatrick, and Kaye (1994), found that playing video games can improve visual skills.

Discussion

Research into online learning in high school students is limited in current literature. This population creates a challenge for researchers and requires multiple opportunities for lost data. Minors, considered a *vulnerable population* for research purposes (National Cancer Institute, 2006), require not only assent for study participation, but also parental consent, along with district and campus level permissions. If students are participating in coursework through a school district, the researcher is first required to receive permission from the district before approaching parents for such consent.

Once the hurdles of permission have been achieved, the challenges presented due to dealing with online students create additional barriers to solid data gathering. Limited numbers of returned responses by online students have been a noted impediment to multiple studies into virtual learning (Bernard, Abrami, et al., 2004; Roblyer & Marshall, 2002). A recent study of algebra students that compared online algebra students with

those taking the course in a classroom setting experienced poor return of responses with online participants. Of the 139 online students, only 12 (9%) completed and returned a voluntary examination sent by mail. An on-site teacher administered the measure to students in the traditional classroom. A second part of the study utilized a pretest/posttest measure. Though 81 online students took the pretest, only 57 of them completed the posttest, resulting in only 47 students who completed both measures (Cavanaugh, Bosnick, Hess, Scott, & Gillan; as cited in Smith, Clark, & Blomeyer, 2005). An additional study cited in Smith et al. (2005), compared 68 online students with 342 face-to-face students. Although 248 (72%) classroom students completed the survey instrument, only 18 (26%) online students participated (Ferdig, DiPietro, & Papanastsiou; as cited in Smith et al., 2005). Methods should be designed that maintain student freedom of responses and anonymity, yet insure participation of both completers and non-completers of online courses. Completion of study tasks upon enrollment in online courses as a part of the registration process with assignment to groups made after students have either completed or failed to complete the coursework could provide greater levels of participation.

This study demonstrated, through the necessity of a "plan B" alternative for the multi-task presentation, that a technological gap between rural high school students and their future institutions of higher learning also remains an obstacle. Though districts and classrooms are well wired (Lazarus, Wainer, & Lipper, 2005), students from those very districts continue to experience technical difficulties from home. With the ability to access high-speed connectivity in a nearby location, the recognition of limited access has dwindled. Yet, the reality is that many students, living miles from their school buildings or town services, generally travel to school daily by bus. With scheduled bus departures in most districts immediately upon the close of the school day, true access to high-speed connectivity is limited by time and place. As colleges and universities increase the

amount of online work required for onsite course completion, students from rural high schools with poor off campus access are not being afforded the opportunity to develop the type of outside-of-school work ethic that will help them to be successful at the next level. In this manner, sustained lack of access to high quality Internet service in the rural areas continues to widen the technological divide.

In examination of the question as to whether or not the use of digital devices is changing the way students think, results of this exploratory study indicated that non-completers tended to begin use of digital devices at an earlier age and that they tended to play video games more frequently than did completers. A 2005 study (Calvert, Rideout, Woolard, Barr, & Strouse, 2005) found that early computer usage generally started on the parent's lap and more often than not involved computer games that may be educational in nature. This evidence, along with this study's findings may indicate a need to improve online course delivery so that courses contain the attributes defined by Gee (2005) as the enticing elements of good video games, including:

> … identity, interaction, production, risk taking, customization, agency, well-ordered problems, challenge and consolidation, just-in-time and on demand content, situated meanings, pleasantly frustrating material, system thinking, goal setting and lateral thinking strategies, smart tools and distributed knowledge, cross-functional teams, and performance before competence. (pp. 34-37)

Dickey (2005) found that in the evolution of video game development, programs have moved from a player outside the game to a player inside the game format. Though online gaming communities have broadened access to this engaging construct, the educational community has yet to embrace it on a wide scale (Dickey, 2005).

Roblyer and Marshall (2003) found significant correlations between personal characteristics such as responsibility, self-esteem, and time management skills, and

success online. The data gathered in the Roblyer and Marshall study were self-report measures. Use of such data exclusively may serve to eliminate students who generally do not perform well in a traditional school setting as do the highly motivated, but who might benefit from appropriately constructed online instruction. This study explored student use of technology, preference for graphics presentation of information, and multi-tasking ability in an effort to uncover more quantifiable, task-based, and media literacy measures that might inform the design of content to improve student success.

The multi-task media presentation developed for this study offered a unique method for determining student ability to gather information simultaneously from different sources. Inspired by current television news presentations, the ability to split attention between multiple frames is quickly becoming a needed skill for today's media consumer. The tool should be refined in such a way that regardless of location, the researcher can be guaranteed, to the greatest possible degree, that all respondents experience the presentation under the same circumstances. Creation in a more robust program may be necessary in order to accomplish this goal.

In conclusion, findings of no significant difference (Bernard, Abrami, Lou, & Borokhovski, 2004) though prevalent in research addressing online instruction should be weighed carefully. In examination of the findings of this study, tendencies and trends emerged that point toward the possibility that significant differences exist between successful online learners and those who were unsuccessful. This study's findings suggest that methods that promote higher study return rates for both completers and non-completers, perhaps designed to be gathered during course completion with assignment to groups made subsequently, could provide meaningful data.

Recommendations for Further Research

The purpose of both exploratory research and grounded theory techniques is to expose, through data gathering and analysis, trends in new areas that emerge inductively

and warrant a more detailed look. Emergent trends are then presented in the form of hypotheses for future research in order to support the development of grounded theory. This study identified trends that generated the following hypotheses, stated in null format, for further study consideration:

1. There is no difference in students who are successful in an online environment and those who are not with regards to their frequency of interaction with video games.
2. There is no difference in students who are successful in an online environment and those who are not with regards to the age at which exposure to digital devices commenced.
3. There is no difference in students who are successful in an online environment and those who are not with regards to their ability to multi-task in a multimedia environment.
4. There is no difference in students who are successful in an online environment and those who are not in their ability to follow multi-step directions presented in a graphic presentation.

The most appropriate question remaining is where should the direction of online research go from here? Although it seems clear that personal characteristics such as time management, goal orientation, and independent learning produce successful online learners, it seems equally clear that other measures that might not be easily identifiable may exist. These factors may help to identify a group of students previously unsuccessful in a traditional school environment that could benefit from the proper form of online instruction. Findings of this study would indicate that skills that promote success in an online environment such as the ability to media multi-task may exist. Further, there may be methods to train and improve such skills to promote online success and thereby open the access door to a broader range of students.

Research and development into producing educational environments that engage learners and promote content mastery could benefit nontraditional learners. Students who already possess the traits that make them successful learners in the traditional environment may benefit from improvements made to online content, but they should not be the focus of ongoing efforts. Rather, reaching those learners who continue to fall through the educational cracks should be the target of future design improvements.

Further, studies should be conducted into methods for closing the technical as well as cultural gaps that continue to keep rural communities "underwired." In this manner, online delivery of content does have the potential to close educational achievement gaps.

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APPENDIX A: TECHNOLOGY USAGE HISTORY

Indicate how often, on average since you first began each activity, that you participate in each.

	daily	weekly	monthly	once in a while	never
video games	○	○	○	○	○
cellular phone	○	○	○	○	○
text messaging	○	○	○	○	○
instant messaging	○	○	○	○	○
internet searching	○	○	○	○	○

Indicate how often, on average, how often you do the following.

	daily	weekly	monthly	almost never	never
Utilize the internet for school work	○	○	○	○	○
Instant message with multiple friends at the same time.	○	○	○	○	○
Download music and load to some type of MP3 player.	○	○	○	○	○
Use a cellular phone for activities other than placing calls.	○	○	○	○	○

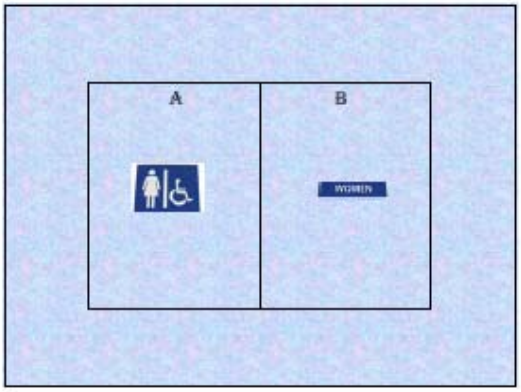
How old were you when you first started using one of the digital devices mentioned in the previous two questions?

- (•) A) under 4 years old
- ( ) B) 5-8 years
- ( ) C) 9-12 years old
- ( ) D) older than 12

APPENDIX B: GRAPHICS PREFERENCE

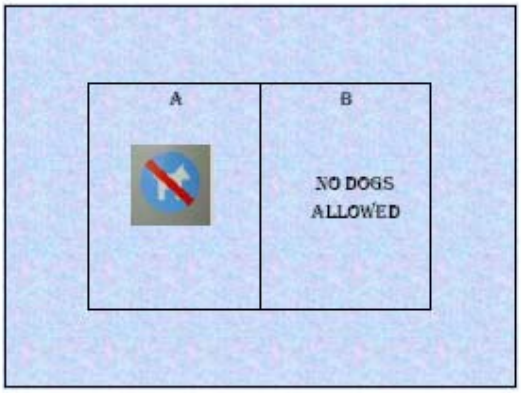
Thank you for taking this survey.

Don't spend too much time thinking about each question- just give your first impression. Each slide view will present two formats for the same information. A question will follow about whether you prefer format A or format B. Mark your preference by placing an X in the box beside your choice.



Which sign would you prefer to see indicating the type of restroom?

- A
- B



Which sign do you think more easily communicates its message?

- A
- B

A	B
	To remove bulb, turn in a clockwise direction until free.

Which set of directions would you prefer to follow when changing a light bulb?

- A
- B

A	B
1. Pour macaroni into 2 cup microwavable cereal bowl. Add 2/3 cup water. 2. Microwave uncovered on High 3 ½ to 4 minutes or until macaroni is tender. DO NOT DRAIN. Some water remaining in bowl is desirable and necessary to make cheese sauce. 3. ADD cheese sauce mix; mix well. If cheese sauce appears thin, do not put back in microwave. Cheese sauce will thicken upon standing.	

Which set of directions would you prefer to follow to make your macaroni and cheese?

- A
- B

A	B
	1. Shake coins. 2. Remove tray and pour into filler. 3. Fill coins to the top of the cylinder. 4. Place paper wrapper inside of coin cylinder, folding top end, turn upside down, remove wrapper. Close other end.

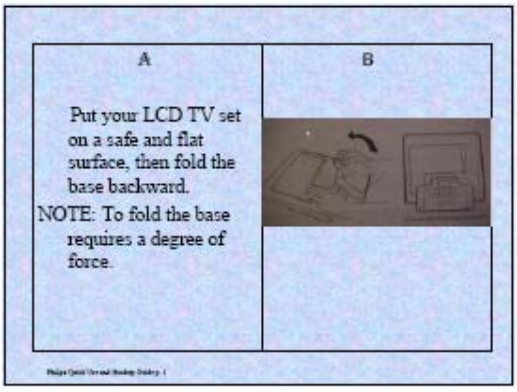
Which set of directions would you prefer to follow to roll coins?

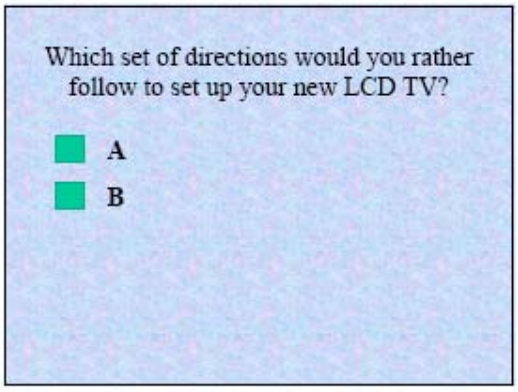
- A
- B

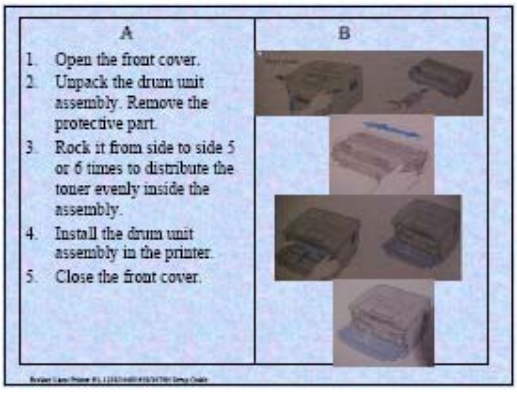
A	B
1. Fill vase with 4 cups of water. 2. Add package of floral food to water and stir well. 3. Cut flower stems at an angle. 4. Place cut flowers in vase.	

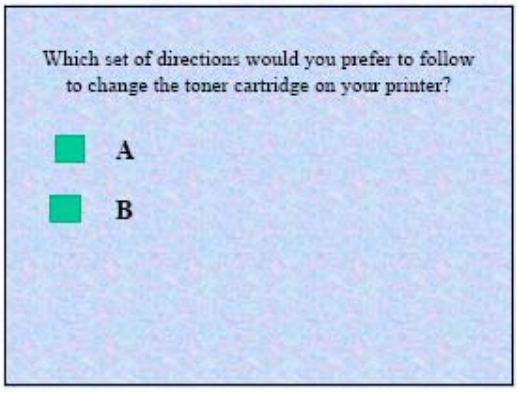
Which set of directions for preserving cut flowers do you prefer?

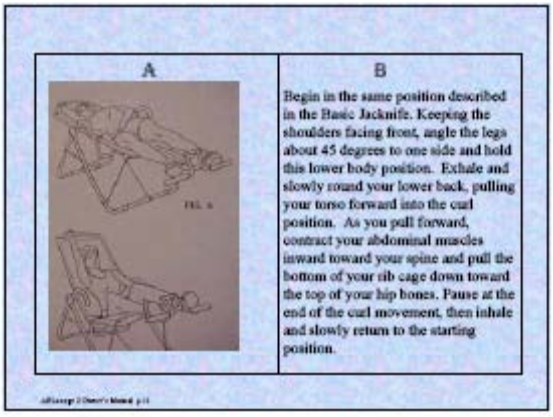
- A
- B





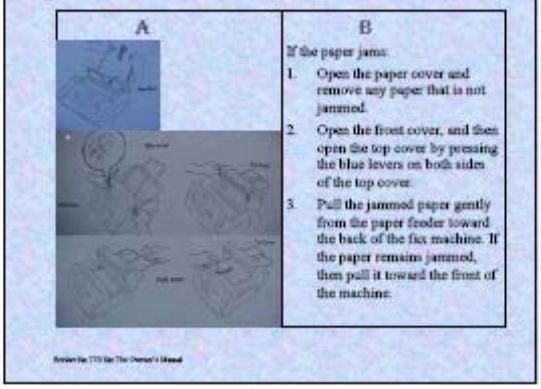






Which set of directions would you prefer to follow to learn this new Ablounge exercise?

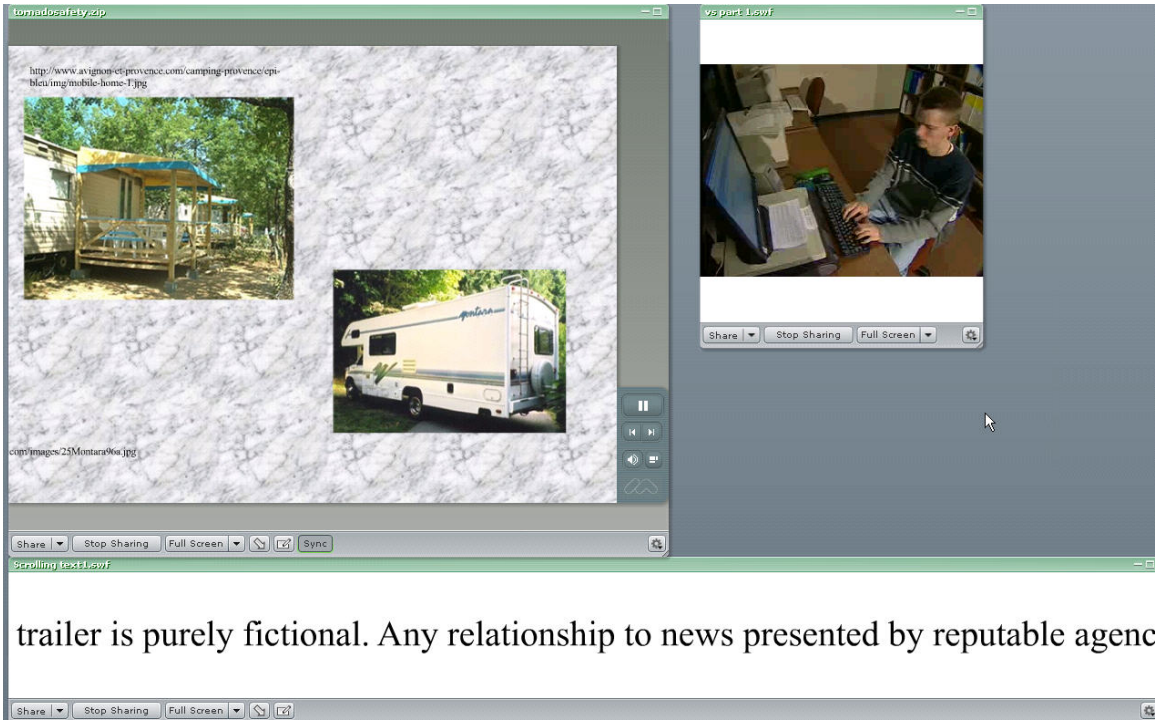
- A
- B



Which set of directions would you prefer to follow when clearing a paper jam from your fax machine.

- A
- B

APPENDIX C: MULTI-TASK SCREEN IMAGE



APPENDIX D: MULTI-TASK QUIZZES

Question Set 1-Clip 1

1. How many school districts make up SUPERNet?

- A) 15
- B) 16
- C) 17
- D) 18

2. Which of the following were mentioned as observed weaknesses in students from SUPERNet schools who were heading to college?

- A) technology skills
- B) content knowledge
- C) independent study skills/time management
- D) A and C

3. Who created the online courses in SUPERNet Virtual School?

- A) a technology company
- B) the teachers
- C) a university
- D) a textbook company

4. According to the presentation, where should you go if you live in a brick or frame home when a tornado hits?

- A) the bathtub
- B) the closet
- C) the lowest area of your house- a basement if you have one
- D) the living room

5. According to the presentation, if you live in a mobile home what should you do in the event of a tornado?

- A) cover yourself with a matterss or blanket in an inner room
- B) get out
- C) get in the bathtub
- D) open the windows to reduce pressure

6. According to the presentation, if you are in a car when a tornado hits you should..

- A) take cover in a ditch or somewhere that will protect you from flying objects
- B) pull over and stay in your vehicle
- C) hit the gas and drive away from the storm as fast as possible
- D) turn into the storm so it will pass by you and you will be headed toward safety.

7. Is the news presented in the scrolling text trailer true?

- A) it's based on fact
- B) no
- C) it doesn't say in the text, so I can't tell
- D) yes

8. What division is Garfield High School?

- A) 1A
- B) 2A
- C) 3A
- D) 4A

9. How was the game between Garfield High School and Ode High School won?

- A) buzzer beater
- B) a steal and a basket
- C) it doesn't say
- D) free throw shots

10. When was the SAT test that Pigeon High had 2 students score perfectly given?

- A) September
- B) November
- C) October
- D) January

Question Set 2- Video Clip 2

1. According to the video, what is keeping Cathy from running away?

- A) her poor grades that she wants to improve
- B) her brother is in the hospital
- C) she is afraid of her uncle
- D) a desire for a better relationship with her mother

2. According to the presentation, why is Cathy angry with her mom?

- A) Cathy doesn't feel like her mother was there for her when she needed her
- B) Cathy's mom grounded her from her phone
- C) Cathy thinks her mom is spoiling her little brother
- D) Cathy's mom has a drinking problem.

3. Who does Dr. James tell Cathy to talk to

- A) her school counselor or a teacher
- B) her pastor or youth director
- C) a doctor
- D) A and B

4. According to the presentation, how many years should you take math and science in high school?

- A) 2
- B) 3
- C) every year
- D) it doesn't say

5. In what year of school does the PSAT count toward National Merit Scholar?

- A) freshman
- B) sophomore
- C) junior
- D) senior

6. According to the presentation, what do you have to do if you wish to play college sports?

- A) earn a scholarship
- B) register with the NCAA Clearning House
- C) complete the FAFSA in January of your senior year
- D) take the THEA

7. What was the new record for high jump set by the Timbercreek High high jumper?

- A) 6' 2"
- B) 7' 1"
- C) 7' 2"
- D) 8' 0"

8. Which class caused the noise at Prairie High?

- A) physics
- B) chemistry
- C) IPC
- D) biology

9. What was the puff at Prairie High School?

- A) smoke
- B) field chalk
- C) talcum powder
- D) their imagination

10. When was the previous high jump record at Prairie High set?

- A) 1950
- B) 1960
- C) 1970
- D) 1980

Question Set 3- Video Clip 3

1. Which of the following was NOT mentioned as a benefit of virtual school?

- A) early graduation
- B) increased course offerings
- C) improved communication skills
- D) no cost

2. Which is NOT one of SUPERNet's goals discussed by the last speaker?

- A) higher levels of technology
- B) broader curriculum opportunities
- C) cost effectiveness
- D) access to highly qualified teachers

3. Which of the following is NOT something a STUDENT mentioned as a benefit to virtual school?

- A) not having to wait for the other student in order to proceed with class
- B) learning to manage their own learning/pacing
- C) not "fenced in"- more opportunities
- D) can be accessed from home

4. Which of the following is NOT one of the elements of a successful PowerPoint design?

- A) Balance
- B) Color
- C) Unity
- D) Simplicity

5. What color does the author of the PowerPoint presentation suggest that you avoid?

- A) red
- B) yellow
- C) green
- D) black

6. How many words per line and lines per slide does the author of the PowerPoint With Style presentation suggest as a good rule?

- A) 4
- B) 5
- C) 6
- D) 7

7. What crushed John's car?

- A) tree
- B) fence
- C) another car
- D) cow

8. What caused John Smith's car to leave the road?

- A) rain
- B) snow
- C) sleet
- D) speed

9. What did the device invented by Cobalt High's physics team do?

- A) light
- B) heat
- C) play
- D) spin

10. How long will it be before the prototypes of the physics team's device is available?

- A) 3 months
- B) 8 months
- C) 6 months
- D) 1 year

APPENDIX E: INFORMED CONSENT

Debi Crawford

204 Hilltop Lane
Lindale, TX 75771
903-882-3161
903-520-5207

Dear Parents,

Your student has been selected to participate in a study concerning online course delivery. This study asks a randomly selected group of students who have enrolled through SUPERNet Virtual School between the spring of 2004 and the summer of 2006 to complete three surveys. The information gathered from these students is very valuable to this study. The data collected will be used to improve online course delivery for all high school students.

This study involves completing three surveys. One of the surveys will ask participants to review information presented on the screen and then to respond to questions. Another survey will ask participants to examine information presented in text and picture format and then select their preference. The last simply gathers information about the student's use of computers and other digital devices. The information will be gathered anonymously so that your student's identity cannot be linked to the data.

It will be greatly appreciated if you allow and encourage your student to complete the surveys by **September 30, 2006.** Please sign and date the statement below and have your student sign and date the student statement. Please return the signed forms to me in the enclosed stamped envelope. Within a few days of receipt of your consent on this signed form, **your student will receive a packet of surveys with a return envelope and postage enclosed.** Feel free to look at the surveys yourself, but please do not assist your student in their completion. Though this consent form will identify your student, **it will not be connected to the survey responses**.

The results of the study, upon completion, will be available to you and your student on a website. You will be notified of the location of this information as soon as it is available. Your cooperation and support is greatly appreciated. Feel free to contact me at the phone numbers above if you have any questions. ***Participation in this study is strictly voluntary and participants may withdraw at any time without penalty.***

Debi Crawford
Principal Investigator

If student is over 18, only student signature is required. If student is under 18, both a parent and the student must sign.

I , _____, agree to allow my child _____
to participate in the three surveys being utilized in Mrs. Crawford's study of virtual high schools.
_____ (parent signature) _____ (date)

I, _____agree to participate in Mrs. Crawford's study on virtual high schools by completing the three surveys. _____ (student signature) _____ (date)

APPENDIX F: INSTRUCTIONS FOR SURVEY COMPLETION

Debi Crawford

204 Hilltop Lane
Lindale, TX 75771
903-882-3161

Dear Students,

I appreciate your assistance with my study on virtual schools.

In this package I have enclosed the surveys in paper form. The questions about your preference for text or graphics presentation style and the ones about what digital devices you use can be done by themselves. The last survey that is in three parts requires that you view the presentation that is posted on the website.

If you have a high speed connection, the site is best viewed from a computer. You may have to open it several times before it runs and it will work better in the evening when internet traffic slows some. If you do not have high speed connection or can't use a high speed connection like at school, I am enclosing a video tape that you can use instead. The tape is rather grainy and may be hard to view. It does contain the material. The web address for the clips is

http://www.sprnet.org/research/comp.htm

Whether you use the tape or the website, please only view each presentation one time and then do the best you can on the questions. Remember, I won't know who you are so your score won't matter.

Please complete all of the surveys and return them to me just as quickly as possible in the postage paid envelope enclosed in this packet. Please also include the tape. Please do not put your name on any of the papers. I will separate the surveys from the envelope as soon as they arrive and I will then have no way of knowing who completed which survey.

Thanks again for helping me out with my project.

Debi Crawford
Principal Investigator