2013

# Predictors of Success for High School Students Enrolled in Online Courses in a Single District Program

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A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University

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May 2013

**Acknowledgement**

I wish to take this opportunity to thank several people who supported me during my pursuit and successful completion of my doctorate degree. First, I would like to thank Dr. Jonathan Becker, my dissertation chair, for serving as a mentor and coach guiding me through the dissertation process, reviewing my work, and making suggestions for improvement. I would also like to thank the members of my dissertation committee, Dr. Lisa Abrams, Dr. Barbara Driver, and Dr. Richard Huff, for their time and counsel supporting this completed work. I thank my mother, Nadine Rankin, who has always inspired me to strive for the best possible result in all that I undertake. And finally, I thank my wife, Twila, for her enduring support, patience, and love that helped me to reach my goal.

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ABSTRACT

PREDICTORS OF SUCCESS FOR HIGH SCHOOL STUDENTS ENROLLED IN ONLINE COURSES IN A SINGLE DISTRICT PROGRAM

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The rapid growth in online learning opportunities and online courses in K-12 education is well documented in the literature. Studies conducted by various researchers that have focused on the K-12 population of online learners demonstrate that certain online learner characteristics and online learning environment characteristics may impact the likelihood of students passing or failing online courses. Research has produced models that predict online course success with measurable degrees of accuracy.

This descriptive study examines characteristics of students enrolled in online high school courses provided by a virtual learning program administered by a single Virginia public school district. The study determined that students' prior academic success; confidence in their technology skills and access to technology; confidence in their ability to achieve; and strong beliefs in their organizational skills proved to have a significant statistical relationship with online course success. The study developed a model with

these factors that predicted success in online courses with a high degree of accuracy and predicted failure with a moderate degree of accuracy.

The study has policy implications for public school leaders in Virginia as they implement recent state legislation requiring students to successfully complete a virtual course to graduate from public high school. The study indicates that additional research is warranted to further delineate learner and learning environment characteristics producing a model that more accurately predicts failure in online courses. Additional research is warranted with larger samples from single district virtual programs.

# Chapter 1

## Introduction

There has been rapid growth in online learning opportunities for and participation by K-12 students over at least the last fifteen years. The first two virtual schools serving K-12 students in the United States, the Virtual High School (VHS) and the Florida Virtual School (FLVS) began in 1997 (Barbour & Reeves, 2009). By 2001, between 40,000 and 50,000 students were taking courses online in 14 states through state-wide virtual schools (Clark, 2001). Watson, Gemin, and Ryan (2008) reported that 44 states had online offerings for students and 34 states had established state-led online programs or initiatives. By the fall of 2011, 49 states offered full time and/or supplemental state-led online learning programs (Watson, Murin, Vashaw, Gemin, & Rapp, 2011). Thirty of these are full time online schools and most are charter schools with some being district run, non-charter schools open to students across the state. Additionally, more and more high schools and school districts are developing and offering their own online courses or directing students to organizations that do offer these opportunities (Watson, et al., 2011).

The comprehensive report published annually by the Evergreen Education Group (Watson, et al., 2011) categorizes these K-12 online learning opportunities into four main areas: state-led programs, multi-district programs, single-district programs, and consortium and other sponsored programs. Online learning and blended learning (a combination of online and face-to-face instruction, see Definitions, p. 14) programs created by a single district, primarily for students in that district, appear to be the fastest-

growing, and perhaps the largest, category of online and blended learning in 2011 (Watson, et al., 2011).

The increase in online learning opportunities for students has naturally led to a significant increase in the number of K-12 students participating in online learning programs. The International Association for K12 Online Learning (iNACOL) estimates that over 1.5 million K-12 students were engaged in online and blended learning for the 2009-2010 school year (Wicks, 2010). This figure is an estimate based on survey data collected by the Sloan Consortium showing a 47% increase in enrollments from their 2005-2006 survey and the 1,030,000 student enrollments reported in 2007-2008 (Picciano & Seaman, 2009).

Growth in student enrollments was further substantiated in a report recently published by the U.S. Department of Education indicating that 55% of public school districts in 2009 - 2010 reported having students enrolled is distance education courses and of these, 96% reported students enrolled at the high school level. Distance education courses were defined for the report as courses offered to elementary and secondary school students regularly enrolled in the district that meet all of the following criteria: (1) are credit granting; (2) are technology delivered; and (3) have the instructor in a different location than the students and/or have course content developed in, or delivered from, a different location than that of the students. Districts reported an estimated 1,816,400 enrollments in distance education courses for the 2009-2010 school year with 74% in high schools, 9 % were in middle or junior high schools, and 4 % were in elementary schools (Queen & Lewis, 2011). While some programs include opportunities for

elementary and middle school students, the majority of online learning courses are taken by high school students.

The online learning landscape in Virginia has begun to shift and significant changes may be forthcoming. The state's virtual school, Virtual Virginia, has been the historical dominant presence for online learning (Watson, et al., 2011). Operated by the Virginia Department of Education, Virtual Virginia began offering online courses to students in 2005 and has seen for-credit course enrollments increase to 6,352 reported in 2010-2011 (Watson, et al., 2011). This represents only a 1% growth rate over the previous year which reported a 30% growth rate over 2008-2009 (Watson, Murin, Vashaw, Gemin, & Rapp, 2010). The recent small growth rate may be a result of limited funding which has forced the program to put students on a waitlist for the past two years (Watson, et al., 2011).

The Virginia legislature passed the state's first statewide online learning legislation, Senate Bill 378 (2010), authorizing the Superintendent of Public Instruction and Board of Education to establish criteria and an application process for approving multidivision online providers (MOP's) of online courses for students in Virginia's school divisions. The legislation allows local school boards to contract with these MOP's to provide online learning programs to their students in grades K-12. The first 13 MOP's were approved for the 2011-2012 school year comprised of 11 vendors and 2 school divisions (Virginia Department of Education, 2011). An additional 6 vendor programs have been approved for the 2012-2013 school year (Virginia Department of Education,

2012). A list and description of each provider is available from the Virginia Department of Education's website.

In an effort to provide a cross-sectional look at Virginia's online learning landscape, a study was undertaken by Virginia Commonwealth University's School of Education. As reported by Becker, Senechal, and Shakeshaft (2011), the study used a slightly modified version of the survey used by the Sloan Consortium in a national study and reported by Picciano and Seamen (2009). The survey looked at data in three main areas, enrollments, reasons for offering online and blended learning opportunities, and perceptions of online and blended learning. The authors reported three main findings based on the results of the survey relative to the Virginia's online learning landscape. Enrollments are growing and are expected to continue to grow. There is a widespread shared perception that online and blended learning courses provide expanded learning opportunities for students. And finally, the costs and limited availability of prepared personnel represent clear barriers to additional growth in online learning (Becker, Senechal, & Shakeshaft, 2011).

The future landscape of online learning in Virginia will certainly be significantly impacted by the most recent state legislation relating to secondary school graduation requirements. Senate Bill 489 (2012) requires the successful completion of one virtual course for students to receive a standard or an advanced diploma. With the Governor's signature on April 5, 2012, Virginia now has joined Florida, Michigan, Alabama, and Idaho as states requiring a virtual class for graduation from high school.

Despite the rapid growth rate of online learning in K-12 education, the U.S. Department of Education reported that as of 2009, few rigorous research studies have been published studying the effectiveness of online learning for K-12 students (U.S. Department of Education Office of Planning, Evaluation, and Policy Development, 2010). The overall finding of this meta-analysis indicated that classes with online learning on an average produced stronger student learning outcomes than classes with solely face-to-face instruction. This was true for completely online courses or blended courses (U.S. Department of Education, 2010). However; of the studies included in the meta-analysis, only five published studies of online learning for K-12 students met the criteria for inclusion. The rest of the studies were done with older learners.

## Statement of the Problem

Despite the documented rapid growth of online learning opportunities for high school students and evidence indicating programs providing online courses are realizing comparable success in terms of student achievement vis a vis the traditional classroom, there appears to be a high rate of attrition with many students not successfully completing or passing their online courses. Online programs are experiencing high dropout rates and research studies have shown that not all students are prepared to take advantage of this new educational environment (McLeod, Hughes, Brown, Choi, & Maeda, 2005; Barbour & Reeves, 2009). For example, a 2011 report published by the Colorado Department of Education stated that 15,249 students registered in online educational programs for the 2010-2011 school year but reported 10,484 enrollments in the end of year count representing over a 30% drop-out rate (Carpenter, Kafer, Reeser, & Shafer, 2011).

Roblyer, Davis, Mills, Marshall, and Pape (2008), identified two lines of research that have emerged to study causes of student failure and drop-outs in online courses and how to address them. The research has focused on either characteristics of the learner or characteristics of the learning environment. Learner characteristics include student cognitive factors such as locus of control and learning styles; prior technology skills and attitudes; and experience and prior knowledge about course content. These types of learner characteristics are often referred to in the literature as student cognitive characteristics to distinguish them from student demographic characteristics such as gender, ethnicity, or age. Learning environment characteristics include course design, course content area, school provided time to work on a course, and accessibility to technology and the Internet.

Logically, if characteristics can be identified that seem to predict whether a student is more likely to be successful in an online course, these findings should also be helpful in identifying those students that are not as likely to be successful. Educational leadership could benefit from not only identifying students who are more likely to be successful in online courses, but also from being able to identify students who are more likely to have problems. The early identification of these students who may be at-risk for success is advantageous for educators to develop and implement strategies to help better prepare them to be successful. Virtual school programs are very interested in accurately predicting low performance and identifying students who may be at risk for success in online courses (Roblyer & Davis, 2008).

However; despite several studies conducted by Roblyer and others, the development of a prediction model to identify these at-risk virtual learners has proven problematic (Roblyer & Davis, 2008). The results from the most recent and largest study ($N = 4{,}100$) conducted by Roblyer, et al. (2008), indicated that characteristics of the learning environment, specifically access to a home computer and time during their school day to work on their online course seemed to contribute as much to online success as student characteristics. This has implications for organizations that offer online courses with regard to providing support, such as providing time and a place during the student's schedule at school to work on the online course. Identifying student's who may not have access to a computer at home and providing alternative points of access for these students may enhance the likelihood of course success. As more public school districts move toward implementing one-to-one computing initiatives (providing a device for all students) access may diminish as a barrier to success in online courses.

The researchers cautioned that their study has limitations for virtual programs attempting to develop a prediction model of success or failure and a support strategy for online students. The best prediction model from the studies conducted by Roblyer et al. (2008) was more accurate predicting success and only moderately accurate predicting failure. The greatest predictor of student success in the model was students' past academic achievement as reflected by GPA. However, this factor was self-reported by the students which raises a question of accuracy. Furthermore, the study was conducted with students in the Virtual High School Global Consortium (VHS) which were 77% Caucasian and had a comparatively low dropout/failure rate (Roblyer & Davis, 2008).

The researchers call for additional studies using the same instrument and research strategy with other populations that may not be as high-achieving or have more diversity.

## Purpose of the Study

Given the limitations of previous studies with regard to population sample and the singular nature of the study in terms of the type of online learning program (consortium sponsored), this study attempted to use the same instrument and strategy as the Roblyer and Marshall studies with a different population from a single-district online learning program. The study collected demographic information from the defined population in an effort to determine if the characteristics identified in the Roblyer and Marshall studies are predictors of high school student success or failure in online courses offered by a single public school district's virtual program. The study attempted to determine if a population with different characteristics would produce different results.

Another purpose of the study was concerned with whether a combination of student and/or learning environment characteristics could produce a model that would accurately predict success, but more importantly failure, for students taking online courses in a public school division's virtual program. The recent legislation enacted by the Virginia legislation (referenced earlier in this chapter) requires students in Virginia public schools to successfully complete a virtual course in order to graduate from high school. This requirement is effective with the 2013-2014 high school freshmen class and public school leadership across Virginia is challenged with providing virtual courses and a support structure for all students to be successful completing these online courses and thereby graduating from high school. The results of this study's attempt to identify a

prediction model have implications for public school policy and practice supporting programs to meet this new graduation requirement.

## Rationale and Significance of the Study

Online learning as manifested through programs that provide online courses represents an alternative learning environment as an outcome of rethinking the effectiveness of education in the United States (Watson, 2007). By providing access to online, collaborative, and self-paced learning environments, online learning programs facilitate the acquisition of 21st Century skills along with the effective use of technology that have been identified as critical to success in today's global economy and work place (Partnership for 21st Century Skills, 2007). The study should provide additional insight into what type of student is more likely to be successful in online courses and what support structures can be developed to help more students be successful. Given the dearth in the literature with regard to empirical studies of K-12 virtual education, this study may also add to the research base upon which educational leaders rely to guide policy and best practice decisions for the development and growth of online learning programs to support academic achievement.

Given the continued growth of K-12 online education at large and the new virtual course graduation requirement in Virginia's public schools, student populations enrolled in online courses will not only increase in size but also in diversity. While some private or even charter virtual programs may be able to address high failure and drop-out rates by selecting and admitting students on the basis of identified criteria, virtual schools and programs governed by public school districts are not able to select only certain students

to take their online courses. The single-district program chosen for this study is a public institution and is bound by federal and state law to provide equal opportunity to its programs. While the district now requires students to complete a survey of learner characteristics as part of their online course orientation, it does not prohibit a student from taking online courses based on the results of that survey. Given the increased use of online courses in the district and the recent state legislation making the completion of a virtual course a graduation requirement, the school district would benefit from a research-based prediction model developed using data from its own online students that can serve as an early warning system to identify students less likely to be successful.

## Literature/Research Background

Online learning is relatively new at the K-12 level when compared to higher education and the private business model. While the rapid growth of online learning opportunities for K-12 students is well-documented in the literature, it is only recently that research studies have begun to focus on the K-12 experience and this body of literature has been developing for a relatively short time. Several meta-analyses of the studies of online learning all point to some common areas of need for further study (Cavanaugh, Barbour, & Clark, 2009; Barbour & Reeves, 2009; Cavanaugh, Gillan, Kromrey, Hess, & Blomeyer, 2004; Bernard, Abrami, Lou, Borokhovski, Wade, & Wozney, 2004; Smith, Clark, & Blomeyer, 2005). Topic areas for future study identified in the literature include student academic performance, qualities of effective online courses and content design, effective professional development for online teachers, and leaner characteristics and the factors that contribute to success.

Research in the topic area chosen for study, identifying learner characteristics and predicting online learning success, has yielded mixed results (Smith, Clark, & Blomeyer, 2005). A prediction instrument developed by Roblyer and Marshall (2003) now commonly referred to in the literature as the Educational Success Prediction Instrument (ESPRI) seemed to discriminate well between successful and unsuccessful students in an online environment. This tool covered a range of factors including study and technology skills, time management, motivation, attitudes, cognitive style, and demographics. The 2003 study looked at 135 students enrolled in the Concord Consortium's Virtual High School Project (VHS). A second much larger study was conducted using the ESPRI by Roblyer, et al. (2008) also with a population sample from VHS. The demographic data reported on the population sample from both studies showed that most students were 16-17 years old and about equally divided between male and female. Approximately 77% of the students reported themselves as Caucasian. Concord Consortium's Virtual High School is an example of what the literature categorizes as a consortium sponsored program (Watson, et al., 2011).

The review of the literature summarized by Barbour and Reeves (2008) indicated that four out of every five students enrolled in the Concord Consortium's Virtual High School students planned to attend a four-year college and were described by their teachers as very capable academically. It appears that while the Roblyer and Marshall studies identified predictors of high school student success in online courses, the sample population may not necessarily be representative of student populations in the other identified categories of online learning programs. These populations may be quite

different in terms of ethnicity, gender, achievement levels, college plans, and attrition rates. The results of the study may not necessarily be applicable to online learning populations in state-led, multi-district, or single-district programs. Other researchers seeking to determine if students with certain characteristics are more likely to be successful have focused primarily on postsecondary online learners who may differ from the high school population sample (Bernard, et al., 2004). There appear to be gaps in the literature with regard to the ability to predict the success or failure of the growing population of high school online learners. Studies that looked at learner characteristics have called for additional research into the factors that affect student success in online learning environments (Butz, 2004; Clark, 2003; Dickson, 2005; McLeod, et al., 2005).

## Research Questions

Focusing on online courses offered through a single-district program at the high school level, four basic research questions will guide the study:

1. To what degree do student cognitive characteristics (e.g., beliefs about their technology skills/self-efficacy, achievement, instructional risk-taking, and organization strategies) as measured in high school students taking online courses in single-district programs predict success in those courses?
2. To what degree do student demographic/environmental characteristics (e.g., gender, grade level, race/ethnicity, home computer/Internet access, prior academic achievement (GPA), course time provided at school, and first online course) predict success in online courses?

3. To what degree do predictors of success vary by the subject area of the online course?
4. What combination of factors produce a model that provides the best prediction of success or failure in online courses?

## Methodology

The research design selected for the study contains elements of a case study, survey research, and secondary data analysis. The study attempted to replicate with minor modifications the strategy used by the earlier Roblyer studies with a different population. The target population for the study was high school students enrolled in online courses offered by a single public school division in Virginia. The school division that agreed to participant in the study supports primarily a suburban student population of approximately 58,000 students enrolled in grades K – 12.

The school division has a well-established online learning program offering courses to high school students for credit. Student enrollments in online classes have been averaging 800-900 students in the fall and spring semesters and during the summer session. The school division surveys all students enrolled in online courses using the most recent version of the 25-item Educational Success Prediction Instrument developed by Roblyer, Davis, Mills, Marshall, and Pape (2008). The student responses are maintained by the school division as an existing data set. Information about student demographics, including each of those identified as independent variables in the research questions for this study, are also maintained by the school division as an existing data set for all students who have taken online courses through the school division's online program.

The school division provided the requested data for students enrolled in online courses for the 2011-2012 school year to the researcher for this study. The division contact worked with the researcher to provide enrollment numbers of high school students taking online courses, and distribution by gender, ethnicity, grade level, course grade, and whether the students was taking an online course for the first time. Using these enrollment numbers as the population size, the variability of the population was analyzed as compared to the school district's general high school population to strengthen the power of the study (see Table 5 in Chapter 3).

## Definition of Terms

The International Association for K12 Online Learning (iNACOL) undertook The Online Learning Definitions Project (2011) "to provide states, districts, online programs, and other organizations with a set of definitions related to online and blended learning in order to develop policy, practice, and an understanding of and within the field". The project undertook a thorough literature review of existing definitions and used a research survey. For the purposes of this study the following definitions from the iNACOL Online Learning Definitions Project are used:

Asynchronous learning – Communication exchanges which occur in elapsed time between two or more people. Examples are email, online discussion forums, message boards, blogs, podcasts, etc.

Blended learning - Blended learning is any time a student learns at least in part at a supervised brick-and-mortar location away from home and at least in part through online

delivery with some element of student control over time, place, path, and/or pace; often used synonymously with Hybrid Learning. (Horn & Staker, 2011)

Brick and mortar schools - Refers to traditional school or traditional school building, as contrasted with an online school.

Credit recovery – Refers to a student passing, and receiving credit for, a course that he/ she previously attempted but did not succeed in earning academic credit towards graduation.

Distance education - General term for any type of educational activity in which the participants are at a distance from each other--in other words, are separated in space. They may or may not be separated in time (asynchronous vs. synchronous).

Distance education course – Any course offered at a distance. See "distance education.

Face-to-face – When two or more people meet in person.

Full-time online program – Full-time online schools, also called cyberschools, work with students who are enrolled primarily (often only) in the online school. Cyberschools typically are responsible for their students' scores on state assessments required by No Child Left Behind, which is the primary way in which student outcomes, and school performance, are measured. In some states most fulltime online schools are charter schools. (Watson, et al., 2010)

Online learning - Education in which instruction and content are delivered primarily over the Internet. (Watson & Kalmon, 2005) The term does not include printed-based correspondence education, broadcast television or radio, videocassettes, and stand-alone educational software programs that do not have a significant Internet-based instructional

component. (U.S. Department of Education Office of Planning, Evaluation, and Policy Development Policy and Program Studies Service, 2010) Used interchangeably with Virtual learning, Cyber learning, e-learning.

Part-time online program – An online program that allows students to take less than a full load of online courses, as defined by local or state legal entities. Sometimes refers to a "supplemental online program".

Synchronous learning – Online learning in which the participants interact at the same time and in the same space.

## Summary

With the continued rapid growth of online learning opportunities for high school students and the integration of 21st Century skills into the high school curriculum, additional knowledge is needed about what determines student success in this new learning environment. Further understanding of students who take courses online will help educational leaders at the high school level make better informed decisions regarding not only the identification process, but also the possible screening of students before they take online course. Leaders will be better equipped to adapt the level of scaffolding for different student populations and provide multiple pathways for students with different learning preferences (Cavanaugh & Clark, 2007). The purpose of this study is to further delineate what learner and learning environment characteristics can predict success for students taking online courses. By identifying the best combination of factors, both cognitive and environmental, a prediction model can be developed that will enable leaders to better meet these challenges.

# Chapter 2

## Review of the Literature

Innovations in technology and the increased use of technology in teaching and learning have grown tremendously over the last twenty years. One major growth area is distance learning. The Internet has afforded a means of providing instruction "at a distance". This study is concerned with the characteristics of secondary students taking online courses and whether these characteristics predict success in the online learning environment.

This chapter will review the literature beginning with a brief history of distance learning. Within this historical framework, the discussion will then focus on the impact of the Internet on distance education first in higher education and then the emergence and growth of online learning in elementary and secondary education, commonly referred to as K-12. This section will conclude with a discussion of the types of online learning offered at the K-12 level.

The chapter will then present literature in the area of student characteristics, first in higher education and then at the secondary level, which is the target population for the study. The chapter concludes with literature supporting the proposed methodology for the study, survey research and proposed statistical analysis of the data. Electronic sources used to conduct the research of the literature include *Dissertation Abstracts International*, *ERIC* (*Education Resources Information Center*), EBSCOhost's *Academic Search Complete,* and *JSTOR*. The literature reviewed includes dissertations, journal articles, and

books. Search terms used in combination that returned consistent results included virtual learning, distance education, online learning, virtual classrooms, high schools, secondary education, and elearning.

## History of Online Learning

Distance education, defined as teachers and students being separated by time, place, or both (Keegan, 1996) is not a new phenomenon. Its roots can be traced back to the first correspondence courses in mid-19th century England and later that same century in America (Matthews, 1999). Relying on the postal service as a delivery system, print-based correspondence courses grew in popularity during the 20th century and are described in literature as the first generation of distance learning (Nipper, 1989; Keegan, 1996). Subsequent generations have been identified based upon the technology used to deliver the instruction.

The second generation involved the use of a broadcast component integrating radio (audio), and later television (video) (Bates, 1991; Kaufman, 1989). Casey (2008) summarized the history of distance education tracing the development of the technologies employed. Relying upon data from the Public Broadcasting Service, Casey reports the first educational radio licenses were granted in 1921 to the University of Wisconsin, the University of Minnesota and the University of Salt Lake City. Between 1918 and 1946, the Federal Communications Commission issued educational radio licenses to over 200 colleges (Casey, 2008). However, distance education programs using radio never really developed and the delivery of education over distance turned to television. The University of Iowa began broadcasting courses via television in 1934 marking the first

use of that technology for distance education (Casey, 2008). The Federal Communications Commission reserved a portion of the open television channel spectrum for education which led to the establishment of the Instructional Television Fixed Service (ITFS) in 1963 (Casey, 2008). This service allowed educational institutions to deliver programming using a low-cost, fixed range, broadcast system. The Public Broadcasting Act of 1967 created the Corporation for Public Broadcasting leading to the establishment in 1969 of the Public Broadcasting Service providing nationwide educational video programming (Boyer, 2001). In 1970, Coastline Community College created, licensed, and implemented the first fully televised college course. Despite the growth of instructional television programming, one-way video and audio lacked the ability to interact with the learner, provide feedback and represented a one-way provider of information (Finn, 2005).

In an effort to provide more interaction for the learner, educational institutions began applying video and audio technology differently than one-way broadcasting. Murphy (2005) traced the development of audio conferencing and then video conferencing in her dissertation examining factors associated with successful distance education programs. According to Murphy, audio conferencing was one method of broadcast medium that used public telephone lines. It did not require speakers and microphones and allowed distant groups to be connected. Educational Telephone Network, the oldest and largest provider of audio conferencing, was developed at the University of Wisconsin as an outcome of the AIM project. Eventually this network provided over 100 programs to 200 locations each week. While this system provided real

time communication using relatively simple equipment and a moderate capital investment, it lacked video and relied on telephone line charges that were expensive (Murphy, 2005). The integration of video into teleconferencing was initially one-way video/two-way audio which used a video and audio signal that originated from a television station. The incorporation of two-way audio/two-way video made audio and video available at both locations and provided improved interaction. Interactive video conferencing allowed teachers to teach a class traditionally while concurrently instructing a distance group (Murphy, 2005).

The third-generation of distance education built on the use of teleconferencing and expanded its capabilities with the emergence of satellite technology in the 1960's. By the 1980's, the television systems linked via satellite became a cost effective way for corporations and the military to provide employee training (Casey, 2008). The National University Teleconferencing Network in 1982 began using satellite technology to transmit programs to its 40 institutional members (Casey, 2008). By 1985, the National Technological University in Colorado began using satellite transmissions to provide online degree courses to graduate and continuing education students. The first state educational satellite system was implemented in Alaska in 1980. Known as Learn/Alaska, this initiative offered six hours of instructional programming daily to Alaskan villages normally accessible only by air (Schlosser & Anderson, 1994).

A fourth generation in the development of distance education is marked by the growth of the Internet and specifically the development of the World Wide Web. Developed in 1991 by Tim Berners-Lee, the World Wide Web provided a common

computer language, hypertext transfer mark-up language (html), facilitating the sharing of information and files between the computer systems linked by the Internet (Casey, 2008). The ability to easily share information across high speed networks provided educational institutions a new avenue for providing instruction online offering greater potential for interactive, virtual classrooms across distance when compared to previous generations (Casey, 2008). A catalyst for developing this potential was provided by the development of online course management systems. Blackboard and WebCT were the two leading software programs that facilitated communication between instructor and student and provided an organized structure to the online environment. In 2005, WebCT and Blackboard merged under the Blackboard brand to become the leading provider of online course management (Casey, 2008).

In a report for the *Higher Education Series*, Taylor (2001) traced a similar pattern of the development of distance education as characterized by the use of available media at a particular time. Taylor, however, described five generations of distance education which he calls models. Taylor's fifth model, the Intelligent Flexible Learning Model, expands the fourth generation by providing online access to not only the academic realm – the instructional materials, activities, and resources, but also access to all aspects of campus life including social, financial, health and personal realms. Table 1 provides a summary of the defining characteristics for each generation or model according to Taylor.

Table 1

*Taylor's Models of Distance Education*

| Model | Characteristics |
|---|---|
| Correspondence Model | Based on print technology |
| Multimedia Model | Based on print, audio, and video technologies |
| Telelearning Model | Based on applications of telecommunications technologies to provide opportunities for synchronous communication |
| Flexible Learning Model | Based on online delivery via the Internet |
| Intelligent Flexible Learning Model | Based on campus-wide portal access to institutional processes and resources |

The evolution of distance education as defined in the literature was accompanied by a consistent growth rate beginning with postsecondary institutions. A study commissioned by the U.S. Department of Education, *Distance Education in Higher Education Institutions* (Lewis, Alexander, & Farris, 1997) reported that by the fall of 1995, one-third of public and private higher education institutions offered distance education courses and an additional one-fourth planned to offer such courses in the next three years. A report released in 1999 by the National Center for Education Statistics (NCES) based on information gathered during the 1997-1998 academic year showed modest growth in postsecondary institutions since the 1995 data. According to the report, 78% of four-year public institutions and 62% of two-year public institutions offered some type of distance education (U.S. Department of Education, National Center for Education Statistics, 1999). Significant growth was reported in *Distance Education at Degree-*

*Granting Postsecondary Institutions: 2000-2001* released in July 2003 by NCES. The data collected since the 1999 report indicated that 90% of public two-year institutions and 89% of public four-year institutions offered distance education opportunities (Waits & Lewis, 2003). The growth was further substantiated by Allen and Seaman (2005) in an annual report on the growth on online course offerings in higher education. This report released in 2005 indicated that the growth rate in the numbers of online students was outpacing the growth rate for traditional enrollment in post-secondary institutions. "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" (Allen & Seaman, 2005, p.15).

## Emergence and Growth of K-12 Online Learning

The rapid growth in online learning opportunities in higher education began to have an impact on secondary education. According to Clark (2001), the pressure to properly prepare secondary students to take full advantage of these new educational post-secondary opportunities created a need for an environment to teach online skills. As a result, virtual schools, defined by Clark as educational organizations that offer K-12 courses through Internet or web-based methods, began to be developed in the K-12 realm. The education of students between the ages of 5 and 18 usually occurs in elementary and secondary schools in classes that range from Kindergarten through 12$^{th}$ grade, collectively referred to as K-12 schools.

The first virtual schools targeting the K-12 population began at about the same time as the exponential increase in Internet access. According to a 2000 report by the

federal Web-based Education Commission, only 14% of all classrooms in the United States had Internet access in 1996 (Crawford, 2006). The Concord Consortium's Virtual High School based in Massachusetts began in 1997 and was funded through a $7.5 million, five-year federal grant (Blomeyer, 2002). It is now Virtual High School, Inc., a non-profit private enterprise. The Florida Online High School (now called Florida's Virtual School) began in 1997 as a cooperative effort of two school districts and funded through an allocation of $200,000 from the state legislature (Friend & Johnston, 2005; Pape, Adams, & Ribeiro, 2005). Florida now recognizes Florida Virtual School (FVLS) as a freestanding district with state funding (Cavanaugh & Clark, 2007).

By 1999, 63% of the nation's classroom had Internet access and by 2000, the figure had grown to 77% (Crawford, 2006). Cavanaugh and Clark (2007) identified technological innovations as having facilitated the development of virtual schools. Examples included the emergence of practical web browsers such as Netscape and Microsoft's Internet Explorer and development tools for the World Wide Web such as the online course management systems Blackboard and WebCT previously mentioned. The federal government has promoted equitable access to technology in schools through such programs as the federal E-rate and Enhancing Education through Technology and state governments have provided school technology revolving funds (Cavanaugh & Clark, 2007). According to data from the National Center for Education Statistics, by 2003, nearly 100% of U.S. public schools had access to the Internet and of those, 95% used a broadband connection. For students in public school, the average nationwide ratio of

students to computers with Internet access was 4.4 students for every computer connected to the Internet (Parsad & Jones, 2005).

Reports that provide K-12 online learning enrollments indicate rapid growth. Clark (2001) reported between 40,000 to 50,000 enrollments in 2000-2001 and the Peak Group (2002) reported approximately 180,000 enrollments in 2001-2002. Data from the U.S. Department of Education based on a national survey of school districts estimated 328,000 public school enrollments in online or video-based distance education courses in 2002-2003 (Setzer & Lewis, 2005). The data from the U.S. Department of Education indicated that of those 328,000 only about 3% were in elementary or middle schools. Approximately 68% were in high school, and the rest were in K-12 unit schools combining elementary and secondary grades (Setzer & Lewis, 2005). These numbers are comparable to the estimates provided by Eduventures based on a survey of 88 online course providers that reported 300,000 K-12 enrollments in online courses in 2002-2003 (Newman, Stein, & Trask, 2003). Picciano and Seaman (2007) estimated that approximately 700,000 K-12 students were engaged in online courses in 2005–2006.

The growth of online learning primarily at the high school level can be further detailed by examining the growth of virtual schools as previously defined by Clark (2001). The first two virtual schools in the United States were both created in 1997. Within a couple of years of virtual schools being introduced to the United States, Clark (2000) presented his report, *Virtual High Schools: State of the States.* He listed three existing statewide virtual schools (i.e., Florida, New Mexico, and Utah), with three more in the planning stages (i.e., Illinois, Kentucky, and Michigan), and also two non-statewide

initiatives (i.e., the VHS and CLASS.com). In his follow-up report a year later, Clark (2001) reported that the list had grown to at least fourteen states with existing or planned virtual schools with between 40,000 and 50,000 students enrolled in courses enrolled through these virtual schools.

Subsequent years have continued to experience consistent growth in the United States. In a summary of the five years of evaluation of the Concord Consortium'sVirtual High School, Zucker and Kozma (2003) reported that the consortium contained almost 200 high schools within 24 states, as well as an expansion to 10 foreign countries. Two years later, Pape et al. (2005) indicated that this consortium had increased to 232 schools in 26 states and 11 countries. In their review of state-level policy for the North Central Regional Educational Laboratory (NCREL), Watson, Winograd, and Kalmon (2004) found that eleven of the 22 states that they surveyed had a substantial level of activity, or the presence of legislation and/or regulations concerning virtual schooling. In a more comprehensive follow-up to that study, Watson and Kalmon (2005) surveyed all fifty US states and found that approximately half of them had significant policies for virtual schooling. They also found that there were 21 states that had virtual schools operating on a statewide basis. Some of these "statewide" programs were being administered by single districts or were university-based programs that had students enrolled from across the state. In their second follow-up report, the authors found that there were now 24 statewide virtual schools (Watson & Ryan, 2006). The continued growth of online learning, both in terms of new programs being created, existing programs growing, and new legislation being passed to facilitate further growth was presented in a more recent

report, *Keeping Pace with K-12 Online Learning*, by Watson, Gemin, & Ryan (2008). As of fall 2008, 44 states offered significant online learning opportunities for students consisting of supplemental or fulltime or both. These are further delineated as follows:

- 17 states offered significant supplemental and full-time, online options for students. Many of these states had both a state-led program and full-time online schools.
- 23 states offer significant supplemental opportunities, but not full-time options. Most of these states had state-led programs, such as the Michigan Virtual School, Illinois Virtual School, and Virtual Virginia.
- Four states offered significant full-time opportunities, but not supplemental. These states had extensive charter schools and/or district online programs, but had no state-led supplemental program that offered courses to students across the state.

*Keeping Pace with K-12 Online Learning* (Watson, et al., 2011) reported single-district programs had overtaken state-led programs as the most rapidly growing and perhaps, the largest type of online learning program. According to the recent data from the NCES (Queen and Lewis, 2011) most of the students in these programs were in high school with some middle school students. In terms of recent policy development, Watson et al. (2011) reported that as of September, 2011, Florida, Michigan, and Alabama had laws requiring an online learning course for high school graduation. West Virginia enacted a State Board of Education Rule that recommends all students complete an online learning experience during grades 9 – 12. *Keeping Pace* (December 1, 2011) reported

that Idaho had become the first state to require two online courses for high school graduation. In Virginia, legislation was signed by the governor on April 5, 2012, making a virtual course a high school graduation requirement for both a regular and an advanced studies diploma (Brown, April 6, 2012).

## Current Variation in K-12 Online Learning

Expanding upon his definition of a virtual school, Clark (2001) provided one of the early categorizations identifying the different types of virtual schools (see Table 2).

Table 2

*Clark's Seven Categories of Virtual Schools*

| Type | Description |
|---|---|
| State-sanctioned, state-level | Virtual schools operating on a state-wide level, such as the Florida Virtual School. |
| College and university-based | Independent university high schools or university-sponsored delivery of courses to K-12 students, such as the University of California College Prep Online (UCCP) |
| Consortium and regionally-based | Virtual schools operated by a group of schools or school districts, such as the Virtual High School (VHS). |
| Local education agency-based | Virtual schools operated by a single school or school district, such as the Gwinnett County Online Campus |
| Virtual charter schools | Virtual schools created under the charter school legislation in many states, such as Connections Academy, also commonly known as cyberschools. |
| Private virtual schools | Virtual schools that are operated in the same manner as a brick and mortar private school, such as the Christa McAuliffe Academy. |
| For-profit providers of curricula, content, tools, and infrastructure | Companies that act as vendors for the delivery or the use of course materials, such as APEX Learning |

Watson et al. (2004) offered a different classification with five different types of virtual schools and summarized by Rice (2006) in Table 3. The main difference between the Clark (2001) classification and the Watson et al. (2004) classification was Clark's focus upon the entity that was responsible for the administration of the virtual program compared to Watson's focus upon the geographic reach of the virtual program and the level of student enrollment (i.e., part-time vs. full-time).

Table 3

*Watson, Winograd, and Kalmon's Five Categories of Virtual Schools*

| Type | Description |
|---|---|
| Statewide supplemental programs | Students take individual courses but are enrolled in a physical school or cyber school within the state. These programs are authorized by the state and overseen by state education governing agencies |
| District-level supplemental programs | Are typically operated by autonomous districts and are typically not tracked by state agencies. |
| Single-district cyber schools | Provide an alternative to the traditional face-to-face school environment and are offered by individual districts for students within that district. |
| Multi-district cyber schools | Are operated within individual school districts but enroll students from other school districts within the state. This represents the largest growth sector in K-12 online learning. |
| Cyber charters | Are charted within a single district but can draw students from across the state. |

Building upon this earlier work, Watson et al. (2011) has recently published a more comprehensive categorization of current online programs with their usual attributes as shown in Table 4.

Table 4

*Watson's Categories of Online Programs*

| Categories of online programs | | | | | |
|---|---|---|---|---|---|
| Category | Organization type/ governance | Full-time/supplemental | Funding source | Geographic reach | Examples |
| State virtual school | State education agency | Supplemental | State appropriation, course fees, funding formula | Statewide | Florida Virtual School, Michigan Virtual Academy, Idaho Digital Academy |
| Multi-district | Charter or district-run | Full-time | Public education funding formula | Statewide | Oregon Connections, Insight School of Washington, Georgia Virtual Academy, Minnesota Virtual High School |
| Single-district | District | Either or both | District funds | Single-district | Riverside (CA), Broward (FL), Plano (TX), Los Angeles, JeffCo (CO), WOLF (NV) |
| Consortium | Variable | Supplemental | Course fees, consortium member fees | Statewide, national, or global | Virtual High School Global Consortium, Wisconsin eSchool Network |
| Post-secondary | University or college | Either or both | Course fees | National | University of Nebraska Independent Study HS, Brigham Young University – Independent Study |

Reproduced from Keeping Pace with K-12 Online Learning, 2011, kpk12.com

The variety in virtual schooling is not limited to the different classifications of virtual schools, but also extends to the actual delivery of virtual schooling. The review of the literature on virtual schooling as compiled by Barbour and Reeves (2008) acknowledged that some virtual school courses operate much like traditional correspondence courses with student interaction being limited to readings and written responses. In other virtual school courses, students interact with their teacher and classmates through e-mail, discussion forums, chat rooms, instant messaging, real-time audio conversations, and even video conferencing. This student interaction can be unscheduled, to allow students to work at their own pace when it is convenient for them, or it can be scheduled to allow for the real-time interactions. Within all of this variety, there are three dominant methods of delivery that have emerged for virtual schooling: independent, asynchronous, and synchronous (or a combination of asynchronous and synchronous) (Barbour & Reeves, 2008).

As previously indicated Watson et al. (2011) reported that single-district programs have become the fastest growing segment of online and blended learning. The report further delineated the attributes that most single-district programs share as:

- Often combining fully online and face-to-face components
- Mostly supplemental with some serving full-time online students
- Often focused on credit recovery or at-risk students
- Funded primarily by the district out of public funds
- Providing courses primarily for high school students with some middle school grade levels

Single-district programs are usually created by a district for students within the district. Because these programs are usually supplemental for students who are enrolled in a traditional school within the district, these programs are leading the trend toward blended learning (Watson, et al., 2011).

## Effectiveness of K-12 Online Learning

According to Patrick and Powell (2009), 15 studies comparing online and face-to-face instruction were published between 1984 and 2004 that met strict criteria for internal experimental validity. The first meta-analysis focusing entirely on online K-12 education outcomes was published by Cavanaugh et al. in 2004. This meta-analysis found that online learning produced results that were "as good or better than" traditional face-to-face instruction (Cavanaugh, et al., 2004). In a synthesis of online learning research, Smith, Clark, and Blomeyer (2005) reported that while the effectiveness of online learning had been the subject of hundreds of studies, few provided evidence of effectiveness meeting the standards of scientifically based research as defined by the U.S. Department of Education.

Florida Tax Watch conducted a study of Florida Virtual School (FLVS) to examine student demographics, achievement, and cost-effectiveness. The 2007 report found that "during the 2004-05 and 2005-06 school years, FLVS students consistently outperformed their counterparts in Florida's traditional middle and high schools on such measures as grades, Advanced Placement scores and FCAT scores" (Florida Tax Watch, 2007).

In 2009, the U.S. Department of Education published a comprehensive meta-analysis that screened over a thousand empirical studies of online learning. A revised report was released in 2010 following revisions that were made to correct transcription errors made in the first report (U.S. Department of Education Office of Planning, Evaluation, and Policy Development, 2010). As stated by Wicks (2010), the meta-analysis reported two key findings with regard to the effectiveness of online learning when compared to both the traditional face-to-face classroom and a blended learning environment:

- "Students who took all or part of their class online performed better, on average, than those taking the same course through traditional face-to-face instruction" (p.38).
- "Instruction combining online and face-to-face elements had a larger advantage relative to purely face-to-face instruction than did purely online instruction" (p.38).

However; a most unexpected finding was that after an intensive initial search of the literature from 1996 through 2006, no experimental or controlled quasi-experimental studies that compared the learning effectiveness of online and face-to-face instruction for K–12 students were found that provided sufficient data for inclusion in a meta-analysis (U.S. Department of Education, 2010). A subsequent search extended the time frame for studies through July 2008 and produced 176 online learning research studies that used an experimental or quasi-experimental design and objectively measured student outcomes. Of these, 99 had at least one contrast between an online condition and face-to-face

instruction that could be used in the meta-analysis. Of those 99 however; only 9 involved K-12 learners and after screening for effect size, only 5 actually met all criteria for inclusion in the meta-analysis (U.S. Department of Education, 2010). To further support that the research is limited, an examination of the categorization charts in the report indicated four of the five were categorized as contrasting blended learning with face-to-face instruction. The research produced only one study of K-12 students meeting the criteria for inclusion in the meta-analysis that contrasted purely online and face-to-face instruction. That study, conducted by Sun, Lin, and Yu in 2008 was a quasi-experimental one conducted with 113 fifth-grade students in Taiwan comparing the effectiveness of virtual science labs with conventional ones (U.S. Department of Education, 2010).

It is important to note the U.S. Department of Education acknowledged that most of the data were from studies not specific to K-12 and cautioned about generalizing to the K-12 population. While there are still relatively few published research studies on the effectiveness of K-12 online learning when compared to the number of studies with students in higher education, the general conclusion has been that online learning can be as effective as traditional classroom learning (Wicks, 2010).

## Student Characteristics

As evidenced in the literature, each virtual course and program has unique features that interact with different types of students in different ways (Cavanaugh & Clark, 2007). Research on the characteristics of successful virtual school learners suggests a common set of characteristics likely to result in successful virtual learning. Students taking online courses for acceleration or for advanced or specialized courses

appear more likely to succeed online than students needing remediation (Barker & Wendel, 2001). One implication from this study is that students who developed strategies as learners in conventional settings can often apply them online. Another key to success for adolescents, both online and offline, appeared to be motivation (Weiner, 2003).

Most of the studies in the literature targeting student characteristics as predictors of success have been conducted with college students and even these call for the need for additional research in this area (Wang & Newlin, 2000). The need for greater learner control and self-direction was examined at the postsecondary level in a study conducted by Bell at a University in the southeastern United States (Bell, 2007). The study examined the effects of self-regulated learning and epistemological beliefs on individual learner levels of academic achievement in Web-based online learning environments. Using a sample of 201 undergraduates students enrolled in a variety of asynchronous Web-based courses, data was collected using an online questionnaire. The study used separate factor analyses of the self-regulated learning and the epistemological beliefs items, correlations between the independent variables and the dependent variable, and linear regression of final course grades with all of the variables. The study used six independent variables as follows: subfactors of self – regulated learning, subfactors of epistemological beliefs, self – efficacy for computer technology, reason for taking an online course, prior college academic achievement and parental level of education. Data analysis found that prior academic achievement, expectancy for learning, and an interaction term based on the cross product of these two variables were significant predictors of success as defined in the model in asynchronous online courses.

An earlier study, not referenced by Bell (2007), that looked at identifying learner attributes that may be used to predict student success in an online environment was conducted by DeTure at a community college in the southeastern United States in the fall of 2002. This quantitative study used a sample size of 73 participants enrolled in six general education courses offered online for credit. The study identified cognitive style scores and online technologies self-efficacy as the independent variables and student success (operationalized as GPA) in the online courses as the dependent variable. Data analysis was conducted using analysis of variance and a post hoc analysis of the correlation between the two independent variables. The study found that although the students who were more field independent tended to have higher online technologies self-efficacy, they did not receive higher grades than those students who were field dependent and had lower online technologies self-efficacy. The author concluded that cognitive style scores and online technologies self-efficacy scores were poor predictors of student success in online courses (DeTure, 2004). The author also cautioned that the conclusions drawn are limited to the sample population and replication of results should be made before making generalizations to other populations (DeTure, 2004).

For students at the K-12 level, learning styles may play a role in the success of online students. For example, students preferring active experimentation and concrete experience tend to have more difficulty with virtual reality than do students preferring abstract conceptualization and reflective observation (Chen, Toh, & Ismail, 2005). For both learning styles, learning increased with the use of guided exploration in the virtual reality setting. The most frequently identified factor influencing the success of virtual

schooling was student learning styles, as reported in a survey of teachers of Australia's virtual schools (Kapitzke & Pendergast, 2005).

The literature focusing on secondary students and for all of K-12 education consistently pointed to only a few studies that examined learner characteristics as possible predictors of success in an online learning environment. The most commonly referenced study was conducted by Roblyer and Marshall (2003) in which they examined certain student characteristics in a student success prediction instrument developed specifically to identify secondary level students who are likely to succeed in virtual school courses. The study was conducted to test the reliability and validity of the prediction instrument. The target population consisted of students enrolled in an online course in the Concord Consortium's Virtual High School (VHS) with students from 13 schools participating in the study. The study identified nine constructs thought to be related to success in VHS courses: locus of control, internal versus external motivation, self-confidence/self-esteem, responsibility, degree of experimentation (risk taking), time management, ability to set goals, achievement motivation, and self-reported computer/technology skills. Additionally, several personal characteristics (age, responsibilities outside school, prior experience with online courses) were identified as contributors to success. The authors included all of the constructs and characteristics in the instrument due to the lack of previous studies in the literature about descriptors of successful online students in high school courses (Roblyer & Marshall, 2003).

A 70 item instrument was developed in the format of a Likert scale as well as a section to collect data on demographic and personal characteristics. The survey was given

to 135 students and post course data were collected from the teachers. Anonymity was preserved by having the students use only the last four digits of their social security numbers when completing the survey. Post course data was only provided for 96 students so the final sample was quite small. A factor analysis was conducted to determine the reliability of the instrument using all the items in the instrument as independent variables and post course grade category (pass/fail) was entered as the dependent variable. The authors reported that the results of the analysis demonstrated that the Educational Success Prediction Instrument (ESPRI) discriminates "with high accuracy and reliability between groups of successful and unsuccessful students" (Roblyer & Marshall, 2003, p. 214). The factors that appear to have the greatest effect on success were hours involved in out-of-school activities, study environment, computer confidence, achievement beliefs, responsibility, self-organization, and technology skills beliefs and access. The authors called for additional testing of the instrument with other groups of high school students taking online courses to confirm the validity of the ESPRI using larger sample sizes.

## Summary

The review of the literature that reported research on virtual schooling indicated that there appears to be a large body of evidence documenting the continued growth of online learning both in higher education and K-12 education, with single district virtual programs reporting the fastest growth. The research into the effectiveness of virtual schooling initially seemed to indicate that virtual learning is at least comparable to traditional learning in a brick and mortar classroom as well as research focusing on student readiness and retention (Cavanaugh, 2001; Cavanaugh et al., 2004; Barbour &

Mulcahy, 2006). A closer examination of the research indicated despite a large number of studies focusing on virtual learning, only a relatively few met the established standards of empirical research (Smith, Clark, and Blomeyer, 2005; Patrick & Powell, 2009)

Over the past decade, several studies have shown that students who were typically successful in online learning environments were those who had independent orientations towards learning, who were highly motivated by intrinsic sources, and who had strong time management, literacy, and technology skills (Wang & Newlin, 2000; Cavanaugh, 2007). However, some of these characteristics are more consistent with traits that are typically associated with adult learners such as maturity, independence and increased self-directedness (Knowles, 1978). A problem with this focus is that adults learn differently from children and adolescents (Bright, 1989; Cavanaugh et al., 2004; Moore, 1973; Vygotsky, 1962, 1978). While discipline and self-motivation seem to be important factors, at the secondary level students are still learning how to learn and may develop responsibility and organization through participation in a structured brick and mortar or online course (Cavanaugh & Clark, 2007).

The literature focusing on learner characteristics as predictors of success in online K12 education identified gaps in the research. The study conducted by Roblyer & Marshall (2003) and the subsequent study by Roblyer, et al. (2008) represent an important contribution to the literature in this arena focusing on how student cognitive factors as predictors of success in online courses. Their research produced better results predicting success than predicting failure and has led to a call for more research into the factors that account for K-12 student performance in online learning.

# Chapter 3

## Methodology

This chapter describes the research design and methodology, the target population, the subjects and how they were selected, the research instrument, the data analyses utilized, and the potential delimitations of the study. Four basic research questions guided the study:

1. To what degree do student cognitive characteristics (e.g., beliefs about their technology skills/self-efficacy, achievement, instructional risk-taking, and organization strategies) as measured in high school students taking online courses in single-district programs predict success in those courses?
2. To what degree do student demographic characteristics (e.g., gender, race/ethnicity, grade level, home computer/Internet access, prior academic achievement (GPA), course time provided at school, first online course) predict success in online courses?
3. To what degree do predictors of success vary by the subject of the online course?
4. What combination of factors produce a model that provides the best prediction of success in online courses?

## Research Design

The research design for this descriptive study was a combination of several design types. It contained elements of a case study in that it involved students taking online high

school courses in a virtual school program of a single school district. It incorporated survey research in that the school district uses a revised version of the survey used in the Educational Success Prediction Instrument (ESPRI). The school district provided the survey responses to the researcher who then coded and analyzed the data. It also incorporated secondary data analysis of student demographic characteristics recorded by the school district. As Mitchell and Jolley (2004) note, descriptive research is appropriate when the researcher wishes to describe variables and the relationships among those variables and as the researcher seeks to describe and to explain behavior.

The study attempted to essentially replicate the research strategy used by the earlier Roblyer studies in an effort to identify the best combination of factors for the study's population that the school district can use to calculate estimates of probabilities for success for students enrolling in their online program. This study analyzed data from the district's use of the latest version of the same instrument developed and used by Roblyer in those earlier studies.

## Subject Selection

The target population for the study was high school students enrolled in online courses offered by a single school division in Virginia. The school division that agreed to participate in this study is a large school division of 62 schools serving approximately 58,000 students located in central Virginia. According to the annual membership reports published on the Virginia Department of Education website, the total high school population for the 2011 – 2012 school year was 18,828 students. The gender distribution of this population was almost split evenly with 49.4% female and 50.6% male. The

distribution of race/ethnicity for that same school year was 56.1% white, 29.2% African American, 7.8% Hispanic, and 3.8% Asian (Virginia Department of Education, 2012).

The participating school division, which has a fully developed online learning program offering courses to high school students for credit, agreed to participate in the study and provided a division contact who served as the on-site facilitator for the study for that school division. The school division's virtual program offers all of the courses needed to graduate with a standard diploma in Virginia. Most of the online courses offered are in the core subject areas of mathematics, science, English, and social studies. Additionally, two credits of Health and Physical Education and the required number of elective credits are also offered as online courses. All of the core subject area courses and Health and Physical Education are offered as full year courses. The electives are offered as semester courses equivalent to a half credit.

The number of students enrolled in all courses averages about 850 each school year with another 750 enrollments during the summer session. These figures have been consistent for the last four years. The division contact provided enrollment numbers and percentages by gender and ethnicity of high school students enrolled in online courses during the 2011 – 2012 school year. Using these enrollment numbers as a population size, Table 5 provides a snapshot of the variability of the student population enrolled in online courses compared to the school division's high school population for the 2011 – 2012 school year. The online student population of 934 students was predominantly female while the ethnic distribution is comparable to the total high school population with some variance for Black and Asian students.

Table 5

*Distribution of Online Enrollments & Total High School Enrollments*

| | Online | | Total High School | |
|---|---|---|---|---|
| | Frequency | % | Frequency | % |
| Males | 317 | 33.9 | 9,512 | 50.6 |
| Females | 617 | 66.1 | 9,316 | 49.4 |
| Caucasian | 557 | 59.6 | 10,558 | 56.1 |
| Black | 216 | 23.1 | 5,492 | 29.2 |
| Hispanic | 77 | 8.2 | 1,475 | 7.8 |
| Asian | 49 | 5.2 | 708 | 3.8 |
| Other | 35 | 3.7 | 595 | 3.2 |
| Total | 934 | 100 | 18,828 | 100 |

Note: Percentages were rounded to the tenth of 1% and therefore do not total 100.

## Data Collection

The data for this analysis came from a combination of a survey that the school division under study administers to students taking online courses and the demographic data provided by the school division. The survey is the most recent version of the Educational Success Prediction Instrument (ESPRI) developed by Roblyer and Marshall (2003, 2008) used with permission of the author. The responses to each of the items in the survey (see Appendix A) were retained by the school division for each student linked to the student identification number. The demographic data about the students were provided by the school division as reported from the division's student information

system. This data included gender, race/ethnicity, grade level, online course enrollment, final grade received for the course, GPA, and whether the course was their first online course. The two datasets were merged by the researcher using the student identification number to link the data and then those numbers were stripped from the research dataset.

**Measuring Predictors of Student Success: The ESPRI**

The instrument used in this study was the Educational Success Prediction Instrument (ESPRI) created and tested by Roblyer and Marshall (2003). The original instrument was a 70 item survey designed to measure the cognitive constructs of beliefs about technology skills/access, organization and self-regulation, beliefs about achievement, responsibility, and risk-taking in order to predict which students will and will not succeed in online courses. The instrument was formatted as an Agree-Disagree Likert scale of 1 to 7 (1 = strongly agree; 7 = strongly disagree). Students were asked to rate their degree of agreement or disagreement with statements such as "I believe myself to be a high achiever." or "I know how to browse to locate Internet sites." The instrument was field-tested with 135 students enrolled in the Concord Consortium Virtual High School and found to discriminate with high accuracy and reliability between groups of successful and unsuccessful students as defined by the grade they received in the course.

The instrument was refined by Roblyer and Marshall eliminating some items that had little impact on the prediction indexes and items were added to gather data on student demographic characteristics. The resulting instrument was a 60 item Likert scale survey which was used in a study conducted with 2,162 students enrolled in the same Virtual

High School consortium as the previous study and reported by Roblyer, Davis, Mills, Marshall, and Pape (2008). Using Cronbach's alpha, the total scale reliability for the sixty-item version of the instrument (ESPRI-V2), was found to be .92.

Online instructors and administrators in the Virtual High School courses in which the students were enrolled from the study observed that online students would be more likely to complete an abbreviated instrument. The researchers performed a factor analysis to determine if further reduction of the survey items would still maintain acceptable reliability and continue to explain high variance among the items (Roblyer, et al, 2008). This analysis produced a 25 item survey targeting the four cognitive constructs identified in the research questions for this study: beliefs about technology use and technology self-efficacy, achievement beliefs, instructional risk-taking, and organization strategies.

The school district incorporated a more recent version of the ESPRI into their online courses during the 2011-2012 school year. This 25-item instrument was formatted as an Agree-Disagree Likert scale of 1 to 5 (1 = strongly agree; 5 = strongly disagree). The language of two of the questions addressing technology use was revised to reflect current technologies. The survey is provided in Appendix A and a breakdown of questions for each of the four factors is provided in Appendix B.

**Reliability and Validity of the ESPRI**

Reliability refers to the consistency of an instrument to produce stable results over time that are not strongly influenced by random error (Mitchell & Jolley, 2004). The instrument used in this study was developed, tested, revised and tested again by the developers. Each time the instrument was tested, reliability was established using

Cronbach's coefficient alpha. The total scale reliability for each version of the EPRI instrument after it was tested was reported as $\alpha = .92$ (Roblyer, et al., 2008). The number of items for each of the constructs in the 25 item instrument were technology skills/self efficacy (10 items), achievement beliefs (6 items), instructional risk-taking (6 items) and organization (3 items). The subscale reliabilities as reported by Roblyer, et al. (2008) for each of the constructs were technology skills/self-efficacy - $\alpha = .94$, achievement beliefs - $\alpha = .80$, instructional risk- taking - $\alpha = .77$, and organization - $\alpha = .59$. While the internal consistency reliability was at least acceptable or stronger for the first three factors, the subscale score for organization is poor according to accepted research standards (George & Mallory, 2003). The researchers acknowledged that there were an insufficient number of items for organization skills (Roblyer, et al., 2008). The latest version of the 25 items instrument has two additional items for organization skills. For internal consistency, the general rule of thumb is that a minimum of five questions is necessary to measure a given trait or construct (McMillan, 2004). The instrument used for this study meets this requirement (see Appendix B). The total scale reliability for the ESPRI as calculated for this study's dataset was $\alpha = .841$. The subscale reliability scores are reported in Table 16 (p.59).

Validity refers to "a judgment of the appropriateness of a measure for specific inferences or decisions that result from the scores generated" (McMillan & Schumacher, 2001, p. 239). Measurement validity, defined as the extent to which an instrument measures what it is designed to measure (Mitchell & Jolley, 1994) includes both construct and content validity. Construct validity is addressed through the

development of the survey instrument based on the testing process and factor analyses of the researcher who created the instrument. In the factor analyses, items were retained that only loaded on one construct or factor strengthening the discriminant validity. Content validity is also addressed through instrument review by experts in the field of online learning as well as the revision process utilized by the developers of the instrument.

**Administration of the survey**

The survey for this study consisted of a web-based questionnaire using the 25 items from the revised ESPRI (Appendix A). Web-based surveys are appropriate for survey populations with high levels of computer access and proficiency, such as those in the field of education (Dillman, 2007). A web-based survey was especially appropriate for students participating in web-based courses. The school division made the survey available in each of the online courses that have students enrolled during the 2011 – 2012 school year. The survey was loaded into the assessment tool of the school division's learning management system for access by all students enrolled in online courses. A three week time window was established during which students responded to the survey. An announcement was posted in each of the courses letting students know that the survey was available and requesting their participation. Directions were provided in the announcement on how to access and complete the survey. A reminder announcement was posted at the end of the first week and the second week of the window in an effort to increase participation. The answers provided by each student that completed the survey were automatically recorded in the grade reporting tool of the learning management

system, were automatically linked to the student using the school division's identification number for that student and were then exported from the learning management system as a table. Each student's responses remain linked with the questions and retained the student's identification number within the table.

**Merging datasets**

The designated school division contact provided a report of the survey results as well as the requested demographic data for each of the students in the population sample. Final grades for each student in each online course were reported by the teacher for that course and uploaded into the school division's student information system. Courses were identified by a unique course number and a prefix identifying the course as an online course. The school division contact generated a grade report by student identification number and online course number. Students who received a grade of A, B, C, or D were designated as having passed the course and were considered successful for the purposes of this study. This represents a deviation from the definition of success used by the earlier studies (Roblyer & Marshall, 2003; Roblyer, et al., 2008). These earlier studies defined passing as receiving a grade of A, B, or C, and students who received a D were included in those that failed the course. School divisions in Virginia calculate passing a high school credit course as having received a grade of D or higher. While there may be variance as to the numerical value used to define passing, the grade of D is considered as a passing grade. The researcher for this study made the decision to be consistent with the definition used by public school divisions in Virginia and included a grade of D as a passing grade and thereby indicating success. The report also included the demographic

characteristics of gender, race/ethnicity, grade level and prior academic achievement (GPA) for each student by student identification number.

The results of the ESPRI survey provided information for the cognitive characteristics as well as the environmental factors of home computer/Internet access and course time provided at school. Since all of the variables, dependent and independent, and the responses to the ESPRI survey were matched to the student identification number, the survey results and the grade report were merged into one dataset for analysis. Following the merging of the datasets, survey responses were examined to identify incomplete surveys and surveys that corresponded to the same student identification number. Incomplete surveys were eliminated and for duplicate surveys that were completed by the same student, only the first survey completed by the student was retained in the dataset for analysis resulting in a dataset of 449 students. Following this examination procedure, the student identification numbers were stripped from the dataset and it was then loaded into the Statistical Package for the Social Sciences software application for analysis.

## Data Analysis

The purpose of the data analysis was to determine if the variables could be combined in an effort to create a model for future use that will better predict success or failure in online courses for K-12 students. To this end, a variety of data analysis methods were utilized in the scope of this study, frequency distributions, descriptive statistics, analyses of variance and logistic regression analysis. Table 6 provides a summary of each

of the variables used for this study and the coding description for each variable in the dataset.

Table 6

*Summary of Variables*

| Dependent Variable | Description | |
|---|---|---|
| Course success | Successful is receiving a passing final grade in the online course; unsuccessful is receiving a failing grade in the course. Passing grades are defined as A, B, C, or D. Failing grades are defined as F or not completing the course. | |
| Independent Variables | | |
| Gender | 0 = male, 1 = female | |
| Race/Ethnicity | 0 = Caucasian, 1 = Black, 2 = Hispanic, 3 = Asian, 4 = other | |
| Grade level | 1 = 8th, 2 = 9th, 3 = 10th, 4 = 11th, 5 = 12th | |
| Home computer/Internet access | 0 = no, 1 = yes | |
| Prior academic achievement (GPA) | 4.0 = A, 3.0 = B, 2.0 = C, 1.0 = D, 0 = F | |
| School provided class time | 0 = no, 1 = yes | |
| First online course | 0 = no, 1 = yes | |
| Subject area | 1 = English, 2 = Health/PE 3 = Math, 4= Science, 5= Social Studies | |
| ESPRI – 25 item survey | Minimum | Maximum |
| Total scaled score | 25 | 125 |
| Technology use/self-efficacy | 10 | 50 |
| Risk-taking | 6 | 30 |
| Achievement beliefs | 6` | 30 |
| Organization beliefs | 3 | 15 |

Given that this study was concerned with analysis and prediction of a dichotomous outcome, student success as measured by passing an online course, the use

of logistic regression is supported by the literature and especially for educational research (Peng, Lee, and Ingersoll, 2002). A binary logistic regression analysis with pass/fail as the dependent variable was performed with various combinations of factors including the student background factors, the sums of the individual ESPRI factors and the total scaled sum from the ESPRI.

Replicating the Roblyer & Davis (2008) data analysis methodology, a logistical equation resulting from the logistic regression was used to calculate success probabilities. The regression coefficients for the variables used were obtained from the regression output for each variable as well as a constant value ($\alpha$). The values for these coefficients and the data values for each student were inserted into the following equation for a probability of passing calculation:

$$Expression = 1 + e^{-(\alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5)}$$

$$p\_ob(event) = \frac{1}{Expression}$$

In the equation above $\alpha$ represents the constant, $\beta$ is the regression coefficient and X is the data value for each of the variables. The cutoff value for the probability of passing calculation was 0.6 which replicates the value used by Roblyer and Davis (2008). This follows established practices for validation of predicted probabilities (Peng, Lee, & Ingersoll, 2002).

## Delimitations

The study was conducted in the context of several delimitations. The study was conducted as a replication of a previous study with a different population. While the

decision to limit the study to a single-district program narrows the focus of the study to a different population of online learners than the previous study, results and implications of the study will need to be applied to similar populations in single-district programs. As noted earlier in the literature review, single-district programs represent the fastest growing category of online programs in K-12 education. A second delimitation involves the use of a web-based survey loaded through the course management system into all of the current school year's online courses. This process allowed the survey to be readily available to all of the online students but also required that students access their course in order to access the survey. Students who were inactive in their classes were probably not included in the population although they were enrolled in the district's online program. As previously reported, after eliminating those surveys from students enrolled in multiple courses, the study had a dataset of 449 unique responses to the ESPRI. A third delimitation involves the selection of the student demographic and environmental variables for the study. The variables selected were chosen in an effort to closely replicate the studies conducted by Roblyer et al., and the researcher is aware that there are other variables, especially environmental, that could be considered as predictors of success that are beyond the scope of this study.

## Sample Descriptives

As previously explained, the data were collected from students enrolled in high school online courses during the spring semester of the 2011-2012 school year in a virtual program provided by a single school division. The responses to the ESPRI survey were collected by the participating school division staff and combined with demographic data

and final course grades producing one dataset provided to the researcher. The student identification numbers were stripped from the dataset and only survey responses that had completed all EPRI items were retained in the dataset for analysis. Similarly, students enrolled in more than one online course were retained in the dataset only once. As explained earlier in this chapter, the first survey completed by the student was retained and thereby determined the subject area identified for that student. The resulting dataset produced 449 students enrolled in one high school online course.

Frequency distributions for each of the demographic independent variables were calculated. Table 7 summarizes the distribution for gender indicating the majority of the students in the sample to be female (294). This was significantly higher than the distribution for the entire school district which reported only 49.4% female high school students but was consistent with the gender distribution of the total online student population for the district.

Table 7

*Gender Distribution*

| | Frequency | % |
|---|---|---|
| Male | 155 | 34.5 |
| Female | 294 | 65.5 |
| Total | 449 | 100 |

A frequency distribution for race/ethnicity is provided in Table 8. While the majority of students are Caucasian, the margin is 61.7% which was slightly higher than the

distribution for the entire school division which reported 56.1% white high school students. The total online population reported 59.6% Caucasian and 23.1% Black. Included in the category labeled Other are students who were identified by the school division as belonging to more than one race/ethnicity.

Table 8

*Race/Ethnicity Distribution*

| | Frequency | % |
|---|---|---|
| Caucasian | 277 | 61.7 |
| Black | 94 | 20.9 |
| Hispanic | 38 | 8.5 |
| Asian | 21 | 4.7 |
| Other | 19 | 4.2 |
| Total | 449 | 100 |

Courses were grouped together into subject areas and a frequency distribution by subject area was calculated as summarized in Table 9. The enrollments in online Health & PE have consistently been between 30% and 40% of total online course enrollments for the past three years and was 34% for the 2011-2012 school year as reported by the school division. The distribution for the other four subject areas reported for all of the online students for that year was: English – 14%, Math – 7%, Science – 11%, and Social Studies – 32%. A comparison of the two populations shows the study sample was very representative of the total online population for subject area distribution.

Table 9

*Subject Area Distribution*

| | Frequency | % |
|---|---|---|
| English | 62 | 13.8 |
| Math | 46 | 10.2 |
| Science | 72 | 16.0 |
| Social Studies | 140 | 31.2 |
| Health & PE | 129 | 31.2 |
| Total | 449 | 100 |

The independent variable of whether the course enrollment represents the first online course experience for the student was reported in the dataset provided by the school division. Slightly more than half of the students in the sample reported that the course was their first attempt at an online course. This finding is consistent with the total population of students enrolled in online courses in the district which was 53%. A frequency distribution summarizing the data is provided in Table 10.

Table 10

*First Online Course*

| | Frequency | % |
|---|---|---|
| Yes | 244 | 54.3 |
| No | 205 | 45.7 |
| Total | 449 | 100 |

The independent variable of whether the student has a computer at home with access to the Internet was self-reported by students in their responses to two questions on the EPRI survey. Table 11 summarizes the frequency distribution for each of those responses.

Table 11

*Home Computer/Internet Access*

| | | Frequency | % |
|---|---|---|---|
| Home Computer | | | |
| | Yes | 440 | 98.0 |
| | No | 9 | 2.0 |
| Internet | | | |
| | Yes | 437 | 97.3 |
| | No | 12 | 2.7 |
| Total | | 449 | 100 |

Whether a student's brick and mortar school provided class time to the student to work on their online course during the school day was also self-reported as a response item in the ESPRI questionnaire. Nearly half the students reported that they were provided such time in their school schedule. Table 12 provides the summary of the frequency distribution for this independent variable.

Table 12

*School Provided Class Time*

| | Frequency | % |
|---|---|---|
| Yes | 211 | 47 |
| No | 238 | 53 |
| Total | 449 | 100 |

Prior academic achievement as an independent variable was identified using the student's grade point average (GPA) as reported by the school division. These averages were reported to the nearest thousandth by the school division and rounded to the nearest hundredth in the dataset that was analyzed. Descriptive statistics for this variable are summarized in Table 13.

Table 13

*Grade Point Average*

| N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|
| 449 | .50 | 4.70 | 3.04 | .83270 |

Of 449 students represented in the dataset, 395 passed their online course with a grade of either A, B, C, or D. 54 of the students failed their online course with a grade of F. Students who dropped out of the course after the first 50 days received a failing grade. Table 14 provides the number of students who passed/failed with percentages of the total.

Table 15 provides the distribution of the grade received in the online course. Of the 395 students who passed, 343 received a grade of C or higher.

Table 14

*Students Passed/Failed*

| | Frequency | % |
|---|---|---|
| Passed | 395 | 88 |
| Failed | 54 | 12 |
| Total | 449 | 100 |

Table 15

*Course Grade Distribution*

| | Frequency | % |
|---|---|---|
| A | 102 | 22.7 |
| B | 138 | 30.7 |
| C | 103 | 22.9 |
| D | 52 | 11.6 |
| F | 54 | 12 |

The twenty-five items in the ESPRI survey were used according to the same four factors that emerged from the previous studies conducted by Roblyer, et al. (2003, 2008). These factors are beliefs about technology use and technology self-efficacy (8 items), achievement beliefs (6 items), risk-taking (6 items), and organization beliefs (5 items).

Given that each of these factors had a different number of items, the means of the items included in each factor were calculated and subsequently compared for analysis rather the means of the sums of the scores of the items. Using this method provided a more accurate comparison since all items have a possible score range of 1 to 5. The response strongly agree was scored as a 5 and strongly disagree was scored as a 1. Questions that were negatively stated were reverse coded prior to the data analysis as shown in Appendix A.

Table 16

*ESPRI-25*

| | Min. | Max. | Mean | Std. Dev. | Scale Reliability (Cronbach's alpha) |
|---|---|---|---|---|---|
| Technology self-efficacy | 3.25 | 5.00 | 4.6178 | .37955 | .725 |
| Risk-taking | 1.83 | 5.00 | 3.7892 | .59426 | .624 |
| Achievement beliefs | 1.00 | 4.83 | 3.7847 | .70994 | .808 |
| Organization beliefs | 1.00 | 5.00 | 3.3933 | .92449 | .828 |

As shown in Table 16 above, the mean score for technology use/self-efficacy was 4.6178 which was very close to the maximum score of 5 for that factor indicating a strong self efficacy and comfort level using technology. The minimum reported score for that factor was 3.25. The mean score of the other factors are also provided in Table 16. The mean score for a student's beliefs about achievement and instructional risk-taking were closer to 4 indicating stronger beliefs for these factors. The mean score for beliefs about

organization skills was only slighter higher than 3 indicating more uncertainty on the part of the students in the sample.

## Summary

The purpose of this study was to examine specific cognitive characteristics of high school students enrolled in online courses offered by a single-district virtual school program to determine if these characteristics predicted success in those courses. Additionally specific demographic characteristics were analyzed to determine if there were relationships between these and the cognitive characteristics as related to student success in online courses. Using a sample population of high school students enrolled in online courses from a single school division in Virginia, the researcher analyzed data collected through a Web-based survey to measure these defined constructs and their potential impact on student learning in the online environment. The school district provided student demographic data and environmental data from the online learning program's informational database and the school division's student information system. Survey responses and secondary data were exported to *SPSS 20.0*, the *Statistical Package for the Social Sciences*, *Version 20.0*, and analyzed using frequency distributions, descriptive statistics, analyses of variance and logistic regression analysis. Based on the data analyses, a model predicting success in online courses for high school students enrolled in a single district program was identified.

# Chapter 4

## Findings

The purpose of this chapter is to report the findings of the bivariate analyses examining student cognitive characteristics of the sample population, the demographics and environmental data from the sample, and the degree to which each of these predict success in online courses. Additionally, this chapter reports the degree to which predictors of success vary by the subject area of the online course and what combination of factors provide the best prediction of success in online courses by high school students.

The chapter is organized into two main sections: the bivariate statistical analyses for significant relationships between the dependent and independent variables, and the regression analyses of cognitive and demographic characteristics as predictors of success.

Research questions guiding the data analysis were as follows:

1. To what degree do student cognitive characteristics (organization beliefs, achievement beliefs, risk-taking, and technology skills/self-efficacy) predict success in online courses?
2. To what degree do student demographic characteristics (e.g., gender, race/ethnicity, home computer/Internet access, prior academic achievement (GPA), course time provided at school, first online course) predict success in online courses?
3. To what degree do predictors of success vary by the subject of the online course?

4. What combination of factors produce a model that provides the best prediction of success in online courses?

## Bivariate Analysis

In order to explore the relationships between each of the independent variables, gender, race/ethnicity, first online course, home computer/Internet access, school provided class time, and prior academic achievement (GPA) and the dependent variable of being successful or not successful in their online course, statistical analyses were performed using either Pearson's Chi Square test for probability of independence for the categorical data ($p<.05$) or a one-way analysis of variance to compare means for the non-categorical data. The dependent variables were grouped into demographic factors, technology/environmental factors, academic factors, and the ESPRI survey factors. The findings are reported for each of the groupings. The final sub-section reports the findings from the analyses performed on the data sample by subject area of the online course. This analysis was performed to determine if there were differences in the relationship between the independent variables and course success within each of the identified subject areas and to compare those results with the findings from the whole data sample.

### Demographic Factors

Pearson's Chi Square statistical test was used to determine if there were gender differences in passing or failing the online course. The test results found no statistically significant relationship between gender and course success. Table 17 provides a summary of the cross tabulation and the test results.

Table 17

*Chi-Square Test of Independence for Gender and Course Success*

| | Gender | | |
|---|---|---|---|
| | Male | Female | Total |
| Pass | 133 | 262 | 395 |
| Fail | 22 | 32 | 54 |
| Total | 155 | 294 | 449 |
| | Value | df | Exact Sig. (2-sided) |
| Pearson Chi-Square | 1.050 | 1 | .305 |

Table 18

*Chi-Square Test of Independence for Race/Ethnicity and Course Success*

| | Race/Ethnicity | | | | | |
|---|---|---|---|---|---|---|
| | Caucasian | Black | Hispanic | Asian | Other | Total |
| Pass | 247 | 78 | 33 | 18 | 19 | 395 |
| Fail | 30 | 16 | 5 | 3 | 0 | 54 |
| Total | 277 | 94 | 38 | 21 | 19 | 449 |
| | Value | df | Asymp. Sig. (2-sided) | | | |
| Pearson Chi-Square | 5.336* | 4 | .255 | | | |

* 3 cells (30.0%) have expected count less than 5. The minimum expected count is 2.29.

Pearson's Chi-Square statistical test was used to compare race/ethnicity and passing/failing the online course. No statistically significant relationship was found

between these two variables. Table 18 above provides a summary of the cross tabulations and the test results.

**Technology/Environmental Factors**

Three technology/environmental factors were analyzed as independent variables to determine whether there was a relationship with the dependent variable of course success. Pearson's Chi-Square statistical test was used to compare whether the course was the first online course for the student and passing/failing the online course. No statistically significant relationship was found between the two variables. Table 19 provides a summary of the cross tabulation and the test results.

Table 19

*Chi-Square Test of Independence for First Online Course and Course Success*

| | First Online Course | | |
|---|---|---|---|
| | Yes | No | |
| Pass | 215 | 180 | 395 |
| Fail | 29 | 25 | 54 |
| Total | 244 | 205 | 449 |
| | Value | df | Asymp. Sig. (2-sided) |
| Pearson Chi-Square | .010 | 1 | .920 |

Pearson's Chi-Square statistical test was used to compare whether the student had class time provided at school and passing/failing the online course. No statistically significant relationship was found between the two variables as reported in Table 20.

Table 20

*Chi-Square Test of Independence for School Provided Class Time and Course Success*

| | School Provided Class Time | | |
|---|---|---|---|
| | Yes | No | |
| Pass | 183 | 211 | 394 |
| Fail | 28 | 26 | 54 |
| Total | 211 | 237 | 448* |
| | Value | df | Asymp. Sig. (2-sided) |
| Pearson Chi-Square | ..557 | 1 | .456 |

*One respondent provided no answer to this question resulting in an N-count of 448.

Pearson's Chi-Square statistical test was used to investigate a possible relationship between a student's having a computer at home and passing/failing the online course as well as a possible relationship between having Internet access at home and passing/failing the online course. These two variables were self-reported by the students in their responses to the survey and recoded as either yes or no in order to be analyzed as independent variables separately from the ESPRI constructs.

A statistically significant relationship was found between both of these independent variables and passing/failing an online course (See Table 21). Nearly all of the students in the sample reported having a computer at home and reported having Internet access. The significant variation in the group sizes resulting in small cell sizes may help explain the test results, which indicate home computer and Internet access almost functioning as constants. This is further discussed as a possible limitation of the study in Chapter 5.

Table 21

*Chi-Square Test of Independence for Home Computer, Internet Access and Course Success*

| | Home Computer | | |
|---|---|---|---|
| | Yes | No | |
| Pass | 390 | 5 | 395 |
| Fail | 50 | 4 | 54 |
| Total | 440 | 9 | 449 |
| | Internet Access | | |
| | Yes | No | |
| Pass | 387 | 8 | 395 |
| Fail | 50 | 4 | 54 |
| Total | 437 | 12 | 449 |
| Pearson Chi-Square | Value | df | Asymp. Sig. (2-sided) |
| Home Computer | 9.122 | 1 | .003 |
| Internet Access | 5.290 | 1 | .021 |

**Academic Factors**

Pearson's Chi-Square statistical test was used to compare whether there was any relationship between the subject area of the online course being taken by the student and whether they passed or failed the course. A statistically significant relationship was found between the subject area of the online course and passing or failing the course. Table 22 provides a summary of the cross tabulations for each of the subject areas and the test results. It is important to note that an examination of the Standardized Residuals for each of the cells within the Crosstab produced a value of -3.2 for students that failed Health

and PE which was the highest for any of the cells. This value indicates the number of students that failed Health and PE is much lower than the expected number and is making a particularly strong contribution to finding a significant relationship between the subject area and passing or failing the course.

Table 22

*Chi-Square Test of Independence for Subject Area and Course Success*

| | Subject Area | | | | | |
|---|---|---|---|---|---|---|
| | English | Health & PE | Math | Science | Social Studies | Total |
| Pass | 56 | 126 | 34 | 63 | 116 | 395 |
| Fail | 6 | 3 | 12 | 9 | 24 | 54 |
| Total | 62 | 129 | 46 | 72 | 140 | 449 |

| | Value | df | Asymp.Sig (2-sided) |
|---|---|---|---|
| Pearson Chi-Square | 23.872 | 4 | .000 |

Pearson's Chi-Square statistical test was used to compare whether there were any differences between the grade level of the student and whether they passed or failed their online course. No statistically significant relationship was found between the student's grade level and passing or failing the course as shown in Table 23.

Table 23

*Chi-Square Test of Independence for Grade Level and Course Success*

| | Grade Level | | | | | |
|---|---|---|---|---|---|---|
| | 8 | 9 | 10 | 11 | 12 | Total |
| Pass | 7 | 88 | 116 | 112 | 72 | 395 |
| Fail | 0 | 11 | 13 | 17 | 13 | 54 |
| Total | 7 | 99 | 129 | 129 | 85 | 449 |

| | Value | df | Asymp.Sig (2-sided) |
|---|---|---|---|
| Pearson Chi-Square | 2.518 | 4 | .641 |

For the independent variables that were scaled rather than categorical, a one-way analysis of variance was used to test for significant differences between the means of these groups. A one-way analysis of variance was conducted on students' prior academic achievement as defined by grade-point average (GPA) and whether students passed or failed their online course. As shown in Table 24, students who passed the course had a mean GPA of 3.16 compared to the mean GPA of 2.16 for students who failed the course.

Table 24

*Grade- Point Average*

| Pass/Fail | Mean | N | Std. Deviation |
|---|---|---|---|
| Yes | 3.16 | 395 | .7692754 |
| No | 2.16 | 54 | .7631625 |
| Total | 3.04 | 449 | .8339518 |

Table 25

*Analysis of Variance for Grade-Point Average*

| | Sum of Squares | df | Mean Square | F | Sig |
|---|---|---|---|---|---|
| Between groups | 47.542 | 1 | 47.542 | 80.487 | .000 |
| Within groups | 264.031 | 447 | .597 | | |
| Total | 311.573 | 448 | | | |

$p<.05$

The means of the GPA for students who passed their online course was the equivalent of one letter grade higher than for students who failed their course. A GPA of 3.17 equates to a letter grade of B. Subsequently, Table 25 shows that a statistically significant difference was found in the means of the grade-point averages of students who passed or failed their online course. Students with higher grade-point averages were more successful in their online course.

**ESPRI Factors**

One-way analyses of variance were calculated for each of the four factors from the ESPRI survey and whether the students passed or failed their online course. Each of these factors may be considered inherently independent of each other in the way they may or may not be related to a student passing or failing their online course. For this reason, an analysis of variance was performed for each factor. A statistically significant difference was found between the mean scores of the students' beliefs about technology and their self-efficacy using technology and whether they were successful in their online course as shown in Table 26. The means of the scores with regard to students'

achievement beliefs and organization beliefs also demonstrated a statistically significant difference when compared with course success. The results of those tests are presented in Table 28 and Table 29 on the following page.

Table 26

*Analysis of Variance for Technology/Self-Efficacy*

| | Sum of Squares | df | Mean Square | F | Sig |
|---|---|---|---|---|---|
| Between groups | 4.817 | 14 | .344 | 3.498 | .000 |
| Within groups | 42.689 | 434 | .098 | | |
| Total | 47.506 | 448 | | | |

p<.05

Table 27 indicates that there was no statistically significant difference between the means of the scores on questions which focused on risk taking and whether students passed or failed their online course.

Table 27

*Analysis of Variance for Risk Taking*

| | Sum of Squares | df | Mean Square | F | Sig |
|---|---|---|---|---|---|
| Between groups | 2.856 | 19 | .150 | 1.444 | .102 |
| Within groups | 44.650 | 429 | .104 | | |
| Total | 47.506 | 448 | | | |

p<.05

Table 28

*Analysis of Variance for Achievement Beliefs*

| | Sum of Squares | df | Mean Square | F | Sig |
|---|---|---|---|---|---|
| Between groups | 7.124 | 21 | .339 | 3.587 | .000 |
| Within groups | 40.381 | 427 | .095 | | |
| Total | 47.506 | 448 | | | |

p<.05

Table 29

*Analysis of Variance for Organization Beliefs*

| | Sum of Squares | df | Mean Square | F | Sig |
|---|---|---|---|---|---|
| Between groups | 5.597 | 20 | .280 | 2.858 | .000 |
| Within groups | 41.909 | 428 | .098 | | |
| Total | 47.506 | 448 | | | |

p<.05

**Subject Area Analysis**

The third research question for this study asked to what degree predictors of success vary by the subject of the online course. In order to answer this question, the independent variables in the study needed to be analyzed with regard to whether students passed or failed their online course within each of the identified subject areas. The number of students enrolled in an online course in each of the identified subject areas and the number who passed/failed were presented in Table 22. The results of that analysis indicated that there was a significant relationship between course success and the subject area of the course. In an effort to examine that relationship more closely, statistical tests

were performed comparing the independent variables and course success for each of the subject areas: English, math, science, social studies, and health & physical education. The results of those tests for each of the subject areas are reported in this sub-section.

Duplicating the process followed in the bivariate analysis of the entire sample, Pearson's Chi-Square test for independence was used to compare course success in English with gender, ethnicity, first online course, home computer, Internet access, and whether the student had a scheduled time at school during the school day to work on the online course. The cases selected from the dataset were students who had been enrolled in online English courses. The results for online English courses were the same as they were for the entire dataset – the only statistically significant relationship found was between home computer/Internet access and passing the online course (See Table 30).

Table 30

*Chi-Square Test of Independence for Gender, Ethnicity, First Online Course, Home Computer/Internet Access, School Provided Class Time and Course Success in English*

| Pearson Chi-Square | Value | df | Asymp.Sig (2-sided) |
|---|---|---|---|
| Gender | 3.599 | 1 | .058 |
| Ethnicity | 2.740 | 3 | .433 |
| First Online Course | 1.669 | 1 | .196 |
| Home Computer | 15.756 | 1 | .000 |
| Internet Access | 29.424 | 1 | .000 |
| School Provided Class Time | 1.545 | 1 | .214 |

A one-way analysis of variance was used to test for significant differences between the means of the GPA for students enrolled in online English courses and course success. The results as reported in Table 31 indicated no statistically significant difference with regard to GPA and course success in online English courses. This represents a difference from the findings for GPA and the entire dataset.

Table 31

*Analysis of Variance for Grade Point Average and Course Success in English*

| | Sum of Squares | df | Mean Square | F | Sig |
|---|---|---|---|---|---|
| Between groups | 4.919 | 52 | .095 | 1.703 | .199 |
| Within groups | .500 | 9 | .056 | | |
| Total | 5.419 | 61 | | | |

$p<.05$

The four ESPRI factors were analyzed for their possible effect on course success in English using a one-way analysis of variance. The results for that analysis are presented in Table 32. Of the four factors, student beliefs about risk taking and organization demonstrated a statistically significant relationship with whether students passed or failed their online English courses. Student beliefs about their technology skills and self-efficacy and their beliefs about academic achievement demonstrated no significant relationship with passing or failing their online English courses.

Table 32

*Analysis of Variance for the Four ESPRI Factors and Course Success in English*

| | Sum of Squares | df | Mean Square | F | Sig |
|---|---|---|---|---|---|
| Technology/Self efficacy | | | | | |
| Between groups | 1.247 | 10 | .125 | 1.524 | .158 |
| Within groups | 4.173 | 51 | .082 | | |
| Risk Taking | | | | | |
| Between groups | 2.366 | 14 | .169 | 2.601 | .007 |
| Within groups | 3.054 | 47 | .065 | | |
| Achievement beliefs | | | | | |
| Between groups | 1.538 | 15 | .103 | 1.216 | .295 |
| Within groups | 3.881 | 46 | .084 | | |
| Organization beliefs | | | | | |
| Between groups | 2.386 | 18 | .133 | 1.879 | .046 |
| Within groups | 3.033 | 43 | .071 | | |
| Total | 5.419 | 61 | | | |

$p<.05$

The same statistical tests and process were followed for each of the other subject areas to determine if there were any differences in the results when compared to the findings for the entire dataset. For the other four subject areas, there was no significant statistical relationship between passing or failing the online course in that particular subject area and differences in gender, ethnicity, whether it was the first online course

attempted, having a computer at home and having internet access, and whether the school provided time during the school day to work on the course.

A one-way analysis of variance was also used to a compare differences in the means of students' GPA and whether they were successful in the online course in each of the five identified subject areas. The results of these tests failed to demonstrate any statistically significant relationship between GPA and course success in any of the identified subject areas.

For each of the four factors from the ESPRI survey instrument, a one-way analysis of variance was used to compare the means for the ESPRI item scores and course success for students who took online courses in each of the other four subject areas - math, science, social studies, and health and physical education. Only the results of those tests that demonstrated a statistically significant difference have been reported in this chapter. Table 33 provides the results for students enrolled in online science courses and Table 34 provides the results for social studies. In both of these subject areas, students' beliefs about achievement and beliefs about their organization skills appeared to have a statistically significant impact on course success. This finding is consistent with the findings for the dataset as a whole.

Table 33

*Analysis of Variance for Achievement, Organization and Course Success in Science*

| | Sum of Squares | df | Mean Square | F | Sig |
|---|---|---|---|---|---|
| Achievement beliefs | | | | | |
| Between groups | 4.672 | 15 | .311 | 5.445 | .000 |
| Within groups | 3.203 | 56 | .057 | | |
| Organization beliefs | | | | | |
| Between groups | 2.553 | 14 | .182 | 1.953 | .039 |
| Within groups | 5.322 | 57 | .093 | | |
| Total | 7.875 | 71 | | | |

p<.05

Table 34

*Analysis of Variance for Achievement, Organization and Course Success in Social Studies*

| | Sum of Squares | df | Mean Square | F | Sig |
|---|---|---|---|---|---|
| Achievement beliefs | | | | | |
| Between groups | 6.801 | 17 | .400 | 3.730 | .000 |
| Within groups | 13.085 | 122 | .107 | | |
| Organization beliefs | | | | | |
| Between groups | 5.913 | 19 | .311 | 2.673 | .001 |
| Within groups | 13.973 | 120 | .116 | | |
| Total | 19.886 | 139 | | | |

p<.05

The results of the one-way analysis of variance for course success in online health and physical education for the four factors from the ESPRI survey were unique for that subject area. The only factor that demonstrated a statistically significant influence on passing or failing the online health and physical education course were items about technology self-efficacy. The other factors demonstrated no statistical significance. Table 35 provides the results of that analysis.

Table 35

*Analysis of Variance for Technology/Self Efficacy and Course Success in Health & PE*

| | Sum of Squares | df | Mean Square | F | Sig |
|---|---|---|---|---|---|
| Between groups | 1.054 | 12 | .088 | 5.433 | .000 |
| Within groups | 1.876 | 116 | .016 | | |
| Total | 2.930 | 128 | | | |

$p<.05$

**Bivariate Analyses After Removing Health and PE Students**

As reported in Table 22, the Chi-square test of independence for subject area and course success produced a significant relationship between the online course subject area and whether students passed or failed the course. The data in Table 22 also reported that of the 129 students who took Health and PE online, 126 passed while only 3 failed. This represents a pass rate of 97.67% which is much higher than the pass rate for any of the other subject areas. As indicated earlier in this chapter, an examination of the Standardized Residual values for each of the subject areas as produced by the Chi-square statistical test for independence indicated that the unexpected low number of students

failing Health and PE was producing a strong effect on the overall relationship produced by the statistical test. Removing the Health and PE students from the sample produced 320 subjects in the sample and of these, 269 passed their online course while 51 failed. This represents a pass rate of 84.06% compared to 88% for the original sample. Subsequently, the bivariate analyses of the dataset as reported in this chapter was repeated after removing the subjects who were enrolled in Health and PE to determine if there were any differences in the new results when compared to the original bivariate analyses. Those results are reported here starting with the demographic factors.

**Demographic Factors without Health and PE**

Pearson's Chi Square statistical test was used to determine if there were gender differences in passing or failing the online course. The test results found no statistically significant relationship between gender and course success for the data subset. This is consistent with the test results from the original sample. Table 36 provides a summary of the cross tabulation and the test results.

Table 36

*Chi-Square Test of Independence for Gender and Course Success without Health and PE*

| | Gender | | |
|---|---|---|---|
| | Male | Female | Total |
| Pass | 96 | 173 | 269 |
| Fail | 22 | 29 | 51 |
| Total | 118 | 202 | 320 |
| | Value | df | Exact Sig. (2-sided) |
| Pearson Chi-Square | 1.022 | 1 | .312 |

Pearson's Chi-Square statistical test was used to compare race/ethnicity and passing/failing the online course. No statistically significant relationship was found between these two variables. This result is also consistent with the original sample. Table 37 provides a summary of the cross tabulations and the test results.

Table 37

*Chi-Square Test of Independence for Race/Ethnicity and Course Success without Health and PE*

| | Race/Ethnicity | | | | | |
|---|---|---|---|---|---|---|
| | Caucasian | Black | Hispanic | Asian | Other | Total |
| Pass | 160 | 58 | 25 | 12 | 14 | 269 |
| Fail | 28 | 15 | 5 | 3 | 0 | 51 |
| Total | 188 | 73 | 30 | 15 | 14 | 320 |

| | Value | df | Asymp. Sig. (2-sided) |
|---|---|---|---|
| Pearson Chi-Square | 4.162* | 4 | .385 |

* 3 cells (30.0%) have expected count less than 5. The minimum expected count is 2.23.

The three technology/environmental factors were analyzed for the sample without the Health and PE students to determine whether there was a relationship with course success. Pearson's Chi-Square statistical test was used to compare whether the course was the first online course for the student and passing/failing the online course. No statistically significant relationship was found between the two variables. Table 38 provides a summary of the cross tabulation and the test results.

Table 38

*Chi-Square Test of Independence for First Online Course and Course Success without Health and PE*

| | First Online Course | | |
|---|---|---|---|
| | Yes | No | |
| Pass | 142 | 127 | 269 |
| Fail | 28 | 23 | 51 |
| Total | 170 | 150 | 320 |

| | Value | df | Asymp. Sig. (2-sided) |
|---|---|---|---|
| Pearson Chi-Square | .077 | 1 | .782 |

Pearson's Chi-Square statistical test was used to compare whether the student having class time provided at school and passing/failing the online course. No statistically significant relationship was found between the two variables for the sample without the students taking online Health and PE which is also consistent with the analysis performed on the original sample. Table 39 provides a summary of the cross tabulation and the test results.

Table 39

*Chi-Square Test of Independence for School Provided Class Time and Course Success without Health and PE*

| | School Provided Class Time | | |
|---|---|---|---|
| | Yes | No | |
| Pass | 143 | 126 | 269 |
| Fail | 27 | 24 | 51 |
| Total | 170 | 150 | 320 |
| | Value | df | Asymp. Sig. (2-sided) |
| Pearson Chi-Square | .001 | 1 | .977 |

Pearson's Chi-Square statistical test was used to investigate whether the student's having access to a computer at home and having Internet access at home was related to passing/failing the online course. A statistically significant relationship was found between having a home computer and passing/failing an online course but not for having internet access and passing/failing an online course. The represents a variation from the original data sample. Table 40 provides a summary of the cross tabulations and the test results for both of these independent variables.

Table 40

*Chi-Square Test of Independence for Home Computer, Internet Access and Course Success without Health/ PE*

| | Home Computer | | |
|---|---|---|---|
| | Yes | No | |
| Pass | 266 | 3 | 269 |
| Fail | 47 | 4 | 51 |
| Total | 313 | 7 | 320 |
| | Internet Access | | |
| | Yes | No | |
| Pass | 262 | 7 | 269 |
| Fail | 47 | 4 | 51 |
| Total | 309 | 11 | 320 |

| Pearson Chi-Square | Value | df | Asymp. Sig. (2-sided) |
|---|---|---|---|
| Home Computer | 9.070 | 1 | .003 |
| Internet Access | 3.548 | 1 | .060 |

Pearson's Chi-Square statistical test was used to compare whether there was any relationship between the subject area of the online course being taken by the student and whether they passed or failed the course (excluding Health and PE). In contrast to the results from the test of the original sample, after the removal of the students taking Health and PE online the test produced no significant relationship between the subject area of the online course and passing or failing the course. Table 41 provides a summary of the cross tabulations for each of the subject areas and the test results.

Table 41

*Chi-Square Test of Independence for Subject Area and Course Success without Health and PE*

| | Subject Area | | | | |
|---|---|---|---|---|---|
| | English | Math | Science | Social Studies | Total |
| Pass | 56 | 34 | 63 | 116 | 269 |
| Fail | 6 | 12 | 9 | 24 | 51 |
| Total | 62 | 46 | 72 | 140 | 320 |

| | Value | df | Asymp.Sig (2-sided) |
|---|---|---|---|
| Pearson Chi-Square | 6.137 | 3 | .105 |

Pearson's Chi-Square statistical test was used to compare whether there were any differences between the grade level of the student and whether they passed or failed their online course. No statistically significant relationship was found between the student's grade level and passing or failing the course as shown in Table 42.

Table 42

*Chi-Square Test of Independence for Grade Level and Course Success without Health and PE*

| | Grade Level | | | | | |
|---|---|---|---|---|---|---|
| | 8 | 9 | 10 | 11 | 12 | Total |
| Pass | 6 | 28 | 62 | 105 | 68 | 269 |
| Fail | 0 | 10 | 13 | 16 | 12 | 51 |
| Total | 6 | 38 | 75 | 121 | 80 | 320 |

| | Value | df | Asymp.Sig (2-sided) |
|---|---|---|---|
| Pearson Chi-Square | 5.020 | 4 | ..285 |

For the independent variables that were scaled rather than categorical, a one-way analysis of variance was used to test for significant differences between the means of these groups. A one-way analysis of variance was conducted on students' prior academic achievement as defined by grade-point average (GPA) and whether students passed or failed their online course. As shown in Table 43, students who passed the course had a mean GPA of 2.95 compared to the mean GPA of 2.11 for students who failed the course. Table 44 shows that a statistically significant difference was found in the means of the grade-point averages of students who passed or failed their online course. Students with higher grade-point averages were more successful in their online course.

Table 43

*Grade- Point Average without Health and PE*

| Pass/Fail | Mean | N | Std. Deviation |
|---|---|---|---|
| Yes | 2.9543 | 269 | .74744 |
| No | 2.1127 | 51 | .72537 |
| Total | 2.8202 | 320 | .80437 |

Table 44

*Analysis of Variance for Grade-Point Average without Health and PE*

| | Sum of Squares | df | Mean Square | F | Sig |
|---|---|---|---|---|---|
| Between groups | 30.366 | 1 | 30.366 | 54.856 | .000 |
| Within groups | 176.031 | 318 | .554 | | |
| Total | 206.397 | 319 | | | |

Duplicating the process for the original sample after removing the Health and PE students, analyses of variance were calculated for each of the four factors from the ESPRI survey and whether the students passed or failed their online course. A statistically significant difference was found between the means for each of the ESPRI factors and whether they were successful in their online course as shown in Tables 45 - 48. The means of the scores with regard to students' belief about technology and their self-efficacy, beliefs about risk taking, achievement beliefs and organization beliefs all demonstrated a statistically significant difference when compared with course success. These results aligned with the results from the original sample with the exception of beliefs about risk-taking. That factor did not show a statistically significant difference with course success in the original sample but did after the Health and PE students were removed from the sample.

Table 45

*Analysis of Variance for Technology/Self-Efficacy without Health and PE*

| | Sum of Squares | df | Mean Square | F | Sig |
|---|---|---|---|---|---|
| Between groups | 3.837 | 14 | ..274 | 2.141 | .010 |
| Within groups | 39.035 | 305 | .128 | | |
| Total | 42.872 | 319 | | | |

$p<.05$

Table 46

*Analysis of Variance for Risk Taking without Health and PE*

| | Sum of Squares | df | Mean Square | F | Sig |
|---|---|---|---|---|---|
| Between groups | 3.952 | 18 | .220 | 1.698 | ..039 |
| Within groups | 38.920 | 301 | .129 | | |
| Total | 42.872 | 319 | | | |

p<.05

Table 47

*Analysis of Variance for Achievement Beliefs without Health and PE*

| | Sum of Squares | df | Mean Square | F | Sig |
|---|---|---|---|---|---|
| Between groups | 6.978 | 20 | .349 | 2.906 | .000 |
| Within groups | 35.894 | 299 | .120 | | |
| Total | 42.872 | 319 | | | |

p<.05

Table 48

*Analysis of Variance for Organization Beliefs without Health and PE*

| | Sum of Squares | df | Mean Square | F | Sig |
|---|---|---|---|---|---|
| Between groups | 6.258 | 19 | .329 | 2.699 | .000 |
| Within groups | 36.614 | 300 | .122 | | |
| Total | 42.872 | 319 | | | |

**Summary of Bivariate Analyses**

The bivariate analyses produced several findings with regard to the relationships between the dependent variable of course success and the various demographic, technology/environmental, academic independent variables as well as the ESPRI instrument factors. There does not appear to be any statistically significant relationship between a student's gender or a student's race/ethnicity and whether they are more likely to be successful in an online course. Nor does there appear to be any statistically significant relationship between whether a student is taking the online course for the first time and whether the student has a designated time in his or her schedule to work on the course at school during the school day. Whether a student had a computer at home and had access to the Internet did prove to be statistically significant with regard to passing or failing the course. This finding held true across all courses and for English courses.

The most significant academic factor related to course success appeared to be the past academic history of the student. A higher GPA indicated a stronger relationship with being successful in the online course. However, that finding was not repeated when GPA was analyzed with regards to success in each of the identified course subject areas.

The results of the analyses of the ESPRI factors and the degree to which each of these was associated with course success varied between subject areas. Technology/self efficacy, achievement beliefs and organization beliefs all demonstrated a statistically significant relationship with course success across all courses. For English, the results showed significant differences for risk taking and organization beliefs. For science, math,

and social studies, achievement beliefs and organization beliefs were significant. For health and physical education the significant factor was technology/self efficacy.

## Logistic Regression Analysis

The research questions for this study are concerned with a dichotomous outcome, whether students pass or fail their online course, and a set of possible explanatory variables. Given that this dependent variable is categorical and the research questions are interested in variations in the probability of passing or failing and variations in the proportions of passing or failing amongst the various continuous and categorical independent variables, logistic regression theory and techniques were used.

In simple terms, logistic regression theory is based on the mathematical concept of the logit – the natural logarithm of an odds ratio (Peng & Ingersoll, 2002). To link the dependent variable (passing/failing the online course) to the set of explanatory variables, a logistic or logit transformation was used. Simply stated if *Y* represents passing the online course then the logit link can be written as Logit $Y$ = Log [$Y$/(1-$Y$)] and the odds of passing the course are represented by the term within the square brackets. The logistic regression model predicts the logit of *Y* from *X*, where *X* is a predictor variable. The logit is the natural logarithm (1n) of odds of *Y*, and odds are ratios of probabilities ($\pi$) of *Y* happening (passing an online course) to probabilities (1-$\pi$) of *Y* not happening (failing an online course).

The model has the form:

$$\text{logit}\,(Y) = \textit{natural}\ \log\,(\textit{odds}) = 1\text{n}\left(\frac{\pi}{1-\pi}\right) = \alpha + \beta X.$$

The regression coefficient (β) is the logit. Applying the antilog of the equation to both sides, an equation to predict the probability of the occurrence of passing the class is derived as follows:

$$\pi = \textit{Probability}\ (Y = \text{outcome} / X = x, \textit{a specific value of } X) = \frac{e^{\alpha+\beta x}}{1+e^{\alpha+\beta x}}$$

where $\pi$ is the probability of passing, α is the *Y* intercept, β is the regression coefficient, and $e$ is the natural logarithm base. This equation was extended to multiple predictors, $X_1, X_2, X_3, X_4,$ using the same logic of the simple logistic regression as follows:

$$\text{logit}\ (Y) = 1n\left(\frac{\pi}{1-\pi}\right) = \alpha + \beta X_1, + \beta X_2, + \beta X_3, + \beta X_4.$$ and subsequently:

$\pi = \textit{Probability}\ (Y = \text{outcome} / X_1 = x_1, X_2 = x_2, X_3 = x_3, X_4 = x_4)$

$$= \frac{e^{\alpha+\beta^1 x^1+\beta^2 x^2+\beta^3 x^3+\beta^4 x^4}}{1+e^{\alpha+\beta^1 x^1+\beta^2 x^2+\beta^3 x^3+\beta^4 x^4}}$$

The null hypothesis underlying the overall model states that all βs equal zero and a rejection of this null hypothesis implies that at least one β does not equal zero.

Initially, a four-predictor logistic model was used to test the means of the scores for the four factors from the ESPRI survey. Using the equation above, $X_1$ represents technology self-efficacy, $X_2$ represents risk-taking, $X_3$ represents achievement beliefs, and $X_4$ represents organization beliefs. The logistic regression analysis was carried out using IBM $SPSS_{20}$ software. Table 49 below provides the data for an overall evaluation of the model, statistical tests of each of the predictors, and goodness of fit statistics. The results showed that:

Predicted logit of (Pass/Fail) = -.787 + (.637) Technology + (-.884) Risk Taking + (1.255) Achievement + (-.390) Organization

According to the model, the log of the odds of a student passing their online course was positively related to their technology self-efficacy and their achievement beliefs, and negatively related to risk taking and organization beliefs. The p value of the Wald statistic from Table 49 on the next page indicates that organization beliefs and technology self efficacy were not statistically significant predictors of passing the online course. Risk taking and achievement beliefs were significant predictors of course success ($p<.05$).

However, an examination of $e^{\beta}$ (the odds ratio) for achievement beliefs indicates that for each unit increase of that factor, the likelihood that a student will pass their online course increases by 3.5 times. For risk-taking, the odds ratio is less than 1 so for each unit increase of that factor, a student's likelihood to pass their online course decreases by 41.3%. The inferential Hosmer & Lemeshow goodness-of-fit test yielded an $X^2(8)$ of 8.551 and was insignificant thereby suggesting that the model was fit well to the data.

Table 49

*Logistic Regression Analysis of 4 ESPRI Factors and Course Success*

| Predictor | β | *SE* β | Wald's $X^2$ | df | p | $e^{\beta}$ (odd ratio) |
|---|---|---|---|---|---|---|
| Constant | -.787 | 1.854 | .180 | 1 | .671 | .455 |
| Technology | .637 | .385 | 2.739 | 1 | .098 | 1.890 |
| Risk Taking | -.884 | .292 | 9.190 | 1 | .002 | .413 |
| Achievement | 1.255 | .306 | 16.875 | 1 | .000 | 3.509 |
| Organization | -.390 | .247 | 2.502 | 1 | .114 | .677 |
| Test | | | $X^2$ | df | p | |
| Overall model evaluation | | | | | | |
| Likelihood ratio test | | | 34.446 | 4 | .000 | |
| -2 Log likelikhood | 295.531 | | | | | |
| Goodness-of-fit-test | | | | | | |
| Hosmer & Lemeshow | | | 8.551 | 8 | .382 | |
| Cox & Snell R Square | .074 | | | | | |
| Nagelkerke R Square | .142 | | | | | |

Table 50 summarizes the data from the classification table indicating the degree to which the predicted probabilities agree with the actual outcomes for passing or failing the online course. According to Table 50, with the cutoff set at .50, the prediction for passing

the online course was more accurate than for failing the course. The overall correction prediction was 89.1%, a much higher rate than chance. This model using the four factors from the ESPRI, demonstrated a high ability to successfully predict whether students would pass their online course (99.5% correct). The model is not very successful predicting those that failed their online course (13% correct).

Table 50

*Observed and Predicted Frequencies for Course Success Using ESPRI Factors (4)*

| | Predicted | | |
|---|---|---|---|
| Observed | Passed | Failed | % Correct |
| Passed | 393 | 2 | 99.5 |
| Failed | 47 | 7 | 13.0 |
| Overall % correct | | | 89.1 |

Using the results from the bivariate analyses discussed earlier in this chapter, previous academic achievement as defined by grade point average (GPA) was shown to have a statistically significant relationship with course success. Adding GPA to the logistic regression model produced the results as shown in Table 51 below. The regression coefficient (β) for GPA (1.347) produces a positive relationship with passing an online course and is a statistically significant predictor of course success. Students who already have a record of high academic achievement will be more likely to pass their online course and for each increase of 1 in their GPA, the likelihood of their passing the

course increases nearly four times ($e^{\beta} = 3.84$). Adding GPA to the model also decreased the β values of technology self-efficacy and achievement beliefs making them less important in the model.

Table 51

*Logistic Regression Analysis of 4 ESPRI Factors, GPA and Course Success*

| Predictor | β | *SE* β | Wald's $X^2$ | df | p | $e^{\beta}$ (odd ratio) |
|---|---|---|---|---|---|---|
| Constant | -.2.726 | 2.050 | 1.770 | 1 | .183 | .065 |
| Technology | .359 | .415 | .746 | 1 | .388 | 1.432 |
| Risk Taking | -.740 | .318 | 5.421 | 1 | .020 | .477 |
| Achievement | .956 | .336 | 8.095 | 1 | .004 | 2.600 |
| Organization | -.342 | .273 | 1.565 | 1 | .211 | .710 |
| GPA | 1.347 | .214 | 39.430 | 1 | .000 | 3.845 |
| Test | | | $X^2$ | df | p | |
| Overall model evaluation | | | | | | |
| Likelihood ratio test | | | 82.431 | 5 | .000 | |
| -2 Log likelihood | 247.546 | | | | | |
| Goodness-of-fit-test | | | | | | |
| Hosmer & Lemeshow | | | 3.232 | 8 | .919 | |
| Cox & Snell R Square | .168 | | | | | |
| Nagelkerke R Square | .322 | | | | | |

Table 52 provides the number of cases predicted correctly compared to the actual number of cases for the model with the addition of GPA as a predictor. This model

correctly predicted 25.9 % of those that failed the course, which represents an increase from the previous model. The overall % correct remained the same after adding GPA to the model. The is an improved model for predicting failure which has implications for use identifying students taking online courses that may be at-risk.

Table 52

*Observed and Predicted Frequencies for Course Success Using EPRI Factors and GPA*

| | Predicted | | |
|---|---|---|---|
| Observed | Passed | Failed | % Correct |
| Passed | 386 | 9 | 97.7 |
| Failed | 40 | 14 | 25.9 |
| Overall % correct | | | 89.1 |

Whether a student had computer access at home and Internet access both demonstrated a significant relationship with whether students passed or failed their online course as previously reported in Table 21. These two factors were then added to the predictor model and analyzed using logistic regression. Table 53 reports the results of that analysis for this six-predictor model and Table 54 reports the degree to which the predicted probabilities for this new model agree with the actual outcomes for passing or failing the online course. The addition of whether students had a computer at home and Internet access increased the percentage of correctly predicting passing and failing the online course as reported in Table 54.

Table 53

*Logistic Regression Analysis of 4 ESPRI Factors, GPA, Home Computer, Internet Access and Course Success*

| Predictor | β | *SE* β | Wald's $X^2$ | df | p | $e^{\beta}$ (odd ratio) |
|---|---|---|---|---|---|---|
| Constant | -.3.784 | 2.107 | 3.227 | 1 | .072 | .023 |
| Technology | .204 | .429 | .228 | 1 | .633 | 1.227 |
| Risk Taking | -.802 | .325 | 6.101 | 1 | .014 | .448 |
| Achievement | .998 | .344 | 8.402 | 1 | .004 | 2.712 |
| Organization | -.402 | .280 | 2.061 | 1 | .151 | .669 |
| GPA | 1.360 | .219 | 38.573 | 1 | .000 | 3.897 |
| Home Computer | 1.353 | .982 | 1.900 | 1 | .168 | 3.870 |
| Internet | .755 | .982 | .591 | 1 | .442 | 2.127 |
| Test | | | $X^2$ | df | p | |
| Overall model evaluation | | | | | | |
| Likelihood ratio test | | | 87.811 | 7 | .000 | |
| -2 Log likelihood | 242.166 | | | | | |
| Goodness-of-fit-test | | | | | | |
| Hosmer & Lemeshow | | | 3.232 | 8 | .919 | |
| Cox & Snell R Square | .178 | | | | | |
| Nagelkerke R Square | .341 | | | | | |

This new model predicted one additional instance of course success correctly. This change slightly raised the prediction percentage to 98% of those that passed the course and correctly predicted 27.8 % of those that failed the course, a small improvement over

the previous model. The overall correct prediction percentage was also slightly higher at 89.5%. A comparison of the odds ratio in this model with the previous model indicates that GPA remains a very strong predictor of course success followed by having a computer at home and then by strong beliefs in achievement.

Table 54

*Observed and Predicted Frequencies for Course Success Using EPRI Factors, GPA, Home Computer and Internet Access*

| | Predicted | | |
|---|---|---|---|
| Observed | Passed | Failed | % Correct |
| Passed | 387 | 8 | 98.0 |
| Failed | 39 | 15 | 27.8 |
| Overall % correct | | | 89.5 |

**Subject Area Regression Analysis**

The binary logistic regression process used for the data sample was then repeated for each subject area by selecting the cases of students only enrolled in that subject area and performing the logistic regression analysis. First the four ESPRI factors were analyzed to determine if any of these factors was a significant predictor of success in English courses. Table 55 presents the results of that test. None of the four ESPRI factors were statistically significant predictors of course success in English.

Table 55

*Logistic Regression Analysis of 4 ESPRI Factors and Course Success in English*

| Predictor | β | *SE* β | Wald's $X^2$ | df | p | $e^{\beta}$ (odd ratio) |
|---|---|---|---|---|---|---|
| Constant | -10.900 | 6.457 | 2.850 | 1 | .091 | .000 |
| Technology | 2.370 | 1.361 | 3.034 | 1 | .082 | 10.698 |
| Risk Taking | -.410 | .872 | .221 | 1 | .638 | .664 |
| Achievement | 1.203 | 1.052 | 1.308 | 1 | .253 | 3.329 |
| Organization | .008 | .829 | .000 | 1 | .992 | 1.008 |
| Test | | | $X^2$ | df | p | |
| Overall model evaluation | | | | | | |
| Likelihood ratio test | | | 98.017 | 9 | .000 | |
| -2 Log likelihood | 32.599 | | | | | |
| Goodness-of-fit-test | | | | | | |
| Hosmer & Lemeshow | | | 12.162 | 8 | .144 | |
| Cox & Snell R Square | .104 | | | | | |
| Nagelkerke R Square | .222 | | | | | |

Table 56 is a classification table providing the comparison of actual cases of passing or failing the online English courses with the predicted cases for the four ESPRI factors. This combination of predictors successfully predicted passing in 100% of the

cases but failed to predict any of the cases that were unsuccessful. The overall prediction rate was 90.3%..

Table 56

*Observed and Predicted Frequencies for Course Success in English Using EPRI Factors*

| | Predicted | | |
|---|---|---|---|
| Observed | Passed | Failed | % Correct |
| Passed | 56 | 0 | 100.0 |
| Failed | 6 | 0 | 0 |
| Overall % correct | | | 90.3 |

Next, GPA was added to the model with the four ESPRI factors and the logistic regression analysis was repeated. There were slight changes in the results for the four ESPRI factors. GPA proved to be a statistically significant predictor of course success in English which was consistent with the findings for the whole data sample. Table 57 provides the results of that test:

Table 57

*Logistic Regression Analysis of 4 ESPRI Factors, GPA, and Course Success in English*

| Predictor | β | *SE* β | Wald's $X^2$ | df | p | $e^{\beta}$ (odd ratio) |
|---|---|---|---|---|---|---|
| Constant | -17.790 | 9.751 | 3.328 | 1 | .068 | .000 |
| Technology | 2.922 | 1.737 | 2.830 | 1 | .093 | 18.570 |
| Risk Taking | -.158 | 1.008 | .025 | 1 | .875 | .853 |
| Achievement | 1.165 | 1.391 | .702 | 1 | .402 | 3.206 |
| Organization | .024 | .965 | .001 | 1 | .980 | 1.024 |
| GPA | 1.700 | .773 | 4.832 | 1 | .028 | 5.472 |
| Test | | | $X^2$ | df | p | |
| Overall model evaluation | | | | | | |
| Likelihood ratio test | | | 13.305 | 5 | .021 | |
| -2 Log likelihood | 26.119 | | | | | |
| Goodness-of-fit-test | | | | | | |
| Hosmer & Lemeshow | | | 2.416 | 8 | .966 | |
| Cox & Snell R Square | .193 | | | | | |
| Nagelkerke R Square | .410 | | | | | |

This same model was then used for the cases in the dataset that were enrolled in mathematics courses. Table 58 provides the results of the logistic regression analysis for

mathematics. GPA proved to be a statistically significant predictor of success in mathematics courses.

Table 58

*Logistic Regression Analysis of 4 ESPRI Factors, GPA, and Course Success in Math*

| Predictor | β | *SE* β | Wald's $X^2$ | df | p | $e^{\beta}$ (odd ratio) |
|---|---|---|---|---|---|---|
| Constant | .839 | 4.473 | .035 | 1 | .851 | 2.315 |
| Technology | .026 | .924 | .001 | 1 | .978 | 1.026 |
| Risk Taking | -1.054 | .942 | 1.251 | 1 | .263 | .349 |
| Achievement | 1.106 | 1.044 | 1.122 | 1 | .289 | 3.023 |
| Organization | -.874 | .658 | 1.767 | 1 | .184 | .417 |
| GPA | 1.167 | .551 | 4.484 | 1 | .034 | 3.213 |
| Test | | | $X^2$ | df | p | |
| Overall model evaluation | | | | | | |
| Likelihood ratio test | | | 11.403 | 5 | .044 | |
| -2 Log likelihood | 41.402 | | | | | |
| Goodness-of-fit-test | | | | | | |
| Hosmer & Lemeshow | | | 5.253 | 7 | .629 | |
| Cox & Snell R Square | .220 | | | | | |
| Nagelkerke R Square | .322 | | | | | |

This same model was then used for the cases in the dataset that were enrolled in science courses. Table 59 provides the results of the logistic regression analysis for science. GPA was not a significant predictor but technology/self efficacy proved to be a statistically significant predictor of success in science courses.

Table 59

*Logistic Regression Analysis of 4 ESPRI Factors, GPA, and Course Success in Science*

| Predictor | β | *SE* β | Wald's $X^2$ | df | p | $e^{\beta}$ (odds ratio) |
|---|---|---|---|---|---|---|
| Constant | -13.912 | 6.490 | 4.595 | 1 | .032 | .000 |
| Technology | 2.558 | 1.304 | 3.845 | 1 | .050 | 12.908 |
| Risk Taking | -1.406 | 1.062 | 1.751 | 1 | .186 | .245 |
| Achievement | 2.041 | 1.218 | 2.809 | 1 | .094 | 7.698 |
| Organization | -.382 | .837 | .208 | 1 | .648 | .682 |
| GPA | 1.270 | .683 | 3.456 | 1 | .063 | 3.562 |
| Test | | | $X^2$ | df | p | |
| Overall model evaluation | | | | | | |
| Likelihood ratio test | | | 23.158 | 5 | .000 | |
| -2 Log likelihood | 31.097 | | | | | |
| Goodness-of-fit-test | | | | | | |
| Hosmer & Lemeshow | | | 5.446 | 8 | .709 | |
| Cox & Snell R Square | .275 | | | | | |
| Nagelkerke R Square | .520 | | | | | |

This same model was then used for the cases in the dataset that were enrolled in social studies courses. Table 60 provides the results of the logistic regression analysis for social studies. GPA was again a significant predictor of success in social studies courses.

Table 60

*Logistic Regression Analysis of 4 ESPRI Factors, GPA, and Course Success in Social Studies*

| Predictor | β | *SE* β | Wald's $X^2$ | df | p | $e^{\beta}$ (odds ratio) |
|---|---|---|---|---|---|---|
| Constant | .518 | 3.841 | .018 | 1 | .893 | 1.679 |
| Technology | -.787 | .775 | 1.032 | 1 | .310 | .455 |
| Risk Taking | -.524 | .494 | 1.127 | 1 | .288 | .592 |
| Achievement | .947 | .507 | 3.480 | 1 | .062 | 2.577 |
| Organization | -.100 | .410 | .059 | 1 | .808 | .905 |
| GPA | 1.448 | .399 | 13.180 | 1 | .000 | 4.256 |

| Test | | $X^2$ | df | p |
|---|---|---|---|---|
| Overall model evaluation | | | | |
| Likelihood ratio test | | 34.215 | 5 | .000 |
| -2 Log likelihood | 94.065 | | | |
| Goodness-of-fit-test | | | | |
| Hosmer & Lemeshow | | 5.827 | 8 | .667 |
| Cox & Snell R Square | .217 | | | |
| Nagelkerke R Square | .361 | | | |

This same model was used for the cases in the dataset that were enrolled in health and physical education courses (See Table 61). While none of the variables proved to be a significant predictor of success in health and physical education courses, the extremely large number of students that passed the course make these results inconclusive.

Table 61

*Logistic Regression Analysis of 4 ESPRI Factors, GPA, and Course Success in Health and PE*

| Predictor | β | *SE* β | Wald's $X^2$ | df | p | $e^{\beta}$ (odds ratio) |
|---|---|---|---|---|---|---|
| Constant | -5.787 | 7.095 | .665 | 1 | .415 | .003 |
| Technology | 1.057 | 1.294 | .668 | 1 | .414 | 2.878 |
| Risk Taking | -.090 | 1.071 | .007 | 1 | .933 | .914 |
| Achievement | 1.357 | 1.372 | .978 | 1 | .323 | 3.883 |
| Organization | -.712 | 1.040 | .469 | 1 | .493 | .491 |
| GPA | .818 | .706 | 1.343 | 1 | .247 | 2.267 |
| Test | | | $X^2$ | df | p | |
| Overall model evaluation | | | | | | |
| Likelihood ratio test | | | 5.203 | 5 | .392 | |
| -2 Log likelihood | 23.294 | | | | | |
| Goodness-of-fit-test | | | | | | |
| Hosmer & Lemeshow | | | 19.712 | 8 | .011 | |
| Cox & Snell R Square | .040 | | | | | |
| Nagelkerke R Square | .199 | | | | | |

**Summary of Logistic Regression Analyses**

Logistic regression was used in an attempt to identify which of the factors that had proven to be significantly associated with passing or failing an online course from the bivariate analysis could be combined in a regression model for predicting course success or failure. The results of these analyses produced a seven-predictor model that accurately predicted success for 98% of those students that passed the course and accurately predicted failure for 27.8% of those students that failed the course. This model was composed of the four ESPRI factors measuring cognitive characteristics, prior academic success operationalized as the student's GPA reported by the school division, whether the student indicated they had a computer at home, and whether the student indicated they had Internet access at home as reported in the survey. These results can be combined as:

> Predicted logit of (Pass/Fail) = (-.3.784) Constant + (.204) Technology + (-.802) Risk Taking + (.998) Achievement + (-.402) Organization + (1.360) GPA + (1.353) Home Computer + (.755) Internet

Within the model, the beliefs a student has about risk-taking and achievement along with their GPA proved to be statistically significant predictors of course success.

Logistic regression was also used to determine if there were significant differences with regard to factors that predicted success within each of the subject areas. A student's GPA was consistently a predictor of success for English, mathematics, and social studies. Of the ESPRI factors, only technology beliefs proved to be a significant contributor and that was only in science.

# Chapter 5

## Conclusions and Recommendations

This chapter presents a summary and a discussion of the findings of the data analyses presented in Chapter 4. It is organized into sections that include an overview of the findings and how they relate to existing literature, discussed in the context of the four research questions; limitations of the study; implications for policy in applied settings; and recommendations for further research.

The purpose of this study was to identify possible predictors of success for students taking online high school courses in a single district program. Given the gaps in the literature and the limitations of previous studies, this study attempted to replicate the research strategy from earlier studies with a different population and different program type. The study also tried to determine which variables might be combined to create a model for predicting success and failure for student populations with similar characteristics and to determine if predictors of success varied for different subject areas. Variance by subject area for the same model of prediction was not addressed in the findings for the previous studies.

## Overview of Findings

### Sample Comparison with Previous Studies

As discussed in the review of literature presented in Chapter 2, previous studies using the ESPRI along with demographic and environmental factors to predict student success in online courses were conducted with students enrolled in the Virtual High

School, Inc. (VHS). This population was approximately 77% white, 50% seniors, and 76% reported an A or B grade point average (Roblyer, et al., 2008). These earlier studies recommended that the ESPRI and research strategy be tried with other virtual school populations that may have a different ethnic composition and/or other demographic characteristics and with different environmental factors. The population sample for this study was composed of students taking online high school courses in a virtual school program created and administered by a single public school district in Virginia. Almost all of the students in both population samples indicated they had a computer with Internet access at home and both reported more girls than boys enrolled in online courses with 62% and 65% respectively.

The population sample for this study proved to be different in several ways from the populations used in earlier studies. As presented in Chapter 4, summary descriptive data for the population sample for this study indicated that 61.7 % were white, 18.9% were seniors, and 56% maintained an A or B grade point average. All of these findings represent differences in the population sample from the study compared to the VHS population sample used by the earlier studies. The findings from this study should be applicable to a more diverse, lower achieving population than the previous studies that focused on predictors of student success using the ESPRI. Another difference between the population samples was whether the online course was the first attempt online for the students. Almost 62% of the population from the VHS sample reported that the course was their first online course compared to only 54.3 % of the students from the school division's sample. A greater difference was found between the populations with regard to

whether they had been provided class time at school for their online course. The VHS sample reported over 82% had been provided such time while only 47% of the school division's sample reported being given time at school.

**Findings by Research Question**

The findings are summarized and discussed for each of the research questions as follows:

1. To what degree do student cognitive characteristics (e.g., beliefs about their technology skills/self-efficacy, achievement, instructional risk-taking, and organization strategies) as measured in high school students taking online courses in single-district programs predict success in those courses?
2. To what degree do student demographic/environmental characteristics (e.g., gender, grade level, race/ethnicity, home computer/Internet access, prior academic achievement (GPA), course time provided at school, and first online course) predict success in online courses?
3. To what degree do predictors of success vary by the subject of the online course?
4. What combination of factors produce a model that provides the best prediction of success in online courses?

**Findings for Research Question 1 – Cognitive Characteristics**

Three of the four ESPRI factors were found to have a significant relationship with course success. Students who indicated strong beliefs about the use of technology and their self-efficacy using technology were more likely to pass their online course. Students who indicated they had a higher degree of proficiency in computer skills and indicated

higher comfort using technology tools were more likely to be successful in their online course. These results are consistent with earlier studies that examined the relationship between technology self-efficacy and online course success.

Significant relationships were also found between course success and student beliefs about achievement and student beliefs about the importance of organization and their ability to organize. Students who indicated that they set goals for themselves regularly and had a stronger commitment to attaining those goals were more likely to pass their online course. Furthermore, students who believed they are well-organized and practiced organizational strategies were more likely to be successful in online courses. These results are also consistent with the findings of the earlier studies with regard to the relationship between a student's beliefs about his/her ability to achieve and practice positive organizational skills and online course success.

**Findings for Research Question 2 – Demographic Characteristics**

No significant relationship was found between differences in gender and online course success. The pass rate for males was nearly 86% compared to 89% for female students. Similarly, no significant relationship was found between differences in race/ethnicity and online course success. The absence of a relationship between race/ethnicity and course success is interesting in that this absence does not mirror the performance gaps in traditional brick and mortar schools and the accountability for school districts implemented by federal and state legislation for closing these performance gaps.

Factors associated with passing or failing the course were found within the environmental/technology category. A statistically significant relationship was found between students having a computer at home with Internet access and success in their online course. While 47% of the students reported that they were provided time in their schedule at school to work on their online course which included computer/Internet access, time at school with access did not prove to be a significant independent variable. Access alone proved significant with 98% of the sample indicating they had a home computer with Internet access. Whether students were taking an online course for the first time or not proved to have no significant relationship with whether the students passed or failed the course.

Within the academic factors, there appeared to be a significant difference between the course subject area and passing the online course. The highest pass rate was found in students taking online Health and PE. Students taking this course completed the health content online and the physical education requirements were met through various physical fitness activities either at fitness centers or through extra-curricular activities. The pass rate for this course was nearly 98%, which was quite high compared to the next highest passing rate of 90% for English courses. The fact that this course did not require students to complete all of the coursework online and that this course is not one of the core academic high school courses may help explain the extremely high pass rate for this course. The course success rate without Health and PE ranged from 78% to 90%. Removing these students from the sample and running the analysis without them produced a different result. There was no significant relationship found between

differences in the course subject area and course success for the rest of the courses after the Health and PE students were removed.

The grade level of the student also failed to show any significant relationship with course success. This is interesting since there is some evidence in the literature that as students mature, they demonstrate greater success in online courses. Grade level was considered a predictor of course success in the earlier Roblyer studies. The population sample for this study demonstrated a fairly even distribution across grade levels giving weight to this finding.

A significant difference was found between prior academic success represented by GPA and passing or failing the online course. Students with a higher GPA tended to be more successful in their online course than those with lower GPA. This finding is consistent with the findings from earlier empirical studies that have found students who have a record of academic success are more likely to be successful when taking online courses. The earlier studies (Roblyer, et al., 2003, 2008) had used GPA as reported by the students while this study used the GPA reported by the school division. This finding from logistic regression analysis from this study showed that for each increase of one grade point in a student's GPA would result in their being nearly 4 times more likely to pass an online course.

**Findings for Research Question 3 – Variance by Subject Area**

The relationship between course success within each subject area of the course was further analyzed and some differences were found when compared to the results from the entire sample. Prior academic success reported as GPA did not show any

significant interaction with course success within any of the individual course subject areas. For the four ESPRI factors, English courses mirrored the results from the larger sample. For science and social studies, however, there were differences. Only achievement beliefs and organizations beliefs proved to have a significant relationship with course success for those subject areas. Only technology beliefs/self efficacy contributed to success for students taking online Health and PE.

It is important to consider the smaller number of students within each of these subject areas when examining these findings. English, Science, and Math courses all had less than 75 students each with Math having the least number of students with 46. These three subjects areas combined represented only 40% of the total sample. The differences between subject areas may be better explained with further research into the differences between subject areas with regard to passing rates but also differences with regard to the online course design. Mathematics courses which require instruction and practice solving problems or science courses which require completion of virtual labs may produce different interactions with student characteristics or the learning environment and whether students pass or fail these courses when compared to students passing or failing English or social studies online courses. The different results produced in the bivariate analysis in this study after removing Health and PE students from the sample also tend to support the need for the consideration of other factors to help explain variance by subject area.

### Findings for Research Question 4 – Best Model of Prediction

Following the strategy used by the earlier Roblyer studies, this study attempted to identify the combination of factors that produced the best model for predicting online course success. As detailed in Chapter 4, binary logistic regression analysis was used to compare combinations of factors that seemed to be associated with whether students passed or failed their online course. The combination that had the highest percentage of correctly predicting passing and failing the online course was the model using all four of the ESPRI factors, student GPA, and whether the student had a computer at home with Internet access. This combination correctly predicted passing for 98% of those students that actually passed and correctly predicted failing for 27.8% of those students that actually failed. The total correctly classified was 89.5%. The earlier Roblyer study using this same strategy and produced a model that had a lower success rate for predicting course success (93%) and overall (79.3%) but was more effective at predicting failure (30.4%). Both studies demonstrated that predicting failure appears to be more challenging with regards to identifying a combination of factors that consistently predict correctly.

## Limitations

The study was conducted in the context of several possible limitations including a possibility that students chose not to complete the survey and therefore the distribution of completed surveys may not have represented all of the online courses that had students enrolled. The researcher's use of secondary data, which should prove more accurate than depending on self-reporting by the students for demographic and environmental factors,

is still dependent on the school district's data collection process for accuracy.

A more important possible limitation of the study stems from the widely different group sizes for some of the variables resulting in reduced variability. This is especially true for the variables whose categories produce larger tables than 2 X 2 tables such as race/ethnicity, grade level, and subject area. Table 14 indicated the pass rate for the entire dataset as 88% with only 54 students failing their online course. As a result, the low number of failures results in small cell sizes for the statistical tests of some of the independent variables increasing the possibility of a Type II error for those variables that indicated no level of significant relationship. Additionally, of the 449 students in the study, only 9 reported they did not have a computer at home and 12 reported no Internet access. As discussed in Chapter 4, the range between students who passed or failed online Health and PE was quite large with only 3 students in the group that failed. The group size limitations for some of these variables may have contributed to a failure to find a significant relationship when statistical tests were applied. Another example may be the failure to find a statistically significant relationship between the four ESPRI factors and passing or failing an online course within the subject areas. As detailed later in the recommendations for further research, repeating this study with larger sample sizes should reduce this limitation.

## Implications for Policy

As indicated in this study, there are a number of factors that influence the success or failure of students enrolled in online classes. Administrators and teachers responsible for student success in virtual school programs in public school divisions can benefit from

understanding which characteristics, both internal learner attributes and external factors, best predict student success in online courses. Knowing that students who have already demonstrated success in school and possess strong beliefs about their ability to achieve along with strong organizational beliefs will also probably be successful in online courses, can be useful to virtual program administrators to identify students who do not possess these attributes as less likely to be successful. Programs that use an instrument like the ESPRI to collect data from students either during the enrollment process or at the beginning of the online course can then flag students whose scores on the instrument indicate low technology self efficacy, weak organizational beliefs, or a lack of confidence in their ability to achieve. If these students also have a low G.P.A. or poor academic performance history, then the virtual program can immediately begin monitoring these students closely with regard to level of engagement and performance in the online course and provide support strategies early in the course to help foster success.

Virtual school programs can develop a profile of a successful online student. Students who enroll in online classes who do not fit the successful profile can begin working with their online teachers and program support staff using an early intervention plan designed to help students develop skills that can lead to academic success. However, this intervention plan must be more than providing time at school to work on their class. This study shows that providing such time in the student's schedule at school is not a significant contributor to student success. The intervention plan needs to incorporate strategies that help the student stay engaged and identify activities or content in the course that represent obstacles to student engagement.

Additional attention can be given to helping students manage their time for working on the course outside of the school day. The results of the data analyses in this study indicated that there were no real differences between course subjects with regard to which characteristics were predictors of success and no differences between courses with regard to success after removing the Health and P.E. students from the sample. This knowledge is helpful for virtual school programs to implement intervention plans across all courses and identify common characteristics across courses with regard to activities and course design that may be obstacles for students taking those courses.

The development and incorporation of scaffolding measures into virtual programs by district instructional leadership is a viable strategy for consideration by policy makers. Students who could be identified as in danger of failing an online course could be provided assignments and other instructional strategies developed to target characteristics that are predictors of success. This strategy is especially applicable for students who may require additional technology skills, time management skills, or other help adapting to the online learning environment. This study has further substantiated that the identification characteristics that accurately and consistently predict failure in an online course remains a challenge. It is the ability to predict failure that continues to have important implications for policy.

School districts in Virginia are faced with implementing initiatives to provide all students an opportunity to successfully complete a virtual course in order to graduate from high school. In the virtual learning environment, the one-size-fits- all practice has no more merit than it does for the brick and mortar learning environment. The

implementation of relevant, meaningful virtual course options for all students continues to be a challenge. This study substantiated the findings from previous studies that prior academic success and a strong belief in one's ability to succeed are just as important in online courses as they are in the brick and mortar ones.

The study attempted to develop a model for predicting success in online courses. While the study demonstrated that 3 of the 4 ESPRI factors along with computer/Internet access are all contributors to student success and are part of a prediction model, the strongest predictor proved to be a student's grade point average. An important implication for policy makers might be that attention to other factors outside of student characteristics is necessary to support students in a virtual environment. It may follow that a best practice for supporting students taking online courses may need to shift from examining characteristics of the learner to an emphasis on characteristics of the learning experience.

When evaluating virtual programs, courses, and online teachers, much emphasis is placed on course design to promote student engagement, communication to provide opportunities for interaction, and the need to establish personal relationships with students to build scaffolding for student support (iNACOL, 2011). Predicting failure may be done more accurately by examining differences in course design, student/teacher communication, and student/teacher relationships as they relate to course success.

## Recommendations for Research

A review of the literature demonstrated a deficiency in empirical research targeting K-12 education and a need to improve upon the identification of characteristics

that predict student success in online learning environments. The literature also called for more research to develop intervention strategies for students who may be lacking these characteristics. After describing the promising results associated with the use of the Educational Success Prediction Instrument (ESPRI), Roblyer (2005) stated that the next step in this line of inquiry is to create materials to assist in the remediation of those students whose ESPRI results indicated potential for problems.

This study incorporated the empirical research strategy undertaken in the earlier studies conducted by Roblyer et al. (2003, 2008); in an effort to provide additional data and analyses to further clarify the identification of characteristics that predict student success taking online courses. This study produced similar results to the earlier studies using a more diverse sample and focusing on a virtual school program as implemented by a single public school district in Virginia.

While the results of the data analyses produced some variance from the earlier studies, a combination student factors and learning environment conditions produced a model that can predict student success in online courses in a single district program successfully. The results of the study were even more conclusive after removing Health and PE students from the sample. All four of the ESPRI factors, GPA, and home computer access proved to have a significantly statistical relationship with course success.

However, while the model produced from this study successfully predicts passing an online course for over 90% of the cases, it does not prove effective predicting failure. The model from the earlier Roblyer studies also proved less effective predicting failure in

online courses. The reality of current educational policy and practice indicates that the range of students enrolling in online learning opportunities is expanding (Barbour & Mulcahy, 2007; Cavanaugh, 2007). In Virginia, all students that enter a public high school in the fall of 2013 will have to complete a virtual course to graduate with either an advanced or a standard diploma. The ability of virtual school programs to support a broad range of student abilities has become an expectation and future research is still needed to examine other factors that may help identify the reasons that students are not successful taking an online course.

Other possible factors for consideration include the degree of support from the student's family, level of instructor interaction with students in the online course, and the online course design. Furthermore, in attempting to identify students who may be less likely to succeed taking online course, research studies focusing on student competencies such as writing skills, communication skills, and reading comprehension are needed targeting the K-12 student population. There have been studies of students taking online courses in higher education emphasizing external competencies and strategies under the control of the student (Xu & Jaggers, 2013), and adapting these for research with K12 virtual students would add to the literature knowledge base.

Additional is warranted with population samples from other single district virtual school programs comparing the results from this study. Attention to the inclusion of more variability in the sample groups thereby reducing the group size limitations of this study. Given the difference in the results of the data analysis from this study after removing the students taking online Health and PE from the dataset and the variances reported in the

results of data analysis within each subject area, additional research is needed with larger sample groups of students in single district virtual programs. The ability to have a larger sample of students within each subject area might provide more conclusive results.

## Summary

This study examined the relationship between high school students' success in online courses in a single district program and various student demographic and cognitive characteristics. As stated in the review of the literature, online courses often have high dropout or failure rates, and the interests of both students and virtual school programs would be served by identifying characteristics of successful online students. Defining such characteristics could assist virtual program administrators and faculty in providing support to students identified as needing support upon admission to the virtual program. With the increasing variety of course venues available, the ability to use internal and external predictors of success to match students to the learning environment that provides the greatest opportunity for each individual student promotes individualize learning and fosters student success.

Overall, the online learning environment is quite different from a traditional classroom. High dropout or failure rates have been established for these courses, at great cost to students and higher education institutions. This study reveals that some commonly available data could be used to guide students, parents, and school counselors into making appropriate course selections for students. However, given the expectation in Virginia and other states that all students must take a virtual course or have a virtual learning experience in order to graduate from high school, virtual school program

administrators and teachers can benefit from being able to flag students that do not posses characteristics that predict success in online courses and be in a better position to support students when they enroll in a virtual course.

The findings from this study provide educational policy makers with an understanding of what characteristics can predict success in a high school virtual course in a single district virtual program. As school divisions across Virginia prepare to implement virtual school programs of their own or contract with an approved virtual school program provider, consideration of these findings would be beneficial. This study also makes recommendations for additional research to shift away from focusing on student cognitive characteristics and to begin emphasizing student competency levels and characteristics of the learning environment to better understand why students are not successful taking online courses and what changes can be made to better support students to promote success.

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Appendix A

Educational Success Prediction Instrument – V3*

For each "agree-disagree" statement below, click the rating to show how much you agree or disagree with it.

1. I know how to use an Internet search engine to locate information.

○ Strongly Agree ○ Agree ○ Unsure ○ Disagree ○ Strongly Disagree

2. I know how to use a browser to locate Internet sites.

○ Strongly Agree ○ Agree ○ Unsure ○ Disagree ○ Strongly Disagree

3. Many times, I lose interest in attaining the goals I set.[1]

○ Strongly Agree ○ Agree ○ Unsure ○ Disagree ○ Not Applicable

4. I do not care what other people think of me if I make mistakes.

○ Strongly Agree ○ Agree ○ Unsure ○ Disagree ○ Strongly Disagree

5. When I have to do something new on a computer, I usually try to figure it out myself.

○ Strongly Agree ○ Agree ○ Unsure ○ Disagree ○ Strongly Disagree

6. I tend to make a schedule or list when I have a lot to do to make sure I get everything done on time.

○ Strongly Agree ○ Agree ○ Unsure ○ Disagree ○ Strongly Disagree

7. I know how to locate a document or a program on my computer.

○ Strongly Agree ○ Agree ○ Unsure ○ Disagree ○ Strongly Disagree

8. I have a computer in my home.[2]

○ Strongly Agree ○ Agree ○ Unsure ○ Disagree ○ Strongly Disagree

9. I am not afraid of making mistakes if I am learning to do new things.

○ Strongly Agree ○ Agree ○ Unsure ○ Disagree ○ Strongly Disagree

10. I rarely set goals for myself.[1]

○ Strongly Agree ○ Agree ○ Unsure ○ Disagree ○ Strongly Disagree

11. I keep my notes on each subject together arranged in a logical order.

○ Strongly Agree ○ Agree ○ Unsure ○ Disagree ○ Strongly Disagree

12. I don't mind showing my work in front of others when I am learning new things.

○ Strongly Agree ○ Agree ○ Unsure ○ Disagree ○ Strongly Disagree

13. I feel comfortable using a computer.

○ Strongly Agree ○ Agree ○ Unsure ○ Disagree ○ Strongly Disagree

14. I find that I try harder if I set high goals for myself.

○ Strongly Agree ○ Agree ○ Unsure ○ Disagree ○ Strongly Disagree

15. If I am given a task to perform that I know little about, I don't mind giving it a try.

○ Strongly Agree ○ Agree ○ Unsure ○ Disagree ○ Strongly Disagree

16. I keep my desk or the place where I work very organized.

○ Strongly Agree ○ Agree ○ Unsure ○ Disagree ○ Strongly Disagree

17. I have easy access to a computer with Internet capability.[2]

○ Strongly Agree ○ Agree ○ Unsure ○ Disagree ○ Strongly Disagree

18. I study hard for all of my classes because I enjoy acquiring new knowledge.

○ Strongly Agree ○ Agree ○ Unsure ○ Disagree ○ Strongly Disagree

19. When I am learning something new, it is okay if I make errors.

○ Strongly Agree ○ Agree ○ Unsure ○ Disagree ○ Strongly Disagree

20. I know how to send an attachment in an email.

○ Strongly Agree ○ Agree ○ Unsure ○ Disagree ○ Strongly Disagree

21. I tend to persist at tasks until they are accomplished.

○ Strongly Agree ○ Agree ○ Unsure ○ Disagree ○ Strongly Disagree

22. I am afraid of failure when I am learning new things.[1]

○ Strongly Agree ○ Agree ○ Unsure ○ Disagree ○ Strongly Disagree

23. I use email, instant messaging, or text messaging at least once a week.

○ Strongly Agree ○ Agree ○ Unsure ○ Disagree ○ Strongly Disagree

24. I believe I am a high achiever.

○ Strongly Agree ○ Agree ○ Unsure ○ Disagree ○ Strongly Disagree

25. I have good word processing skills.

○ Strongly Agree ○ Agree ○ Unsure ○ Disagree ○ Strongly Disagree

26. I tend to wait until the last minute to get things done.[1]

○ Strongly Agree ○ Agree ○ Unsure ○ Disagree ○ Strongly Disagree

27. I feel that I am a very well-organized person.

○ Strongly Agree ○ Agree ○ Unsure ○ Disagree ○ Strongly Disagree

28. I have a scheduled time during the school day to work on my online class at school.[3]

○ True ○ False

[1] Scores for these items were reversed to reflect the same direction as the other items.

[2] The responses for these items were re-coded as Strongly Agree or Agree = Yes and Unsure, Disagree, Strongly Disagree = No by the researcher. Access to a computer at home and to the Internet were treated as independent variables in the study.

[3] This question was added by the school division to the survey,

*Used with permission of the author, M.D. Roblyer, Ph. D., based on her original work.

Appendix B

Items in the ESPRI Survey Instrument by Factor

| Factor | Item | Statement |
|---|---|---|
| Technology skills/ self efficacy | q1 | I know how to use an Internet search engine to locate information. |
| | q2 | I know how to sue a browser to locate Internet sites. |
| (8 items) | q5 | When I have to do something on a computer, I usually try to figure it out myself. |
| | q7 | I know how to locate a document or a program on my computer. |
| | q13 | I feel comfortable using a computer. |
| | q20 | I know how to send an attachment in an email. |
| | q23 | I use email, instant messaging, or text messaging at least once a week. |
| | q25 | I have good word processing skills. |
| Achievement beliefs | q3 | Many times I lose interest in attaining the goals I set. |
| | q10 | I rarely set goals for myself. |
| (6 items) | q14 | I find that I try harder if I set high goals for myself. |
| | q18 | I study hard for all of my classes because I enjoy acquiring new knowledge. |
| | q21 | I tend to persist at tasks until they are accomplished. |
| | q24 | I believe I am a high achiever. |
| Instructional risk-taking | q4 | I do not care what other people think of me if I make mistakes. |
| (6 items) | q9 | I am not afraid of making mistakes if I am learning to do new things. |
| | q12 | I don't mind showing my work in front of others when I am learning new things. |
| | q15 | If I am given a task to perform that I know little about, I don't mind giving it a try. |
| | q19 | When I am learning something new, it is okay if I make errors. |
| | q22 | I am afraid of failure when I am learning new things. |
| Organization | q6 | I tend to make a schedule or list when I have a lot to do to make sure I get everything done on time. |
| (5 items) | q11 | I keep notes on each subject together arranged in a logical order. |
| | q16 | I keep my desk or the place where I work very organized. |
| | q27 | I feel I am a very well-organized person. |
| | q26 | I tend to wait until the last minute to get things done. |

# VITA

David Theron Rankin was born on July 7, 1953, in New Orleans, Louisiana. He grew up in Eagle Rock, Virginia and graduated valedictorian from James River High School, Buchanan, Virginia in 1971. He earned a Bachelor of Arts degree in History from Mars Hill College in 1976 and a Master of Education in Curriculum and Instruction from Virginia Commonwealth University in 1993. He has worked in public education in Virginia for 24 years as a teacher, school librarian, instructional specialist, and administrator. He is currently employed by Chesterfield County Public Schools as Manager of Online Learning.