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A STUDY OF STUDENT ACHIEVEMENT AND EDUCATIONAL INTERVENTION
STRATEGIES IN TRADITIONAL AND VIRTUAL FORMAT ALGEBRA 1 COURSES
WITHIN VOLUSIA COUNTY SCHOOL DISTRICT

by

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A dissertation submitted in partial fulfillment of the requirements
for the degree of Doctor of Education
in the School of Teaching, Learning, & Leadership
in the College of Education
at the University of Central Florida
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ABSTRACT

The purpose of this study was to compare achievement results of students enrolled in traditional and virtual Algebra 1 courses in the School District of Volusia County, Florida and to identify which educational interventions are utilized by traditional and online teachers to promote student success, especially for at-risk populations. Two research questions guided this study. This study is significant, as school districts expand virtual options for K-12 students to meet legislative mandates and student demand, while also exploring and developing methods to ensure student success.

Student scores on the Florida Algebra 1 End of Course Exam (EOC) were compared to determine what difference, if any, existed in the performance of students in traditional face-to-face classrooms and virtual settings. Surveys were also distributed to traditional brick-and-mortar and virtual teachers to identify which educational interventions were provided to at-risk students and to measure teacher perception of the relative effectiveness of those interventions in each setting.

One-sample t-test results indicated a statistically significant difference in the mean scale scores of traditional and virtual students on the Florida Algebra 1 EOC. Survey responses indicated little variation in the interventions provided by teachers to at-risk students in each setting. Low effectiveness ratings for interventions in the Resources category, such as Mentors from the Community, warrant further investigation, as these responses run counter to previous research. Due to this study's small sample and wide disparity between the number of traditional and virtual students, caution is advised in the interpretation of results.

To my wife, Lisa, and our daughter, Emma Grace.

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CHAPTER 1 THE PROBLEM AND ITS CLARIFYING COMPONENTS

Introduction

Virtual Kindergarten through Grade 12 (K-12) education is emerging as an increasingly popular mode of instructional delivery. Within a decade, K-12 online learning has grown from a novelty to an established educational option for many students in all 50 states (Glass, Welner & University of Colorado at Boulder, 2011; Watson, Murin, Vashaw, Gemin, & Rapp, 2011). A variety of vendors, including cyber charter schools, large for-profit corporations, state departments of education, and local school districts have begun to enter the marketplace to offer a number of virtual education options (Ellis, 2008; Glass, Welner & University of Colorado at Boulder, 2011; Holstead, Spradlin, Plucker & Indiana University, 2008; Huett, Moller, Foshay, & Coleman, 2008; Watson et al., 2011). An example of virtual education's expansion at the state level was the recent enactment of a mandate by the Florida state legislature stating that all students, beginning with those who enter ninth grade in the 2011-2012 school year, complete at least one online course as part of their high school graduation requirement (Florida Statute 1003.428, 2011). At the same time as online learning choices proliferate, traditional brick and mortar public schools faced greater levels of accountability for student learning. Various authors have noted a need to remove barriers for students who wish to receive their education in the virtual environment, while ensuring the same level of accountability for online providers as traditional public schools (Dillon & Tucker, 2011; Ellis, 2008; Glass, Welner & University of Colorado at Boulder, 2011; Hasci & Arizona State University, 2004; Holstead et al., 2008).

Much of the research comparing virtual and traditional settings is inconclusive regarding which environment produces greater student achievement. Comparison studies and meta-analyses have shown no advantage for student learning inherent in either type of delivery model (Glass, 2010; Huett et al., 2008; Rice, 2006; U.S. Department of Education, 2009). In order to identify successful instructional methods which may contribute to student learning in an online course, researchers have urged for future studies to move beyond simple comparisons to examine best practices in virtual education (Rice, 2006) and development of interventions for at-risk students (Cavanaugh, Barbour & Clark, 2009b; Roblyer, Davis, Mills, Marshall & Pape, 2008).

Roblyer et al. (2008) developed an instrument useful for identifying student characteristics likely associated with success in virtual education. Hughes, McLeod, Brown, Maeda, and Choi (2007) conducted a study comparing student achievement data on a standardized Algebra assessment between virtual and traditional classroom students, combined with student perceptions of their classroom environments. Citing a dearth of studies on the perspectives of K-12 virtual educators, DiPietro, Ferdig, Black, and Preston (2008) conducted qualitative research in which virtual school teachers were interviewed and observed, in order to identify instructional best practices.

By studying best practices in virtual schooling and the interventions available for students who were likely to struggle in a virtual school environment, student outcomes were likely to be improved. According to Rice (2006), “the question of the effectiveness of student supports is critical in the K-12 context, especially when considering the alternative nature of the educational experience and the proclivity for its attractiveness to at-risk populations” (p. 441). Studies which

examined student achievement data in combination with instructional best practices may provide helpful information to educators as they work with a wide range of learners in virtual education courses.

Statement of the Problem

Virtual education options have expanded greatly during the previous decade (Glass, Welner & University of Colorado at Boulder, 2011; Watson, et al., 2011). In spite of its popularity, there is a lack of clear data indicating higher student achievement due to the virtual education setting. Policymakers, encouraged by virtual education providers and education reform activists, seek to find additional opportunities for virtual education to grow (Dillon & Tucker, 2011).

With Florida's mandate that all students complete at least one online course in order to graduate, many students lacking the characteristics predictive of success in virtual education will likely need support as they attempt to meet this requirement (Florida Statute 1003.428, 2011). There is a lack of research indicating the types of interventions utilized in online courses, or their potential effectiveness with at-risk populations. Much of the previous research on virtual education focused on simple comparisons between student achievement in online coursework and traditional schooling (Cavanaugh et al.; 2009b; Huett et al., 2008; Rice, 2006; U.S. Dept of Ed, 2009). To date, no studies have been located which combine comparisons of student achievement between traditional and virtual classrooms with teacher-reported interventions or supports for student learning.

Purpose of the Study

The purpose of this study was to compare the relative achievement levels of students in traditional and virtual Algebra 1 courses and to identify educational interventions offered by virtual school teachers that may promote student success, especially for at-risk populations.

Significance of the Study

The significance of this study was in the identification of educational interventions offered by virtual programs which teachers associate with student success. As school districts expand virtual options for K-12 students in response to state legislation and increased interest in online education, they will seek to explore and develop methods to ensure student success.

Those general support strategies which emerged as widely utilized and seen by teachers as highly effective may be isolated for further study and more detailed description. Examination of characteristics of successful online programs also may aid in the development of evaluation tools used by districts to determine eligibility for charters or other virtual education providers when applying for contracts or certification. For students exhibiting risk factors for failure in a virtual education setting, interventions which effectively address those factors may be identified and implemented by a wider number of virtual providers, thereby increasing overall student achievement. As stated by Cavanaugh et al. (2009b), “Research studies investigating the online learning experience for lower performing students will assist personnel to design appropriate interventions as this particular population of students continues to grow within virtual schools” (p. 13).

Definition of Terms

At-risk Student. An at-risk student is “any student who is performing poorly academically, or who may face learning impediments not limited to socioeconomic status, behavioral and learning disabilities, and home, family, and community stresses; may also specifically refer to students in danger of not passing a course or graduating” (International Association for K-12 Online Learning; 2011, p.3).

Brick-and-Mortar School. A brick and mortar school is a “traditional school or traditional school building, as contrasted with an online school” (International Association for K-12 Online Learning; 2011, p.3).

Distance Education. Distance education is a “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) (International Association for K-12 Online Learning; 2011, p.5). Distance education may be used interchangeably with online learning or virtual education.

Florida Algebra 1 End of Course Exam. According to the Florida Department of Education Florida End-of-Course (EOC) Assessments web page (<http://fcat.fldoe.org/eoc/>), “EOC assessments are computer-based, criterion-referenced assessments that measure the Next Generation Sunshine State Standards for specific courses, as outlined in their course descriptions. The first assessment to begin the transition to end-of-course testing in Florida was the 2011 Algebra 1 EOC Assessment.”

Online Learning. Online learning is “Instruction via a web-based educational delivery system that includes software to provide a structured learning environment. It enhances and expands educational opportunities and may be synchronous or asynchronous. It may be accessed from multiple settings” (Watson et al., 2011, p. 8). Online learning may be used interchangeably with distance education or virtual education.

Traditional Public School. A traditional public school is a brick and mortar school serving students in grades K – 12, in a face-to-face, synchronous setting. Traditional public schools are funded and regulated by state educational agencies, with local oversight provided by an elected board of education.

Virtual Education. Virtual education is “Instruction via a web-based educational delivery system that includes software to provide a structured learning environment. It enhances and expands educational opportunities and may be synchronous or asynchronous. It may be accessed from multiple settings” (Watson et al., 2011, p. 8). Virtual education may be used interchangeably with distance education or online learning.

Virtual School. A virtual school is an educational organization which provides virtual education as defined by Watson et al., (2011) above. Virtual schools may vary in governance and funding, and may be run by state education agencies, single school districts, charter organizations, or for-profit education companies.

Theoretical Framework

The theoretical framework for this study was based upon the concept of scaffolding, as an element of Constructivism. McLoughlin (2002) related scaffolding to Vygotsky's concept of the zone of proximal development, in which learners reach their highest potential if provided with timely and appropriate assistance from another person. Rice (2006) stated that advocates for online learning have argued for shifting the pedagogical conversation from behaviorist to constructivist approaches, taking advantage of the technologically mediated learning tools of virtual education to develop a student-centered, interactive learning experience. In a survey of university-based experts in 13 states, Herring (2004) developed a list of guiding practices promoting a constructivist approach. Key among the findings was the high degree of consensus regarding the changing role of the teacher from content-matter expert to guide and facilitator. As such, the teacher works to create a learning environment that is engaging, relevant, and encourages students to employ higher-order thinking skills and solve problems.

Scaffolding is described as the key concept behind learner support, providing students with temporary assistance in accomplishing tasks (Winnips & McLoughlin, 2001). The goal is to remove the support once students are able to perform independently. Much of the literature surrounding constructivism and virtual education focus on postsecondary settings, and assume a degree of learner motivation and self-regulation much higher than typically observed in K-12 students (Cavanaugh et al., 2009b; Ronsisvalle & Watkins, 2005). Therefore, the types of constructivist supports described tend toward utilization of questioning techniques, modeling, and developing problem-solving scenarios (Herring, 2004; McLoughlin, 2002). The scaffolding

examined in the present study is more direct – frequent and direct teacher communication with students and parents, varying the structure and pacing of coursework based on student needs, and providing supplemental materials or support persons in the form of mentors or tutors.

Research Questions

The following were the research questions which guided this study:

1. What difference, if any, is there in student performance on the Florida Algebra 1 End-of-Course Exam for students who participated in traditional public school settings and those who participated in virtual school instructional settings?

H₀₁ No significant difference exists between the student performance in traditional public schools and virtual schools on the Florida Algebra 1 End-of-Course Exam.

2. What educational interventions are provided to at-risk Algebra 1 students in traditional public school settings versus virtual school instructional settings?

Limitations

This study has the following limitations:

1. Student achievement was measured by the Florida Algebra 1 End-of-Course Exam. The accuracy of student learning data was limited to the validity and reliability of the instrument. Although the test items on the Algebra 1 EOC exam have undergone a thorough review process for item difficulty, cognitive complexity, and potential bias, validity and reliability data are not published (Florida Department of Education, 2012b).
2. Student characteristics such as responsibility, organization, self-regulation, and technology skills have been hypothesized to contribute to success in online coursework by researchers such as Ronsisvalle & Watkins (2005), Roblyer et al., (2008), and others. Due to time and resource constraints, these characteristics were outside the scope of the present study, and their potential impact on achievement may confound the results.
3. Data obtained for this study were provided by the School District of Volusia County Office of Accountability and Evaluation. The study's results were limited by the accuracy and availability of district records.
4. A survey designed to gather information regarding educational interventions was distributed to Algebra 1 teachers in the School District of Volusia County traditional classrooms and teachers in a public online school in the southeast. The accuracy and completeness of the information provided by the respondents may limit the strength of the conclusions which may be drawn about the use and perceived effectiveness of those interventions.

5. None of the students representing the virtual school setting were full-time virtual students, which may limit the generalization of the results.

Delimitations

This study has the following delimitations:

1. The present study was delimited to student achievement on the Florida Algebra 1 End-of-Course Exam. Therefore, the results may not be generalizable to student performance in other virtual courses.
2. The student population for this study was delimited to the School District of Volusia County. The students sampled were not representative of students outside of the district boundaries, and therefore their performance data may not be generalizable to other students in other districts.
3. Student participant information was delimited to demographic characteristics and results on the Florida Algebra 1 EOC. Student in-course performance prior to taking the Algebra 1 EOC and performance in previous mathematics courses was not measured. Therefore, pre-existing student aptitude may have confounded the results.
4. Student and teacher participant samples were not matched. It was not possible to identify which individual students received the educational interventions listed in the teacher surveys. Therefore, the overall relative effectiveness of the educational interventions was delimited to teacher ratings and the student EOC scores.

5. The brief length of time virtual school has been in existence as compared to the length of time traditional schools have been in existence may delimit the results of the study.
6. The large variance in sample sizes between students in traditional school settings and students in virtual school settings may delimit the results of the study.

Overview of Methodology

Research Design

The research design for this study was quantitative. Algebra 1 End of Course (EOC) exam results and basic demographic information were collected for School District of Volusia County students in grades 6-12 enrolled in Algebra 1 courses in traditional brick-and-mortar schools, in a franchise of a public online school in the southeast, or a public online school in the southeast during the 2011-2012 school year. Surveys on educational interventions were provided to Algebra 1 instructors in School District of Volusia County traditional brick-and-mortar schools, in a franchise of a public online school in the southeast, and a public online school in the southeast. Data gathered from EOC exam results were analyzed to determine the variance in mean scale score between traditional brick-and-mortar and virtual education settings. Survey responses were used to compare the educational interventions and support strategies provided to students in each setting, as well as measuring the overall effectiveness rating assigned to each intervention by the teacher respondents.

Selection of Participants

There were two groups of participants in this study. The student population for this study consisted of all School District of Volusia County students in grades 6-12 enrolled in an Algebra 1 course during the 2011-2012 school year in either a traditional School District of Volusia County public school, a public online school in the southeast, or a franchise of a public online school in the southeast. The teacher participants in this study were those assigned to teach grade 6-12 Algebra 1 courses in School District of Volusia County traditional brick-and-mortar schools, a public online school in the southeast, or a franchise of a public online school in the southeast.

Population

The population for this study included 5,716 School District of Volusia County students; 5,623 enrolled in 2011-2012 in an Algebra 1 course in a School District of Volusia County traditional school and 93 enrolled in a public online school in the southeast or a franchise of a public online school in the southeast, who took the Florida Algebra 1 EOC during the spring 2012 administration. All School District of Volusia County teachers assigned to teach Algebra 1 in a traditional classroom or a franchise of a public online school in the southeast, along with a sample of Algebra 1 teachers in a public online school in the southeast as identified by their Instructional Program Managers, were included in the survey. Survey responses were collected from 13 traditional classroom teachers and 16 teachers in a virtual setting.

Data Collection

The researcher presented this research proposal to the Educational Leadership faculty at the University of Central Florida and the Superintendent of the School District of Volusia County. The researcher then submitted the proposal to the Institutional Review Board (IRB) of the University of Central Florida and received approval to proceed with the study (Appendix A). A Research and Permission Request was also submitted to the School District of Volusia County Office of Program Accountability, which granted approval to obtain the relevant student demographic and achievement data and to send a letter via email to School District of Volusia County Algebra 1 teachers inviting them to participate in the web-based survey (Appendix B). The researcher then forwarded a Research Request Proposal to a public online school in the southeast seeking permission to send a letter via email to Algebra 1 teachers inviting them to participate in the web-based survey, which was granted as well (Appendix C).

Dependent Variables

The dependent variable for Research Question 1 of this study was student performance on the Florida Algebra 1 End-of-Course exam as measured by mean scale score and percentage of students achieving a passing score. The dependent variables for Research Question 2 of this study were the educational interventions utilized by teachers in each setting, as well as the mean effectiveness rating assigned by the teachers to each intervention.

Independent Variables

The independent variable for Research Question 1 of this study was student enrollment in traditional or virtual education Algebra 1 courses. The independent variable for Research Question 2 of this study was teacher assignment to teach Algebra 1 in a traditional brick-and-mortar or virtual school setting.

Data Analysis

To answer Research Question 1, a one-sample t-test was used to compare the mean scale scores of the two groups of students (traditional and virtual). Due to the large difference in group size between the traditional and virtual students, the 5,922 students in traditional courses were treated as the population against which the 93 virtual students, who were treated as the sample, was compared to test for achievement differences in the EOC test data. Descriptive statistics were used to analyze responses to the teacher survey and answer Research Question 2. The survey response data were used to compare interventions provided to varied groups of students in each setting, and measure the relative effectiveness of each intervention according to teacher perception.

Organization of the Study

This research study is organized into five chapters. Chapter 1 served as the introduction to the study and included the following: the background of the study, statement of the problem, purpose of the study, significance of the study, definition of terms, theoretical framework, research questions, hypotheses, limitations, delimitations, overview of the methodology, and organization of the study. Chapter 2 contains a review of literature relevant to the subject and purpose of the study. Chapter 3 contains the methodology of the study including: selection of participants, sample, instrumentation, data collection, data analysis, and summary. The results of the study are presented in Chapter 4. A summary of the study, discussion of the findings, implications for practice, and recommendations for future research are presented in Chapter 5.

CHAPTER 2 REVIEW OF LITERATURE

Introduction

The review of related literature presented in this chapter reveals a young and growing field of inquiry in which studies such as this one may play a significant part. K-12 virtual education is a relatively recent phenomenon, growing in popularity and changing rapidly in response to technological advances, demographic shifts, and political forces. The space this research seeks to occupy can be found at the intersection of student achievement, specifically the achievement of student populations deemed to be at-risk for academic failure, and teacher intervention practices supportive of those students' success.

By the early twenty-first century, virtual education in the K-12 setting was an increasingly popular option for students across the United States (Watson, Murin, Vashaw, Gemin, & Rapp, 2011), estimated to account for up to 50% of all course enrollments by 2019 (Christensen & Horn, 2008). Virtual education's popularity was partly due to its many perceived benefits, including personalization (Project Tomorrow Speak Up, 2011; Shoaf, 2007), flexibility (Christensen & Horn, 2008), and ability for learners to take courses not available at their local school (Marsh, Carr-Chellman & Sockman, 2009; Project Tomorrow Speak Up, 2011). At the same time, several challenges inherent in virtual education were addressed in the literature. For example, growth in enrollment and the variety of public and private providers continued to outpace virtual education policy in many states (Watson & North American Council for Online Learning, 2007). Concerns were raised over student achievement, authenticity of student work,

teacher certification and training, and how to provide instruction in art and physical education (Dillon & Tucker, 2011; Ellis, 2008; Glass, 2010; Glass, Welner, & University of Colorado at Boulder, 2011; Holstead et al., 2008; Huerta, d'Etremont & Gonzalez, 2006; Shoaf, 2007; Watson & North American Council for Online Learning, 2007; Watson et al., 2011).

Student achievement has not been shown to be improved or harmed due to participation in virtual education (Cavanaugh et al., 2009b; Glass et al., 2011; Huett et al., 2008; U.S. Department of Education, 2009). With a lack of conclusive evidence of either mode's superiority in raising student achievement, some authors have suggested that future research should focus on examining varying levels of effectiveness among distance education providers and identifying best practices in online education, instead of only comparing virtual school to brick and mortar settings. (Cavanaugh et al., 2009b; Huett et al., 2008). Because students who are often less successful in traditional brick-and-mortar schools find virtual education to be an attractive alternative, Roblyer et al. (2008) argued that research should be done to identify effective interventions to address student risk factors.

Many K-12 students need support to gain independence and proficiency in their learning process. Based on Vygotsky's zone of proximal development, these supports have been described as scaffolding (Vygotsky, 1978, as cited in McLoughlin, 2002; Winnips & McLoughlin, 2001). This refers to the gap between what a student can now do, and what he or she could achieve if timely assistance from another is provided (Kozma & Croninger, 1992; McLoughlin, 2002). Due to the separation between student and teacher in virtual education, a Distancing Effect may occur in which the student feels isolated and disconnected (Russell, 2005;

Wolcott, 1996). Because virtual teachers are unable to utilize visual cues and physical proximity to establish rapport and a sense of community, learner supports for at-risk students in a K-12 virtual setting are especially important (Wolcott, 1996), yet have not been thoroughly studied (Roblyer et al., 2008). This study sought to compare student achievement between traditional face-to-face and virtual settings and to examine interventions utilized by teachers in both settings for at-risk students.

The review of the literature which follows provides a context and rationale for this study, including student achievement in K-12 virtual education, teacher best practices in virtual instruction, and educational interventions/support strategies for at-risk students in the K-12 virtual setting. This chapter is organized into four sections: Historical Overview of K-12 Public Education in the United States, Overview of K-12 Virtual Education, Key Issues in Virtual Education, and Student Achievement in Virtual Education.

Historical Overview of K-12 Public Education in the United States

Beginnings

The American system of public education began in the 1600s in Puritan New England. Although the term “education” originated in 1531, referring to the means of rearing society’s youth, it was not associated with an organized system of institutional schooling until the establishment of colonies of European settlers in what was to become the United States (Marlow-Ferguson, 2002).

Schools were exceedingly important to the early colonists. Not only were schools among the first societal institutions to be established in the colonies, only houses of worship and family homes were considered to be of greater value. The clergy saw formal education as a necessary means of making sure that their religion continued down through the generations. All education was instruction in religion, "...to preserve the Puritan culture and keep all followers homogenous and disciplined" (p. 1491). Early schoolteachers believed that the best method for transmitting common values was a strict adherence to fundamental teachings. Corporal punishment was administered to those who disobeyed, usually in the form of whipping with a lash or causing the student to sit in an ox's yoke (Marlow-Ferguson, 2002).

By 1634, children in Massachusetts began their education around the age of eight and remained in school for six years. In contrast to the English practice of educating only children of the wealthy, Massachusetts also educated children of poor settlers, ministers, and merchants (Marlow-Ferguson, 2002).

From 1638 through the 1660s, institutional education of children experienced tremendous growth. New Haven, Connecticut opened a school as soon as the town was founded, followed quickly by Hartford, Connecticut and Newport, Rhode Island. Not only did the Massachusetts Bay Colony open schools in every town, the schools were supported with buildings, land, and financing. By 1647, the colony began requiring that larger cities have a secondary school. As teachers began to graduate from the newly founded Harvard (established in 1636), the quality of education began to improve. However, as the colonists became wealthier overall, their zest for religious instruction declined and enrollments fell through the 1670s (Marlow-Ferguson, 2002).

Interest in education was renewed, however, during a period known as “The Great Awakening”, in which preachers such as Jonathan Edwards focused the public on spiritual and educational topics. Colonists saw a need for more preachers and the schools required to educate them (Marlow-Ferguson, 2002).

Free schools were an important contribution of colonial America, a concept not found in the European countries from which the settlers came. As schools proliferated, subjects taught were of a practical nature and included arithmetic, languages, and reading. Massachusetts and Connecticut established Latin schools to prepare students for study at Harvard (Marlow-Ferguson, 2002).

While schools continued to open throughout the northern colonies, the southern colonies did not establish or operate many public schools, instead focusing on schools formed on plantations. These schools were run by tutors and educated the children of the wealthy plantation owners, who then sent their children to schools in England. Young men were often expected to return as Anglican ministers. In the early 1700s, immigrants from Germany, Scotland, and Ireland began to flee to America for economic reasons, and more public schools were founded to educate their children. Poor and later-settled colonies such as Georgia, however, struggled to establish and operate even the most rudimentary of schools (Marlow-Ferguson, 2002).

During the American Revolution, education quality suffered due to a lack of access to books and qualified teachers. Many schoolmasters were themselves uneducated, and relied upon heavy-handed corporal punishment to keep students in line. Students were required to memorize

long passages, and discussion was restricted in favor of discipline and silence. After the revolution, education gradually became one of the new country's priorities. Congress reserved land in every township dedicated for public schools. Founders such as James Madison and Thomas Jefferson advocated the establishment of public universities, with Jefferson largely responsible for the founding of the University of Virginia (Marlow-Ferguson, 2002).

Although public schooling began to flourish during the early to middle nineteenth century, wartime would again deal a serious blow. Education, especially in the South, suffered numerous setbacks as monies to support schools were diverted to the war effort and teachers were in short supply. Many schools were shut down altogether. During the post-war Reconstruction, few towns could afford to invest in schools or teachers. Schools established to educate the freed slaves were also poorly financed. Many students needed financial support to stay in school and dropped out (Marlow-Ferguson, 2002).

As the turn of the 20th century drew near and the country's population continued to grow, single-room schoolhouses were replaced with larger elementary and secondary schools. The curriculum offered few choices for students, however, and common curricula began to be adopted by schools within larger geographic regions. Vocational schools for students not planning to attend college began to be established, and an industrial education association was formed in 1884. With the Industrial Revolution came a great demand for a literate workforce with practical training, and the growth of public schools continued to surge (Marlow-Ferguson, 2002).

Perhaps one of the most important visionaries in the early history of American public education, Horace Mann (1796 – 1859) promoted state-run public schools and opposed Calvinist schools. Mann believed that democracy needed to be preserved through educating the citizenry, and common schools were crucial to train the country's young people to become self-sufficient and mold their character. He also championed higher taxes to pay teachers a fair salary, curriculum reform, and improved teacher training colleges (Marlow-Ferguson, 2002).

School governance and organization

Although the U.S. Constitution does not specifically refer to education, a U.S. Office of Education was established in 1867. Education is a responsibility of the states, but in spite of this constitutional reservation, many of the country's founders strongly valued education and promoted its importance. Over the years, through presidential and congressional action, the federal government has had an influence on education. Through targeting federal funds and establishing national goals, major legislation has supported public education, vocational training, and addressed the education of students with special needs. The courts have also influenced education on a national scale, with decisions based on constitutional amendments such as the first, fourth, and fourteenth, on issues ranging from due process, freedom of speech, the prohibition of the establishment of religion in schools, and racial integration (Wickremasinghe, 1991).

The concept of education as a responsibility reserved for the states has led to each of the fifty states developing their own public school systems. States govern and support education

through legislation, the establishment of state departments of education, and taxation. Although guidelines for school operations and curriculum are generally legislated, the state department of education monitors district implementation of these minimum standards. Typically, the authority for operating schools is vested in local school districts, delegated by the state through the department of education. The state department of education is also tasked with the certification of school personnel. Generally, a teaching certificate requires a four year degree from a post-secondary institution and specific training in pedagogy and the academic content areas to be taught (Wickremasinghe, 1991).

Local districts are governed by a board of education, which is usually elected by the citizens of that district. School boards have the primary responsibility for governing local schools, which includes "...hiring of professional and support staff, determining the most appropriate local curriculum, and developing and approving a budget to carry out educational programs..."(p. 861). The school board also hires or appoints a superintendent of schools, who serves as a chief executive officer. School principals perform the administrative duties at the individual school level (Wickremasinghe, 1991).

Schools are typically organized in a pattern of elementary and secondary graded schools. Students move through elementary (kindergarten through grade five or six), middle or junior high (grades six or seven through eight or nine), and high schools (grades nine or ten through 12) in age-group cohorts. Although some variations exist from state to state, education is compulsory until age 16. In general, most school days are from 6-7 hours long and a school year

is usually 180 days, beginning in August or September and ending in late May or early June. This pattern for the school year is grounded in historical tradition (Wickremasinghe, 1991).

Historical roots of Virtual Education

The concept of Virtual Education can be traced back to 1436 and Johann Gutenberg's printing press. With moveable type, information could be reproduced relatively easily and disseminated to a wide audience over great distances. Mass production of books and newspapers made acquisition of knowledge more accessible to greater numbers of people (Rosenberg, 2001). Over the centuries, postal systems were established to deliver printed materials. A growing need for a more educated workforce during the Industrial Revolution, combined with a reliable means of delivery of information, led to the development of what Sumner (2000) describes as the "First Generation" of distance learning, correspondence study. Correspondence courses made education more convenient for adults seeking education while continuing to work, or for many in sparsely populated areas who had limited access to schools (Sumner, 2000). For example, Thomas J. Foster developed correspondence courses for coal miners who sought to learn advanced skills and earn promotions. Foster's work led to the establishment of International Correspondence School (ICS) in Scranton, Pennsylvania (Bower & Hardy, 2004). Essentially, correspondence learning involves the mail delivery of course materials to individual students from an educational institution, with very limited interaction between student and instructor and no interaction among students. By the end of the 19th century, correspondence study was a

firmly established and quite popular form of education, widely used by many institutions of higher learning (Sumner, 2000).

Although correspondence learning at this time was predominantly post-secondary, an early example of K-12 distance education was the University of Nebraska-Lincoln in 1929 (Clark, 2003). This federally funded program of supervised correspondence study was aimed at providing vocational training to students likely to drop out of traditional high schools. The distinguishing characteristic of this model was instead of studying independently at home, students were supervised on-site at the local school (Clark, 2003).

Sumner's (2000) "Second Generation" of distance learning was characterized by the emerging media technologies of film, radio, and television. These new forms of communication continued the advancement towards virtual education. During the 1920s and 1930s, educational radio was used on a limited basis for K-12 instruction (Clark, 2003). As visual media such as film began to be developed as an educational tool, audio-only radio courses were quickly replaced by this new format (Bower & Hardy, 2004). During the lead-up to World War II, the United States military began to use film to educate troops across the globe (Rosenberg, 2001). Commanders were so pleased with the consistency and efficiency provided by educational films, they continued to expand their use of film and eventually, television, for training after the war and are still considered a leading organization in the field of virtual education (Rosenberg, 2001). In the post-war era, television became more widely available and popular. In the 1950s, the Federal Communications Commission (FCC) reserved television network channels for educational use, which led to the creation of a national network of educational stations (Clark,

2003). By the 1970s, educational television programming such as Sesame Street and 3-2-1 contact was being broadcast throughout the country (Clark, 2003). According to Rosenberg (2001), a critical drawback of radio, film, and television as educational technologies was their inherent one-way communication patterns. The learner was a passive recipient of information and has little, if any interaction with an instructor or fellow students (Rosenberg, 2001).

The “Third Generation” of distance learning began with the invention of the personal computer and the development of the World Wide Web (Sumner, 2000). As early as the 1970s, universities and the military began work on projects to connect organizations via computers across the globe (Moore, 2003). For example, the University of Illinois’ PLATO project allowed multiple sites to connect by computer, which demonstrated the possibility of instruction over an electronic network (Moore, 2003). By the 1980s, the National Science Foundation established the NSFNet, consisting of five supercomputers networked to research centers and universities (Moore, 2003). Later that decade, the University of Pennsylvania developed adult education via computer and supplemented by audio conferencing. By the 1990s, the transition from correspondence learning to distance education to virtual education was complete, with many universities offering entire degree programs online (Moore, 2003). In the K-12 setting, early virtual programs also began to appear in the 1990s, with the private California school Laurel Springs cited by Barbour & Reeves (2009) as the first example. Utah’s Electronic High School began in 1994, and Florida opened the Florida Virtual School (FLVS) in 1997 (Christensen & Horn, 2008). K-12 virtual education has seen tremendous growth, in large part due to legislation

promoting the development of charter schools (Barbour & Reeves, 2010), and online education options are now available to students in all fifty states (Rice, 2006).

Overview of K-12 virtual education

Definition of Virtual Education

Virtual school, or virtual education, in a K-12 setting has been defined in various ways by different researchers or governing bodies. Clark (2001) defined a virtual school as “an educational organization that offers K-12 courses through Internet- or Web-based methods.” (p. 1). The U.S. Department of Education (2009) defined virtual education as “Learning that takes place partially or entirely over the Internet” (p. 9). A more expansive definition offered by Watson et al. (2011) includes elements of the two previously cited, in addition to characteristics reflective of current online learning options: “Instruction via a web-based educational delivery system that includes software to provide a structured learning environment. It enhances and expands educational opportunities and may be synchronous or asynchronous. It may be accessed from multiple settings” (p. 8). Because the current state of online education includes an array of modes, formats, providers, curriculum choices and options for students, Watson’s definition serves as the description of virtual schooling for the purposes of the current study.

Expansion and Current Status

Clark (2001) estimated K-12 virtual school enrollment nationwide at between 40,000 and 50,000 students for the 2000-2001 school year. By 2007, that number had grown to between 500,000 and one million students (Watson & North American Council of Online Learning, 2007). Although reliable estimates of current total enrollment in K-12 virtual programs were not readily available, Watson et al. (2011) reported rapid growth in every category of virtual schools. For example, state virtual schools accounted for 536,000 individual course enrollments, a 19% increase over the previous year (Watson et al., 2011). Christensen and Horn (2008) predicted that by 2014 ten percent of all courses would be offered online, increasing to fifty percent by 2019.

Modes of Virtual Instruction

An examination of the literature surrounding virtual education reveals that the online landscape is continually evolving and complicated, including public, private and charter virtual school choices. Various authors have described from five to seven different categories of online education, which fall into one of two main modes; supplemental or full-time (Clark, 2001; Barbour & Reeves, 2009; Glass, 2010; Holstead et al., 2008; Rice, 2006; Watson et al., 2011; Watson, Winograd, Kalmon & North Central Regional Educational Laboratory, 2004).

In addition to his definition of virtual education listed above, Clark (2001) delineated virtual schools into seven categories:

- State-sanctioned, state-level
- College and university-based
- Consortium and regionally-based
- Local education agency-based
- Virtual charter schools
- For-profit providers of curricula, content, tools and infrastructure

Watson et al. (2004) provided a somewhat different classification of virtual schools, which can be summarized as the following five types:

- Statewide supplemental programs
- District-level supplemental programs
- Single-district cyber schools
- Multi-district cyber schools
- Cyber charters

According to Barbour and Reeves (2009), the main difference between classifications offered by Clark (2001) and Watson et al. (2004) is Clark focused on which governing body was responsible for administering the program and Watson et al. (2004) focused on the geographic scope of the virtual school, along with whether students were enrolled full-time or part-time.

Watson et al. (2011, p. 10) listed five major categories of virtual programs that combined the concepts of governance and geographic scope, and included types of schools from both Clark (2001) and Watson et al. (2004):

- Single district programs
- Multi-district full-time schools
- Consortium programs
- State virtual schools
- Programs run by post-secondary institutions

In addition to this list of categories, Watson et al. (2011, p.9) improve upon the previous attempts in the literature to simply list differing types of virtual programs by also providing a set of ten defining dimensions to reflect the many possible combinations of elements that currently characterize virtual schools. A continuum or listing of defining attributes is situated within each dimension.

The ten dimensions are listed below with the attributes for each dimension in parentheses:

- Comprehensiveness (supplemental or full-time)
- Reach (District, multi-district, state, multi-state, national, global)
- Type (District, magnet, contract, charter, private, home)
- Location (School, home, other)
- Delivery (Asynchronous, synchronous)
- Operational control (Local board, consortium, regional authority, university, state, independent vendor)
- Type of instruction (Fully online, blended online & face-to-face, fully face-to-face)
- Grade level (Elementary, middle school, high school)
- Teacher-student interaction (High, moderate, low)
- Student-student interaction (High, moderate, low)

Instead of attempting to delineate distinct boundaries between the governance of public, private, and charter virtual schools, much of the literature details essential differences between the primary modes in which virtual education is delivered, regardless of the type of governance in place. Two main modes of virtual education are described: supplemental and full time (Glass, 2010; Holstead et al., 2008). Supplemental virtual school consists of classes students take to recover a credit for a previously failed course, or classes that are not available in a traditional face-to-face setting. State departments of education or local school districts generally offer these supplemental courses (Holstead et al., 2008).

Holstead et al. (2008) describe full time programs as public charters that are most commonly developed and administered by public school districts, working in partnership with private education service providers. Full time programs were not as prevalent as supplemental programs, but were growing. According to Watson et al. (2011), there were 30 states with full time, multi-district schools with 250,000 students enrolled during the 2010-2011 school year. This represents a 25% increase over just the previous year. As previously described, state-led virtual programs are on the rise, although Watson et al. (2011) describe them as reaching a plateau in enrollment due to uneven state-by-state policies and funding mechanisms. In many state budgets, state-run virtual schools were a line item that was capped at a set amount. This limited the virtual schools' ability to respond to increasing student demand for courses (Watson et al., 2011). By contrast, Florida Virtual School (FLVS) flourished due to a unique funding mechanism enacted by the Florida legislature in 2003 (Tucker, 2009). FLVS was funded on a per-student basis, according to successful course completion. The more students who enrolled in and passed FLVS virtual classes, the more funding FLVS received, allowing it to expand its programs to more flexibly respond to increases in student demand (Tucker, 2009).

Program costs & funding

Due to the wide variety of virtual programs, questions regarding their true cost structures and how to fund them remained difficult to answer (Watson et al., 2011). A typical per-pupil expenditure for virtual schools was \$6,500 distributed into the following cost categories: Teachers and instruction, Curriculum materials, Technology infrastructure, School outreach, and

School office. Different virtual school programs allocated different percentages of their expenditures among each of these categories (Watson et al., 2011).

The level of funding provided by states to virtual school programs also varied, but was typically between \$6,000 and \$7,000 per student per year. Differences among states or regions reflected variance in the cost of living in those areas (Watson et al., 2011).

Four main methods for calculating funding for virtual schools were described by Watson et al. (2011), several of which pose challenges in accurately determining correct funding levels: Average Daily Attendance (ADA) or Average Daily Membership (ADM), Count Days, Size-based, and Funding based on successful completion. ADA and ADM were designed for traditional brick-and-mortar schools and assume a daily head count, which was difficult for virtual schools to document in an asynchronous setting where students complete coursework at night or on weekends. Count Days, in which funding levels were determined based on the number of students enrolled on a given day, posed challenges to virtual schools with rolling enrollment windows or high mobility rates. Size-based funding decreased the per-pupil amount as enrollment increased, assuming an economy of scale which virtual schools do not experience to the degree that brick-and-mortar schools do. Lastly, the funding mechanism described by Watson et al. (2011) that may prove most effective is based on successful completion. Under this model, virtual schools receive funding based on the number of students successfully completing courses. This flexible method allows virtual schools to keep up with growth in student demand and holds them accountable for student achievement at the same time.

Virtual School Teachers

As participation in virtual education continued to grow, greater numbers of educators were making the transition from traditional brick-and-mortar schools to an online setting, or will be recruited directly from teacher preparation programs (Archambault & Crippen, 2009). To describe the population of teachers in online K-12 programs and understand their experiences teaching in a virtual environment, Archambault and Crippen (2009) administered a national survey to those teaching in K-12 virtual school programs in the United States. Of 1,795 surveys distributed, 596 responses were received from teachers in 25 states, including Florida. Results were compared to the National Center for Educational Statistics School and Staffing Survey of the same year. Although similar in most aspects, the areas of difference were full-time versus part-time employment status, amount of teaching experience, and levels of education (actual # in each group) (Archambault & Crippen, 2009). Ninety-one percent of traditional teachers reported working full-time positions, as compared to 54% of online teachers. A greater percentage of virtual teachers (36%) reported working part-time than traditional teachers (3%). Ninety percent of virtual educators reported having four or more years of teaching experience versus 82% of traditional teachers. Online teachers also reported holding advanced degrees at a greater rate, with 62% holding a master's degree as compared to 41% of traditional, brick-and-mortar teachers (Archambault & Crippen, 2009).

One finding which received notice was the large number of students virtual teachers were expected to serve. Responses ranged from none to 2,000 students, although the authors indicated that such a high number was likely due to the respondent also serving as a guidance counselor

and teaching such courses as character development and career exploration, and counting every student with whom she had contact. In spite of the wide range of responses, the themes indicated larger numbers of students in virtual courses than seen in traditional brick-and-mortar classrooms (Archambault & Crippen, 2009). The authors determined that this was due to virtual schools lacking the constraints of physical space found in traditional classrooms, allowing virtual teachers to be asked to teach more students. The higher student-teacher ratios raise concerns over the impact on the quality of instruction (Archambault & Crippen, 2009).

Through open-ended responses, a qualitative profile was also developed by Archambault & Crippen (2009) which described virtual school teachers as:

...those who are seeking a means to engage with students, parents, and content via the Internet in order to meet a variety of needs including a greater sense of community; a better, albeit different, connection with students and parents; and the ability to teach without the constraints of a bell schedule or having to contend with issues of classroom management (p. 382).

DiPietro, Ferdig, Black, and Preston (2008) also found that K-12 virtual teachers possessed skills which were comparable to both traditional brick-and-mortar classroom teachers and post-secondary virtual instructors, but also utilized a skill set unique to the online K-12 setting. Because online instruction lacks the visual cues present in a face-to-face classroom which assist the teacher in identifying when a student is confused, frustrated, or bored, virtual teachers must employ enhanced written presentation skills, virtual classroom management

techniques, and the ability to engage and motivate students through virtual communication skills (Cyr, 1997; DiPietro et al., 2008; Easton, 2003; Holstead et al., 2008).

Easton (2003) investigated the new roles which might be emerging in the delivery of virtual education. Although the study focused on college-level virtual instruction, Easton's findings regarding the shift in the teacher's role from content expert to learning facilitator have been echoed elsewhere in the literature (Edwards, Perry, & Janzen, 2011; Herring, 2004). Due to virtual education's suitability for collaboration among students, the teacher performs social responsibilities such as developing a community of learners, assisting students with group projects, and encouraging a productive, interactive culture (Easton, 2003).

Based on their finding that a large number of virtual teachers had years of experience in traditional classrooms, and that many were teaching in both settings, Archambault and Crippen (2009) asserted that it is logical for teachers with strong backgrounds in content and pedagogy to have an easier time transitioning to online teaching. However, as student enrollment increased, more virtual school teachers may be recruited directly from colleges of education. This had implications for teacher preparation programs and the professional development efforts of virtual schools, which will need to address the use of modern technology tools used to teach in a virtual environment (Archambault & Crippen, 2009).

Archambault and Crippen (2009) concluded their study with a description of virtual educators as:

...a group of motivated, innovative individuals who were eager and willing to learn and valued the opportunities and advantages that online distance education can provide... K-12 online teachers are highly experienced, educated, enthusiastic about teaching online, and on the forefront of the 21st century classrooms of tomorrow (p. 385).

Virtual School Students

In a survey conducted by David B. Glick & Associates, LLC, in cooperation with iNACOL, online students were shown to differ in significant ways from national K-12 population as a whole (Watson, et al., 2011). Although male students outnumbered females in the country's total student population, females accounted for 55% of students in virtual education. Black, Hispanic and Asian students were underrepresented, while White and Native American students were overrepresented. While English Language Learners (ELL) were only 2.3% of the virtual student population, they comprised 11% of the total number of students nationwide. Only 6.2% of online students were classified as special education, as compared to 13.2% of students in the total K-12 population. Students qualifying for free or reduced-price lunch made up 45% of students nationwide, but only accounted for 21.7% of the virtual student population. According to the authors, the survey revealed access and equity issues regarding all students' ability to participate in virtual education programs (Watson et al., 2011).

Florida Virtual School

Florida had the largest number of students enrolled in online courses of any state, due in part to the existence of a wide array of providers of full-time and supplemental virtual options (Tucker, 2009). Florida Virtual School (FLVS), one of those virtual education options, was the largest state virtual school in the country (Tucker, 2009). Originally named “Florida High School”, Florida Virtual School’s motto was “Any time, any place, any path, any pace” Clark (2001). Courses were free to students in state of Florida (Clark, 2001).

In 1995, Florida’s Alachua County and Orange County school districts each began pilot programs to establish Internet-based high school programs. To obtain funding through a state grant, the two districts formed an alliance. This cooperative program between Orange and Alachua school districts began Florida Virtual School (Clark, 2001). The goal was to provide a completely online high school, along with services for students to transition to postsecondary education or the workplace (Clark, 2001). Florida High School, whose staff and students were limited to those in Orange and Alachua counties, launched in 1997 with 77 course enrollments (Clark, 2000; Clark, 2001; Christensen & Horn, 2008). A needs assessment was distributed in 1997 by Florida High School to superintendents throughout the state that revealed strong interest in providing AP courses, especially in rural districts that found it more difficult to offer a full range of AP courses (Clark, 2001). In response, Florida High School offered the five most requested AP courses. In spite of continued enrollment growth, FLVS students’ AP exam pass rates outpaced the national average (Clark, 2001).

Within a few years of opening, Florida Virtual School extended its reach beyond Orange and Alachua counties and experienced a rapid expansion, enrolling 2,800 students in 1999-2000 and 5,900 students in 2000-2001 (Clark, 2001). A \$2.4 million appropriation was made to Florida Virtual School as part of the “One Florida” plan in 2001 to expand college preparatory and Advanced Placement offerings. “One Florida”, agreed upon by the Florida Governor and Board of Regents in 1999, bans college admissions preferences based on race or gender, and provides technology funding to low performing high schools to increase internet connectivity for access to virtual coursework (Clark, 2001).

By 2003, FLVS had grown to over 12,000 individual course enrollments (Tucker, 2009). During the 2006-2007 school year, Florida Virtual School served 52,000 students with 92,000 course enrollments (Christensen & Horn, 2008). By 2008-2009, FLVS grew to 84,000 students completing 168,000 course enrollments (Tucker, 2009), and 259,928 course enrollments were completed in 2011 (Watson et al., 2011).

Florida Virtual School’s funding was provided by a yearly appropriation in the state budget. Due to strong support from former Florida Governor Jeb Bush, the state department of education and legislature, funding grew from \$1.3 million in 1997 to \$6.9 million in 2003 (Tucker, 2009). However, annual appropriations did not keep up with demand, and 8,000 students were on waiting lists in 2002. In 2003, the legislature included FLVS in the state educational financing program, establishing a performance-based funding model based on the number of students successfully completing online courses (Tucker, 2009).

In 2008, the Florida legislature required each school district offer a full-time virtual school option to K-8 students by developing their own program or contracting with an online provider. FLVS responded by partnering with Connections Academy to become a provider of virtual content and administer K-8 programs for Florida districts. This approach allowed FLVS to continue its growth and ensure program quality for districts faced with a lack of resources to develop their own programs or contracting with low-cost, potentially low-quality outside vendors (Tucker, 2009).

Florida Virtual School added a full-time program option in 2011 (FLVS FT) available directly to all K-12 students in Florida. Prior to that, school districts were required to offer students a full-time program through the School District Virtual Instruction Program (VIP) (Watson et al., 2011). Districts met this requirement through contracting with FLVS, establishing a franchise of FLVS, operate an independent program, contract with a state-approved provider, or enter into agreement with other school districts or community colleges (Tucker, 2009). Students began earning high school diplomas through FLVS FT in the 2012-2013 school year (Watson et al., 2011).

Key Issues in Virtual Education

Benefits & challenges

Numerous benefits and challenges inherent in virtual education were cited in the literature. In surveys and focus groups, parents perceived a variety of benefits in virtual education. A report of a national survey by Project Tomorrow Speak Up (2011) listed the following benefits of online learning cited by parents:

- Ability to work at his/her own pace (57%)
- Ability to review the material as many times as he/she wanted (54%)
- Take a class not offered at his/her school (49%)
- Get college credit for an advanced class (38%)
- Increase my child's motivation or engagement in the course material (26%)
- Get more individualized attention from the teacher (17%)

Themes of increased choice and customization were echoed in another study that surveyed parents of the Pennsylvania Virtual Charter School (PAVCS). The researchers found three main reasons for their decision to enroll their children in a virtual charter school: the ability of the charter school to customize based on student need, the parents' ability to try the program without financial penalty but potential benefit, and a disposition of hope inherent in choosing a different option than their traditional public school (Marsh et al., 2009). One finding of particular interest cited by the researchers was that parents who generally represented a conservative worldview were willing to take a non-conservative risk on a new, high-tech school for their children (Marsh et al., 2009).

Administrators also perceive benefits associated with virtual education. The Project Tomorrow Speak Up (2011) survey listed ways in which administrators believe online learning addresses challenges faced by school districts. The percentage of administrators citing each item in 2009 and 2011 is listed below, showing an increase for each:

- Eliminate costs associated with textbooks (14% in 2009, 38% in 2011)
- Keep students engaged in school (34% in 2009, 47% in 2011)
- Provide classes in “hard to staff areas” (18% in 2009, 26% in 2011)
- Provide personalized instruction to students (17% in 2009, 27% in 2011)
- Offer academic remediation to students (23% in 2009, 46% in 2011)

Mirroring the growth of enrollment in virtual education and the increased advocacy at the state and national level, administrators, parents and students support the continued expansion of virtual education as well (Project Tomorrow Speak Up, 2011). In the Project Tomorrow Speak Up (2011) survey, one-third of parents supported greater investments in virtual education at their children’s school, which represented an 80% increase since 2007. The same survey found that 69% of administrators and 50% of middle school students favored making online courses a graduation requirement (Project Tomorrow Speak Up, 2011).

A benefit of virtual education cited by other authors is the potential of providing quality educational opportunities more cost-effectively than traditional, face-to-face schools (Christensen & Horn, 2008; Holstead et al., 2008). Christensen and Horn (2008) asserted that online course costs ranged from \$200 to \$600 per course, which was significantly less than for traditional school. Some virtual program administrators argued that the actual costs to operate a

virtual program were not actually lower, but different (Holstead et al., 2008; Watson et al., 2011). While physical plant and transportation costs associated with traditional schools did not apply to virtual programs, technology, curriculum, and start-up costs were often much higher (Holstead et al., 2008).

Challenges

Along with the many benefits seen in virtual education, some challenges existed as well. Due to the speed at which virtual school options and enrollment were expanding, coupled with an ongoing lack of research on student achievement and instructional best practices along with accountability concerns, authors have advocated for increased oversight and caution in developing sound policy to guide further expansion of the virtual education (Cambre, 2009; Dillon & Tucker, 2011; Ellis, 2008; Glass, 2010; Glass et al., 2011; Holstead et al., 2008; Watson et al., 2011). Concerns have been raised regarding a number of issues: assessing student achievement in virtual school, how to provide instruction in special subjects such as art and physical education, teacher certification requirements, authenticity of student work, calculating the true cost of providing virtual education, the challenge of creating and maintaining a sense of community online, and accreditation of virtual providers (Dillon & Tucker, 2011; Ellis, 2008; Glass, 2010; Glass et al., 2011; Holstead et al., 2008; Huerta, d'Entremont & Gonzalez, 2006; Shoaf, 2007; Watson & North American Council for Online Learning, 2007; Watson et al., 2011).

Another challenge described by Wolcott (1996) and Russell (2005) was the Distancing Effect, or separation between teacher and student in virtual education. This combination of physical and psychological distance may lead to feelings of isolation on the part of the learner.

Virtual teachers lack physical proximity and visual cues available to brick-and-mortar teachers with which to establish rapport and sense of community. To address the Distancing Effect, Wolcott (1996) advocated for the use of learner-centered instructional practices which promote communication, collaboration, and nurture rapport among students and teachers.

Cambre (2009) raised concerns over the public endorsement of religion. In the case of cyber charter schools, students were primarily home-schooled, with content of curriculum accessed through online courses. Due to their classification as charter schools, cyber charters received public funding to operate. Because parents were responsible for facilitating instruction for students enrolled in cyber charters, Cambre (2009) questioned whether the parent is subject to same regulatory oversight as teachers in traditional public schools in matters of religion. If so, parents therefore may not be allowed to alter aspects of the curriculum delivered by the cyber charter to suit their own religious preferences. Certain religious activities were not permitted during instructional time in a public school setting, raising the question of what constitutes instructional time in a cyber charter school. Due to online education's asynchronous delivery model and flexible scheduling to meet student needs, it was difficult to define exactly what constituted instructional time. Each of these considerations raised concerns over privacy rights and accountability (Cambre, 2009).

Teacher Certification / Training Programs / Professional Development

Cyrs (1997) described six areas of competence needed by distance educators: course planning and organization, verbal and non-verbal presentation skills, collaborative teamwork,

questioning strategies, subject matter expertise, and involving students and coordinating their activities at field sites. Although these same skills are required of face-to-face instructors, each area of competence takes on a unique dimension due to the constraints imposed by the distance between teacher and student. Ferrara and Ferrara (2005) cited the critical importance of parental involvement in promoting student success, and the need for teacher education programs to address strategies which overcome barriers to involving parents.

Apart from the unique skills virtual teachers possess and the facilitative roles they play, practical questions were raised over training programs, certification requirements, and ongoing professional development for virtual teachers (Archambault & Crippen, 2009; Holstead et al., 2008; Watson et al., 2011). Teachers may reside in one state while teaching for a virtual school administered in another state, and/or serving students from numerous other states. Because teacher certification is a state responsibility, and not all states have certification reciprocity agreements, it is not always clear which state's certification requirements take precedence (Holstead et al., 2008). The Southern Regional Education Board (SREB) published the Standards for Quality Online Teaching in 2006. The standard for Academic Preparation according to SREB includes a requirement that the teacher has academic credentials in his or her field of teaching or otherwise meets the professional standards established by their state (Southern Regional Education Board, 2006).

Archambault and Crippen (2009) described the need for colleges of education to improve teacher preparation programs to address the unique aspects of online pedagogy, virtual classroom management, and the use of modern technology to deliver content and assess student

proficiency. Recently, university teacher preparation programs in some states have begun to develop certificate programs and continuing education courses focused on K-12 virtual education (Watson et al., 2011). One example offered by Watson et al., (2011) is that of Virtual High School Global Consortium, which has partnered with six institutions of higher learning across the United States to develop and offer graduate credit courses in virtual education best practices.

In addition to requiring initial certification and ongoing professional development, many virtual schools provided mentors for their teachers (Wortman, Cavanaugh, Kennedy, Beldarrain, Letourneau, Zygoris-Coe & North American Council for Online Learning, 2008). Florida Virtual School supports all of its newly hired teachers through a structured mentoring program. Mentors were fellow experienced teachers with a reduced teaching load. New hires were required to complete a training module, then attend a four day face-to-face training session where they began developing skills and forming working relationships with their mentors and other members of their support team (Wortman et al., 2008).

Research on the professional development needs for virtual teachers currently in the field was also cited as critically important (Archambault & Crippen, 2009). One example was a follow-up study to the DiPietro et al., (2008) survey of best practices in online teaching, in which Black, DiPietro, Ferdig and Polling (2009) assessed virtual teachers' perceived professional development needs. Results indicated that online educators believed they would benefit from training focused on technological skills, ways to integrate technology in their content areas, and finding and evaluating resources for their students. Areas of focus for future research advocated

for by Archambault and Crippen (2009) were determining what professional development would be most helpful in the areas of content, pedagogy and instructional technology.

Accountability / Assessment of Program Effectiveness

Efforts to implement accountability systems and determine the effectiveness of virtual programs were complicated by several factors (Watson et al., 2011). A wide variety of providers allowed greater student choice and it was often difficult to identify which entity was ultimately accountable for results (Watson et al., 2011). Student choices vary between full-time virtual schools that provide the content, teachers, and technology, to individual courses sold to school districts by course content publishers, with a variety of options in between. In each of these scenarios, accurately assessing responsibility for student learning is complicated and states were just beginning to develop policies and legislation to address this fact (Watson et al., 2011).

Although virtual schools share many of the same problems with assessing program effectiveness that have been documented with traditional brick-and-mortar schools, Watson et al. (2011) describe some challenges were unique to online education. Online students have a high mobility rate, limiting the accuracy of student assessment that measures groups of students from one year to the next, not the annual growth of individual students. Virtual schools in states that do not measure student growth were at a disadvantage because they often served students who have not been successful in a traditional school setting. In many cases, districts designated a virtual program as imbedded within a traditional school setting or as part of the district as a

whole, making disaggregating achievement data at the virtual school level difficult (Watson et al., 2011).

A number of groups have formed to promote the expansion of online options. Dillon and Tucker (2011) offered the example of former Florida Governor Jeb Bush and former West Virginia Governor Bob Wise, who have partnered to form the Digital Learning Council, one of many influential pro-virtual school advocacy groups. Among their recommendations and policy papers, the Digital Learning Council called for removing restrictions on student access to virtual courses, eliminating seat time requirements, and increasing choices in online providers (Dillon & Tucker, 2011).

As state legislatures enacted laws regarding increased virtual education options for students, large corporate entities such as K12 Inc. and Pearson Education have entered the marketplace, partnering with districts and states to provide these services (Glass, Welner & University of Colorado at Boulder, 2011; Watson et al., 2011). In fact, according to Glass, et al. (2011), a majority of the content sold to full-time virtual schools was produced by only six large companies: K12 Inc., Educational Options Inc., Apex Learning, PLATO, A+LS, and Connections Education. In some cases, these companies take advantage of the lack of state-level regulatory legislation regarding virtual school funding and oversight. In one example, K12 Inc. established a virtual charter school in a rural Virginia county which received a per-pupil funding allocation \$3,500 higher than the state average due to the county's poverty rate. Of the 400 students enrolled in the K12 Inc. charter school, only five actually resided in the county, but K12

Inc. received the higher allocation for all of its students because the charter was headquartered in that county (Glass et al., 2011).

Because charters for public schools were only granted to non-profit organizations in most states, for-profit corporations such as the ones listed previously set up non-profit foundations that were eligible to receive the charter for a virtual school. Once the charter was established, the non-profit would then purchase the services needed to run the school from the for-profit corporation. These services included the courses taught, human resources, the management of student records, and professional development for teachers (Glass et al., 2011). An example of this arrangement was the Pennsylvania Virtual Charter School (PAVCS), which received its curriculum package exclusively from K12 Inc. (Marsh et al., 2009).

Based on numerous funding and accountability difficulties in Pennsylvania regarding cyber charter schools, Huerta et al., (2006) proposed policy recommendations to address these concerns (p. 28, 29):

- Adjust per-pupil funding levels to reflect the real costs of cyber schooling
- Define appropriate state and local mechanisms for holding cyber charter schools accountable
- Define enrollment boundaries and oversight responsibilities to improve accountability
- Provide state-level funding to address the influx of formerly home-schooled students

Student achievement in virtual education

Comparison Studies: Virtual vs. Brick-and-Mortar

There is little evidence that student achievement is improved or harmed by participation in virtual education (Cavanaugh et al., 2009b; Glass et al., 2011; Huett et al., 2008; U.S. Department of Education, 2009). Previous reviews of the literature by Cavanaugh et al., (2009b), Glass et al., (2011) and meta-analyses conducted by Cavanaugh, Gillan, Kromrey, Hess, Blomeyer, & North Central Regional Education Lab (2004) and the U.S. Department of Education (2009) produced two main findings: very few rigorous research studies have been conducted to determine student achievement in the virtual K-12 setting as compared to traditional, brick-and-mortar schools; and those studies which have been conducted show that student achievement was similar in both environments. The 2009 U.S. Department of Education analysis found only five studies that examined virtual schools in the K-12 setting, and concluded that any results showing improved student achievement in a virtual school must be viewed with caution and may be attributable to other factors than the different delivery model. For example, many virtual programs provided more flexible and extended learning time frames than were possible in traditional face-to-face settings. The additional time allowed may account for some differences in student achievement, not the virtual delivery model per se (U.S. Department of Education, 2009).

An example of a student achievement comparison study was conducted by Barbour and Mulcahy (2006). The researchers examined retention rates and achievement on Advanced Placement (AP) exams among brick-and-mortar and virtual students in Newfoundland and

Labrador, which revealed mixed results. Although urban virtual school students and rural brick-and-mortar students completed AP courses and took the AP exam at higher rates than did rural virtual students, those rural students who took the AP exam generally earned higher scores (Barbour & Mulcahy, 2006).

Three studies regarding student performance in virtual Algebra courses are of interest in relation to the current study. Researchers examined differences in student performance on standardized assessments between virtual and brick-and-mortar settings, surveyed students to gauge their perceptions of each type of learning environment, and examined the impact of teacher feedback and student time-on-task. While achievement varied across studies, student perceptions, teacher feedback, student-to-student and student-to-teacher interaction, student characteristics, and student learning behaviors emerged as important factors in the results.

In the first study, Hughes, McLeod, Brown, Maeda, and Choi (2007) conducted a study comparing student performance on Assessment of Algebraic Understanding (AAU) between virtual and brick-and-mortar students, combined with a survey measuring student perceptions of their learning environments. Online students generally outperformed students in traditional brick-and-mortar settings on the AAU test. On the classroom environment survey, virtual students rated Teacher Support more highly, and traditional students rated higher on the Student Cohesiveness, Involvement, and Cooperation subscales. The researchers concluded that the positive results on the AAU indicate that virtual Algebra is a viable option that offers as good or better standards and performance as traditional courses. Important limitations cited by the authors of this study were: few of the virtual students chose to take the optional AAU

assessment, and the participating schools did not require a supervised testing situation. Although it is possible that students could have obtained assistance while completing the test, the researchers did not believe the time limitations of the test would permit it. Another conclusion of the authors based on the survey results was that professional development geared towards increasing student cooperation and interaction in virtual education may be warranted (Hughes et al., 2007).

A second study by O'Dwyer, Carey, and Kleiman (2007) examined an online Algebra program in Louisiana. The program was designed to provide students with an online Algebra course taught by certified teacher when sufficient numbers of certified teachers were not available in their brick-and-mortar school. Students met on a standard schedule in an on-campus computer lab. Students also had access to a computer at home and were able to access the coursework outside of school hours. Two teachers taught the course: an online, certified math teacher and a classroom-based teacher who was not certified in math but was available to monitor and assist as needed. Results indicated that participants performed as well on the post-test as non-participants in a traditional Algebra 1 course. A survey of student participants revealed that while peer-to-peer interactions were roughly equivalent for both groups, the treatment group indicated a desire for greater interaction with the online teacher.

In the third study, Liu and Cavanaugh (2012) conducted a study of Algebra students in a midwestern state virtual school to determine the influence on student achievement of school characteristics such as teacher feedback, and student characteristics such as time spent in the learning management system (LMS) and free or reduced lunch program participation. Teacher

feedback had a significant and positive effect for Algebra students, which the researchers concluded was due to the fact that many online students either were taking the course as their first high school math credit or for remedial credit, and needed teacher support to be successful in either scenario (Liu & Cavanaugh, 2012). Time spent in the LMS also correlated positively with student outcomes. Because virtual teachers are unable to gauge student understanding and engagement through the visual cues available to traditional classroom teachers, the researchers indicated that virtual teachers should monitor student LMS utilization for early warning signs of struggle and possible failure later in the course.

In spite of a lack of rigorous comparative research to date, Huett et al. (2008) and Cavanaugh et al. (2009) proposed that the research agenda move beyond comparisons of virtual school to traditional settings, and focus instead on measuring varying levels of effectiveness among distance education providers and identifying best practices in online education. Due to virtual education's attractiveness to students who are less successful in traditional school settings, Roblyer et al., (2008) argue for research which identified effective interventions which were able to overcome student risk factors.

Instructional Best Practices in Virtual Education

Contrasted with traditional brick-and-mortar classrooms, the nature of online learning promotes student-centered approaches to knowledge construction and requires instructional best practices which support students in this environment. According to Kozma and Croninger (1992), cognitive psychology indicates that the learner creates new knowledge by combining

information around him with knowledge stored in memory as part of a constructive process. Herring (2004) stated “No longer the delivery truck of information, technology can now be a partner in the students’ construction of knowledge” (p. 232). Due to the collaborative yet self-regulated nature of virtual education, with students expected to become more responsible for their learning and emerging technologies supporting an interactive learning environment, Herring (2004) asserted that constructivist principles and online learning are well matched.

An important aspect of constructivist approach is the concept of teacher as a skilled person of influence with power of presence who initiates interaction, models and encourages (Edwards, et al., 2011). Virtual teachers must use different tools and techniques to create a sense of what Edwards et al. (2011) called “Teacher Presence” and promote a positive classroom environment online. Similarly, Cavanaugh et al. (2009a) described highly facilitated interaction, in which virtual teachers employ a wide array of practices aimed at maintaining close contact with students, being responsive to student need, encouraging collaborative learning, fostering student independence and self-regulation, yet intervening when necessary.

In recognition of the need to address standards of quality and identify best practices, the Southern Regional Education Board (SREB) published a series of three documents establishing guidelines for the virtual education community. *Essential Principles of Quality: Guidelines for Web-based Courses for Middle Grades and High School Students* (2001) focuses on three areas of web-based courses: curriculum, instruction, and student assessment; management; and course evaluation. *Essential Principles of High-Quality Online Teaching: Guidelines for Evaluating K-12 Online Teachers* (2003) provides a checklist to assist schools and districts with the selection,

training and evaluation of virtual school teachers. The third document, *Standards for Quality Online Teaching* (2006), addresses specific competencies in teacher academic preparation, technology skills, and teaching methodology. Areas of common emphasis within all three documents include the encouragement of active learning; the facilitation of student interaction, cooperation and community; frequent interactions between teacher, students, and parents; responsiveness to student needs; and development of interventions for unsuccessful learners. In 2010, iNACOL published *National Standards for Quality Online Teaching*, in which fully endorsed and included the SREB standards, with minor revisions.

An examination of teacher practices in a virtual setting was conducted by DiPietro et al., (2008) who studied 16 virtual school teachers from Michigan Virtual School (MVS). Interview and observation notes formed 12 general characteristics, two classroom management strategies, and twenty-three pedagogical strategies. The pedagogical strategies were further subdivided into six categories: Assessing Students, Communication and Community, Meaningful Content, Student Engagement, Student Support, and Technology. The study's authors call for further study of larger and more diverse populations of online teachers to validate their findings and develop recommendations for policy in teacher preparation, certification, and professional development (DiPietro et al., 2008).

In an effort to provide a set of quality guidelines for virtual programs, the International Association for K-12 Online Learning (iNACOL) published *National Standards for Quality Online Programs* (Pape & Wicks, 2009). This document contains standards for “program leadership, instruction, content, support services, and evaluation” (p. 4). Instructional standards

include practices that are adaptable to meeting varying student learning styles; include frequent teacher to student, teacher to parent, and student to student interaction; training in and demonstration of competency in virtual instructional techniques and ability to utilize online learning technology.

Student Characteristics / Predictors of Student Success

Even with excellent teacher preparation programs and the utilization of instructional best practices, the separation between teacher and student makes identifying students at-risk for failure more difficult in a virtual setting than in traditional brick-and-mortar classrooms. Virtual teachers lack the visual cues typically seen in a face-to-face setting which might reveal at-risk indicators such as inattentiveness or apathy (Wang & Newlin, 2002). Instead, factors such as educational background, technological proficiency, internal locus of control, and amount of online activity in a course are described as predictive of likely student success or failure in a virtual course (Wang & Newlin, 2002).

Black, Ferdig and DiPietro (2008) advocated the use of a pre-course assessment to provide support for students identified as at-risk for course failure, such as the Educational Success Prediction Instrument (ESPRI) developed by Roblyer and Marshall (2002). The ESPRI identified students likely to be successful in a virtual school setting, and aided in supporting students interested in taking virtual coursework to become successful. Through interviews with virtual high school (VHS) teachers, nine characteristics thought to be indicative of successful online students were identified and included in the Educational Success Prediction Instrument, or

ESPRI. These included attributes such as locus of control, internal versus external motivation, responsibility, time management, and computer skills. Several cognitive factors were found to combine in the predicted success of virtual students. Due to the fact that students differed on characteristics that potentially could be impacted through intervention such as achievement beliefs, responsibility, organization and technology skills, the researchers concluded that the ESPRI would be useful in identifying and assisting students who might otherwise be at risk for failure in a virtual school setting. The results suggested “three kinds of implications for VHS teachers and programs: precourse counseling, structuring of courses, and support during courses” (p. 252-253).

In a follow-up study, Roblyer et al., (2008) administered an updated version of the ESPRI, the ESPRI-V2, to 4,110 Virtual High School Global Consortium (VHS) students enrolled in 196 courses during Spring 2006. The researchers sought to learn whether a combination of learner attributes and learning environment variables could predict student success in a virtual school setting. Findings indicated that student success could be predicted using this method, although the authors were able to predict success much more accurately than failure. The researchers asserted that because course environmental factors were as important as student characteristics in contributing to success, virtual schools needed to offer support to all students to increase their likelihood of being successful. Through the use of a predictive instrument like the ESPRI or ESPRI-V2, virtual schools could identify students at risk for failure and provide them with individual interventions.

Supports for At-Risk Students

In a K-12 context, many students require support in their learning process as they move towards independence and proficiency. Because the population of students considered at-risk is increasing in virtual schools, research is needed to understand the online experience of these struggling students. Such research will help design supports for at-risk students (Cavanaugh et al., 2009b). These supports have been described as scaffolding, a term which originated with the concept of Vygotsky's zone of proximal development (Vygotsky, 1978, as cited in McLoughlin, 2002; Winnips & McLoughlin, 2001). This refers to the gap between what a student is currently able to do and their optimal development if provided timely assistance by another (Kozma & Croninger, 1992; McLoughlin, 2002). Like physical scaffolds which are put in place temporarily to support builders as they construct buildings, educational scaffolds can be removed as learners build their own skills and no longer need the additional support (Winnips & McLoughlin, 2001). McLoughlin (2002) advocated designing scaffolds in ways that promote student progression from teacher-directed to student-directed learning. According to Frid (2002), students need in-person adult supervision and support. Students receiving encouragement or guidance from an active adult supervisor participated more actively, persisted with difficult problems, and were more responsive to the online tutor.

Watson and the North American Council for Online Learning (2007) described two main types of support – technical & academic. Watson et al. (2009) added a third type of support – administrative. Administrative support dealt with student enrollment and orientation. A pre-course orientation could include surveys to gauge student understanding and readiness for virtual

coursework, and information regarding school policies and performance expectations. Technical support included assistance with accessing course content online and resolving problems with hardware and software through tutorials and online orientation sessions. Academic supports included frequent assessment of student progress, support materials such as student guidebooks, organizing students into study groups, regular contact between teacher, parents, and students, and providing tutoring and counseling services (Watson & North American Council for Online Learning, 2007; Watson et al., 2009).

Archambault, Diamond, Brown, Cavanaugh, Coffey, Foures-Aalbu, Richardson, and Zygoris-Coe (2010) described school-level interventions such as increasing communication between teachers and students/families and identify at-risk students as early in the process as possible. Schools are also encouraged to provide professional development for teachers and other virtual school staff in topics such as classroom management, identifying resources to support struggling students and coordinating services (Archambault et al., 2010). Additionally, ongoing support from teachers, counselors, tutors, and other adults was emphasized by some programs as particularly effective, as well as individualizing supports in one-to-one or small group instruction using tutorials and curriculum scaffolding (Archambault et al., 2010).

Summary

Virtual schools are a rapidly expanding and evolving educational option, especially in the K-12 context. (Watson et al., 2011). The growth seen in virtual school enrollments can be attributed to the perception of students, parents, and administrators that online schooling offers many benefits (Project Tomorrow Speak Up, 2011).

A review of the literature revealed few rigorous studies comparing student performance in virtual school with that of students in traditional, face-to-face settings. Most studies and meta-analyses demonstrated that in those studies, student achievement was not increased or decreased as a result of virtual education alone (Cavanaugh et al., 2009b; Glass et al., 2011; Huett et al., 2008; U.S. Department of Education, 2009).

Limited research had been conducted which compared student achievement between brick-and-mortar and virtual settings, coupled with surveys of student perceptions of their respective learning environments (Hughes et al., 2007; Liu & Cavanaugh, 2012; O'Dwyer et al., 2007). Surveys also have been administered to determine student characteristics associated with success or failure in online coursework (Roblyer et al., 2008; Roblyer & Marshall, 2002). Teachers have been surveyed to develop better understandings of their practices in an online setting (DiPietro et al., 2008).

To date, however, no studies have been located which combine a direct comparison of student achievement between brick-and-mortar and virtual settings with a teacher survey on interventions for at-risk or struggling students. Several researchers, citing the popularity of virtual education among students who have been less successful in traditional settings, advocated

for identifying best practices and effective intervention strategies for at-risk students (Cavanaugh et al., 2009b; Huett, et al., 2008; Roblyer et al., 2008). This study attempted to address an existing gap in the literature by both examining student performance and identifying intervention techniques designed to effectively support at-risk students.

CHAPTER 3 METHODOLOGY

Introduction

This chapter contains a presentation of the methods used to conduct the research for this study. It begins with the problem and the purpose of the study, followed by a description of the participants and data collection. The two research questions and hypotheses used to guide this study are presented, and the chapter concludes with analyses of the data.

Problem Statement

Virtual education options have expanded greatly during the previous decade (Glass et al., 2011; Watson et al., 2011). In spite of its popularity, there is a lack of clear data indicating higher student achievement due to the virtual education setting. Policymakers, encouraged by virtual education providers and education reform activists, seek to find additional opportunities for virtual education to grow (Dillon & Tucker, 2011).

With Florida's mandate that all students complete at least one online course in order to graduate, many students lacking the characteristics predictive of success in virtual education will likely need support as they attempt to meet this requirement (Florida Statute 1003.428, 2011). There is a lack of research indicating the types of interventions utilized in online courses, or their potential effectiveness with at-risk populations. Much of the previous research on virtual education focused on simple comparisons between student achievement in online coursework and traditional schooling (Cavanaugh, et al., 2009b; Huett et al., 2008; Rice, 2006; U.S. Dept of

Ed, 2009). To date, no studies have been located which combine comparisons of student achievement between traditional and virtual classrooms with teacher-reported interventions or supports for student learning.

Purpose of the Study

The purpose of this study was to compare the relative achievement levels of students in traditional and virtual Algebra 1 courses and to identify educational interventions offered by virtual school teachers that may promote student success, especially for at-risk populations.

Participants

The population for this study included 5,716 School District of Volusia County students enrolled in an Algebra 1 course in a School District of Volusia County traditional school, a public online school in the southeast, and a franchise of a public online school in the southeast in 2011-2012 and who took the Florida Algebra 1 EOC during the spring 2012 administration. All School District of Volusia County teachers assigned to teach Algebra 1 in a traditional classroom, in a franchise of a public online school in the southeast, and those in a public online school in the southeast identified by their Instructional Program Managers were included in the survey. Survey responses were collected from 13 School District of Volusia County traditional classroom teachers, and 16 teachers assigned to a public online school in the southeast or a franchise of a public online school in the southeast.

Data Collection

The researcher presented a proposal to the Educational Leadership faculty at the University of Central Florida and the Superintendent of the School District of Volusia County. The researcher then submitted the proposal to the Institutional Review Board (IRB) of the University of Central Florida for approval to proceed with the study. A Research and Permission Request was also submitted to the School District of Volusia County Office of Program Accountability, which granted approval to obtain the relevant student demographic and achievement data and to send a letter via email to Volusia County School District Algebra 1 teachers inviting them to participate in the web-based survey (Appendix B). The researcher then forwarded a Research Request Proposal to a public online school in the southeast seeking permission to send a letter via email to their Algebra 1 teachers inviting them to participate in the web-based survey, which was granted as well. To maintain confidentiality, all identifying information in the student achievement data files was removed by the School District of Volusia County Office of Program Accountability. The web-based teacher survey was also designed to be anonymous and included no identifying information.

Research Questions

Two research questions and hypotheses were developed to guide the research conducted for this study as follows:

1. What difference, if any, is there in student performance on the Florida Algebra 1 End-of-Course Exam for students who participated in traditional public school settings and those who participated in virtual school instructional settings?

H₀₁ No significant difference exists between the student performance in traditional public schools and virtual schools on the Florida Algebra 1 End-of-Course Exam.

2. What educational interventions are provided to at-risk Algebra 1 students in traditional public school settings versus virtual school instructional settings?

Sources of Data

The data obtained through the School District of Volusia County Office of Accountability and Evaluation included student results on the Florida Algebra 1 End-of-Course Exam for School District of Volusia County students enrolled in Algebra 1 courses in a traditional School District of Volusia County public school , a public online school in the southeast or a franchise of a public online school in the southeast and student demographic information including ethnicity, gender, grade level, and socio-economic status. A listing of teachers assigned to teach Algebra 1 courses in School District of Volusia County schools was obtained from the School District of Volusia County Mathematics Specialist for the purposes of distributing the survey invitation to those teachers.

A letter inviting teachers to participate in a web-based survey was distributed in May of 2013 via email to all Algebra 1 teachers in traditional settings in the School District of Volusia County, along with Algebra 1 teachers in the franchise of a public online school in the southeast, and those identified by program managers in the public online school in the southeast. The letter contained instructions and a link to a web-based survey. This researcher was aided in the development of the web survey by Dr. Jeff Reiss of stathelpers.com who built the survey based on the researcher's design and who provided the data generated by the survey to this researcher.

The teacher survey was divided into three sections: Section 1 was a basic questionnaire designed to obtain teacher demographic and experience data, Section 2 was a listing of identified intervention strategies to determine which interventions were used by which category of teacher (traditional versus virtual) with certain groups of students (all, none, identified as at-risk, students who request the assistance, or those performing poorly in the current course), and Section 3 was a repeated listing of the same interventions which teachers were asked to rate for perceived effectiveness using a Likert-style rating scale. Sections 2 and 3 also included blank cells for teachers to provide narrative information on interventions they provided but were not listed on the survey.

The interventions listed on the teacher survey were divided into three main categories: first, Communication, which were strategies related to interaction between the teacher, students, and parents; second, Course Structure/Scheduling, which were strategies related to customizing the learning experience based on the needs of the students; and third, Resources, which included

added supports such as mentors, tutors, and supplemental materials such as tutorial software, videos, or web-based resources.

Data Analysis

To answer the first research question, student achievement data on the 2012 Florida Algebra 1 End-of-Course exam for students in traditional brick-and-mortar classrooms and those enrolled in virtual courses were compared using a one-sample *t*-test. Due the large difference in group size, the 5,619 students in traditional courses with Algebra 1 EOC scale scores were treated as the population against which the 93 virtual students, who were treated as the sample, was compared to test for achievement differences in the EOC test data. Student achievement was measured by mean scale scores, with one-sample *t*-test data and exact significance (p-value) reported. For the purposes of determining student success on the assessment, scale scores were matched to five achievement levels: Level 1 (scale score of 325 – 374), Level 2 (scale score of 375 – 398), Level 3 (scale score 399 – 424), Level 4 (scale score 425 – 436), and Level 5 (scale score 437 – 475). Scale scores at or above Level 3 are considered passing.

For Research Question 2, teacher responses to items in Survey Section 2 and 3 were collected, tabulated, and presented using descriptive statistics. Total numbers of responses to categorical items in Survey Section 2 describing which students receive certain educational interventions were calculated for each teacher type. For Survey Section 3, Teacher Likert-scale survey responses were converted to numerical values ranging from 1 through 5 and matched to each response choice (Almost never effective = 1, Seldom effective = 2, Sometimes effective =

3, Often effective = 4, Almost always effective = 5). Mean effectiveness values and standard deviations were then calculated in two ways. First, the total response value for all items within an intervention type was divided by the number of respondents, providing a mean effectiveness rating for each group of interventions. Second, the mean effectiveness rating for individual educational intervention / support strategies was calculated by dividing the total response value for each item by the number of respondents.

Summary

This chapter contained the methods used to conduct this research study. The chapter began with the problem statement and purpose of the study. The study's participants were briefly described. The research questions and null hypothesis were restated, followed by a description of the procedures used to gather the data for this research. Finally, the chapter contained the statistical procedures used to analyze the data gathered for this study. The results of the data analysis are presented in Chapter 4. Chapter 5 contains a summary of findings, implications for practice, and recommendations for further research.

CHAPTER 4 DATA ANALYSIS

Introduction

This study was conducted to measure what difference if any existed in student performance on Florida's 2012 Algebra 1 End-of-Course (EOC) exam between students in traditional brick-and-mortar classrooms and those in virtual settings, and to determine if differences exist in educational intervention/support strategies utilized by Algebra 1 teachers to assist at-risk students within each setting. This chapter presents an analysis of Algebra 1 EOC data from the 5,716 School District of Volusia County students in Grades 6 through 12 who took the Florida Algebra 1 EOC during the spring 2012 administration, collected from the testing database of the School District of Volusia County, along with survey responses gathered from 29 teacher respondents; 13 in School District of Volusia County traditional brick-and-mortar classrooms and 16 in the virtual setting. This chapter is organized as follows: Introduction, Descriptive Statistics, Testing the Research Questions and Hypothesis, and Summary.

Descriptive Statistics

The student population consisted of 5,623 School District of Volusia County students in grades 6 through 12 enrolled in Algebra 1 during the 2011-2012 school year in a traditional brick-and-mortar class setting and 93 who took the course in a virtual setting. The data gathered for this research did not distinguish between students enrolled in the franchise of a public online school in the southeast or the public online school in the southeast itself, although all students attended a brick-and-mortar School District of Volusia campus at least part-time. None of the student population was a full-time virtual school student.

Table 1 presents the number and percent of students in each setting by demographic category: Gender, English Language Learner (ELL) status, Free or Reduced-price Lunch (FRL) eligibility, and Ethnicity. In the traditional setting, 52.0% of students ($n = 2,924$) were male, as compared to 45.2% of virtual students ($n = 42$). In the traditional setting, 2.1% of students ($n = 117$) were ELL, compared to 3.2% of virtual students ($n = 3$). Students eligible for the Free or Reduced-price Lunch program were a majority in both settings, with 50.5% of traditional ($n = 2,842$) and 55.9% of virtual students ($n = 52$) belonging to this category. In the Ethnicity category, greater percentages of White ($n = 3,402$, 60.5%) and Other ($n = 296$, 5.3%) students are seen in the traditional setting than in virtual courses, while Black ($n = 17$, 18.3%) and Hispanic ($n = 23$, 24.7%) students compose larger percentages of virtual classes than traditional ones.

Table 1

Student Demographics by Algebra 1 Course Setting

Status	Traditional (<i>n</i> = 5,622)		Virtual (<i>n</i> = 93)	
	<i>n</i>	%	<i>n</i>	%
Gender				
Male	2,924	52.0	42	45.2
Female	2,698	48.0	51	54.8
ELL				
No	5,505	97.9	90	96.8
Yes	117	2.1	3	3.2
FRL*				
No	2,781	49.5	41	44.1
Yes	2,842	50.5	52	55.9
Ethnicity				
White	3,403	60.5	52	55.9
Black	853	15.2	17	18.3
Hispanic	1,070	19.0	23	24.7
Other	296	5.3	1	1.1

Note. ELL = English Language Learners. FRL = Free or Reduced-price Lunch eligibility. *N* for FRL Face-to-Face is 5,623.

Table 2 displays the number and percent of students in each Algebra 1 course setting by grade level. In the traditional setting, 0.1% of students ($n = 6$) were enrolled in grades 6 or 7, and no students in the virtual setting were enrolled below grade 8. The grade level with the largest number and percent of students in the traditional setting was grade 10 ($n = 2,379$, 42.3%) and grade 11 ($n = 39$, 41.9%) was the grade with the largest number of students within the virtual setting.

Table 2

Descriptive Statistics for Class Type by Grade Level

Grade	Traditional ($n = 5,622$)		Virtual ($n = 93$)	
	n	%	n	%
Below 8	6	0.1	0	0.0
8	515	9.2	4	4.3
9	1,652	29.4	10	10.8
10	2,379	42.3	25	26.9
11	749	13.3	39	41.9
12	321	5.7	15	16.1

Demographic data were collected from Algebra 1 teacher survey participants through responses to questions in Section 1 of the survey administered as part of this study. The teacher population for the survey administration included 44 teachers in School District of Volusia County traditional brick-and-mortar classrooms, 2 teachers from a franchise of a public online school in the southeast and 80 teachers from a public online school in the southeast. Of those, 13 teachers in the traditional setting and 16 teachers in the virtual setting responded to the survey.

Table 3 presents demographic data collected through Section 1 of the survey. Among survey respondents in the traditional setting, 23.1% were male ($n = 3$) and 76.9% were female ($n = 10$). This compares to 18.8% male ($n = 3$) and 81.3% female ($n = 13$) in the virtual setting. While a greater percent of virtual teachers indicated prior experience with teaching Algebra 1 ($n = 13$, 81.3%) compared to traditional teachers ($n = 9$, 69.2%), the majority of virtual teachers belong to younger age categories ($n = 12$, 75.0% in the 20 – 40 year-old range) and have fewer years of teaching experience ($n = 9$, 56.3% with 5 years experience or less).

Table 3

Teacher Demographics by Algebra 1 Course Setting

Demographic	Traditional (N=13)		Virtual (N=16)	
	N	%	N	%
Gender				
Male	3	23.1	3	18.8
Female	10	76.9	13	81.3
Taught Alg I Prior				
No	4	30.8	3	18.8
Yes	9	69.2	13	81.3
Age				
20-30	1	7.7	6	37.5
31-40	4	30.8	6	37.5
41-50	2	15.4	3	18.8
51-60	6	46.2	1	6.3
Years Experience				
0-5	5	38.5	9	56.3
6-10	3	23.1	5	31.3
11-15	1	7.7	2	12.5
16-20	3	23.1	0	0.0
21+	1	7.7	0	0.0

In addition to teacher demographic data, information was collected regarding the grade levels and number of students taught by teachers in each setting. Table 4 displays the number and percent of teachers who taught Algebra 1 at each grade level during the current (2011-2012) and prior (2010-2011) school years.

Table 4

Grade Levels Taught by Algebra 1 Course Setting

Grade	Traditional (N=13)		Virtual (N=16)	
	N	%	N	%
Grades Taught Current (2011-2012)				
6	0	0.0	6	37.5
7	1	7.7	13	81.3
8	4	30.8	14	87.5
9	9	69.2	14	87.5
10	8	61.5	13	81.3
11	5	38.5	12	75.0
12	0	0.0	12	75.0
Grades Taught Prior (2010-2011)				
6	0	0.0	4	25.0
7	2	15.4	7	43.8
8	3	23.1	10	62.5
9	5	38.5	9	56.3
10	4	30.8	8	50.0
11	2	15.4	9	56.3
12	1	7.7	8	50.0
Did not teach course in prior year	5	38.5	3	18.8

Note. Percentages are calculated for individual items. Respondents were able to select more than one grade level.

Algebra 1 teachers provided data regarding the number of students they were responsible for teaching. Survey respondents were also asked to indicate if they taught students in the other setting during the same school year. For example, teachers who identified themselves as teaching in the traditional setting may have taught one or more classes in a virtual setting. In Table 5, the mean total number of students taught by teachers in traditional and virtual settings during the current and prior school year is presented with standard deviation calculations for each.

Table 5

Mean Total Number of Students Taught by Algebra 1 Course Setting

Category	Traditional (N=13)		Virtual (N=16)	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Traditional Current	24.90	43.13	3.13	9.99
Traditional Prior	25.92	53.30	6.90	24.86
Virtual Current	0.10	0.28	125.30	64.40
Virtual Prior	0.23	0.83	67.40	81.56

Testing the Research Questions and Hypothesis

Student achievement data on the 2012 Florida Algebra 1 End-of-Course exam for students in traditional brick-and-mortar classrooms and those enrolled in virtual courses were compared using a one-sample *t*-test. The 5,919 students in traditional courses with an Algebra 1 EOC scale score were treated as the population against which the 93 virtual students, who were treated as the sample, was compared to test for achievement differences in the EOC test data. Student achievement data for Research Question 1 is presented as mean scale scores, with one-sample *t*-test data and exact significance (*p*-value) reported. For Research Question 2, teacher survey responses are presented in two ways. Categorical responses describing which students receive certain educational interventions are presented using bar graphs which display the total number of responses for each item choice. Likert-scale survey responses describing the teacher-perceived effectiveness of each educational intervention are presented as means (*M*) and standard deviations (*SD*).

Research Question 1

What difference, if any, is there in student performance on the Florida Algebra 1 End-of-Course Exam for students who participated in traditional public school settings and those who participated in virtual school instructional settings?

H_{01} No significant difference exists between the student performance in traditional public schools and virtual schools on the Florida Algebra 1 End-of-Course Exam.

For this question, student achievement on the May 2012 administration of the Florida Algebra 1 End-of-Course Exam was measured by scale scores reported by the Florida Department of Education. Scale Scores range from 325 to 475. For the purposes of determining student success on the assessment, scale scores are matched to five achievement levels: Level 1 (scale score of 325 – 374), Level 2 (scale score of 375 – 398), Level 3 (scale score 399 – 424), Level 4 (scale score 425 – 436), and Level 5 (scale score 437 – 475). Scale scores at or above Level 3 are considered passing. Table 6 presents the mean scale scores for students in virtual and traditional settings. The students in virtual Algebra 1 courses ($n = 93$) earned lower scores ($M = 387.63$, $SD = 28.09$) than those in traditional brick-and-mortar classrooms ($n = 5,619$), who had a mean scale score (μ) of 394.13 with a standard deviation (σ) of 29.13.

Table 6

Descriptive Statistics for t-Test: 2012 Algebra 1 End-of Course (EOC) Scale Scores (N = 93)

Status	M	SD	95% CI	
			LL	UL
Virtual ($n = 93$)	387.63	28.09	381.85	393.42
Traditional ($n = 5,619$)	394.13	29.13	393.37	394.89

Note. $t(92) = -2.23$, $p < .03$. CI = confidence interval, LL = lower limit, UL = upper limit.

The one-sample t -test result is shown in Table 7. The virtual students indicate lower achievement scale scores as compared with the traditional students, $t(92) = -2.23, p = .03$. The probability that the difference between the sample mean of 387.63 and the population mean of 394.13 was due to mere chance rather than an actual difference in achievement is less than 3%. There was a statistically significant difference in the achievement scale score of the virtual students when compared with the traditional population on the one-sample t -test.

Table 7

t-Test: 2012 Algebra 1 End-of-Course (EOC) Scale Scores (N = 93)

					95% CI	
	t	df	p	Difference	LL	UL
EOC Scale Score	-2.23	92	0.028	-6.49	-12.28	-0.71

CI = confidence interval, LL = lower limit, UL = upper limit.

Research Question 2

What educational interventions are provided to at-risk Algebra 1 students in traditional public school settings versus virtual school instructional settings?

Data for this question were gathered through Section 2 and 3 of the teacher survey distributed to teachers in traditional brick-and-mortar and virtual school settings. In Section 2 of the survey, teachers were asked to indicate which category of students received various educational interventions/support strategies in their classes. Educational interventions were grouped into three types: Communication, Course Structure/Scheduling, and Resources. Student categories were listed as: All, None, At-risk, Student Request, and Low Grades. Each student category was briefly described as part of the survey instructions. Teachers were asked to indicate which students received the intervention/support strategy by selecting the category which best described those students. If more than one category applied, teachers were asked to select the choice which corresponded with the largest number of students served, thereby giving respondents a forced choice for each intervention/support strategy.

Overall, teacher responses indicating which interventions they provided to at-risk students did not vary widely between traditional and virtual teachers. On all but two items, response totals were the same or varied by two points or less. Survey item 7 (Teacher establishes firm assignment deadlines embedded within course) and item 11 (Students provided with mentors from community) resulted in the greatest difference between teacher groups. Bar graphs arranged in groups by intervention / support strategy type are presented in Figures 1 through 3.

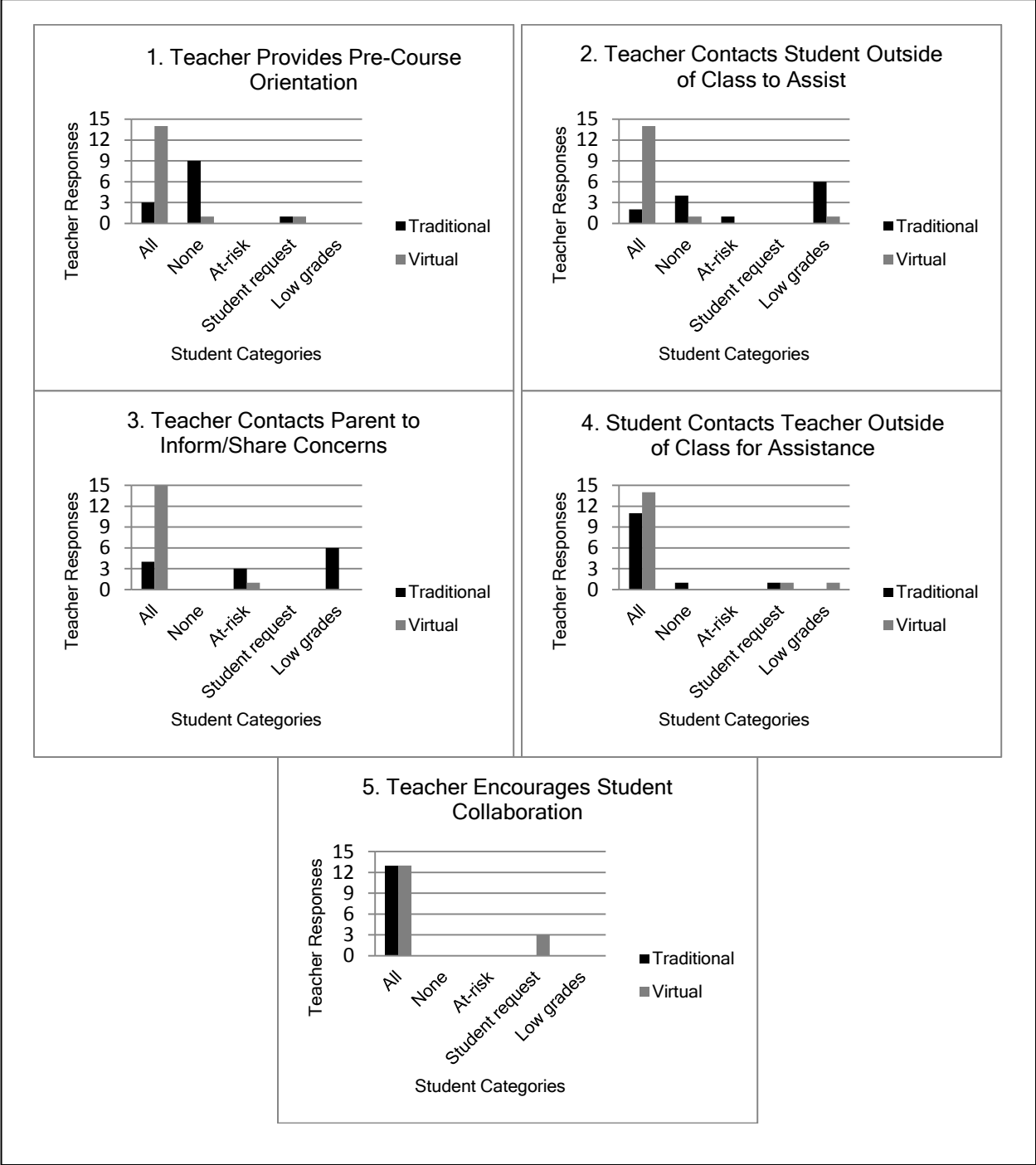


Figure 1. Teacher survey responses from survey Section 2, items 1 through 5, “Communication”.

As shown in Figure 1, interventions/support strategies grouped under Communication are provided to all students by a majority of teachers in virtual settings. The provision of these interventions by traditional teachers is more varied, and in the case of Pre-Course Orientation, a majority of traditional teachers (9 out of 13 respondents) did not provide this intervention to any students. Students were encouraged to collaborate by every teacher respondent in both settings, with the exception of three virtual teachers, who indicated that students receive this support by request.

While teachers in virtual settings appear to provide Communication interventions to most or all students, the responses of teachers in traditional settings show that certain of these interventions/support strategies are provided when students request them or appear to struggle in the course. This is seen in the responses to questions which relate to teachers contacting parents and students outside of class time. Only two traditional brick-and-mortar teachers indicated they contact parents of all students, and four responded that they contact all students outside of class time for encouragement and support.

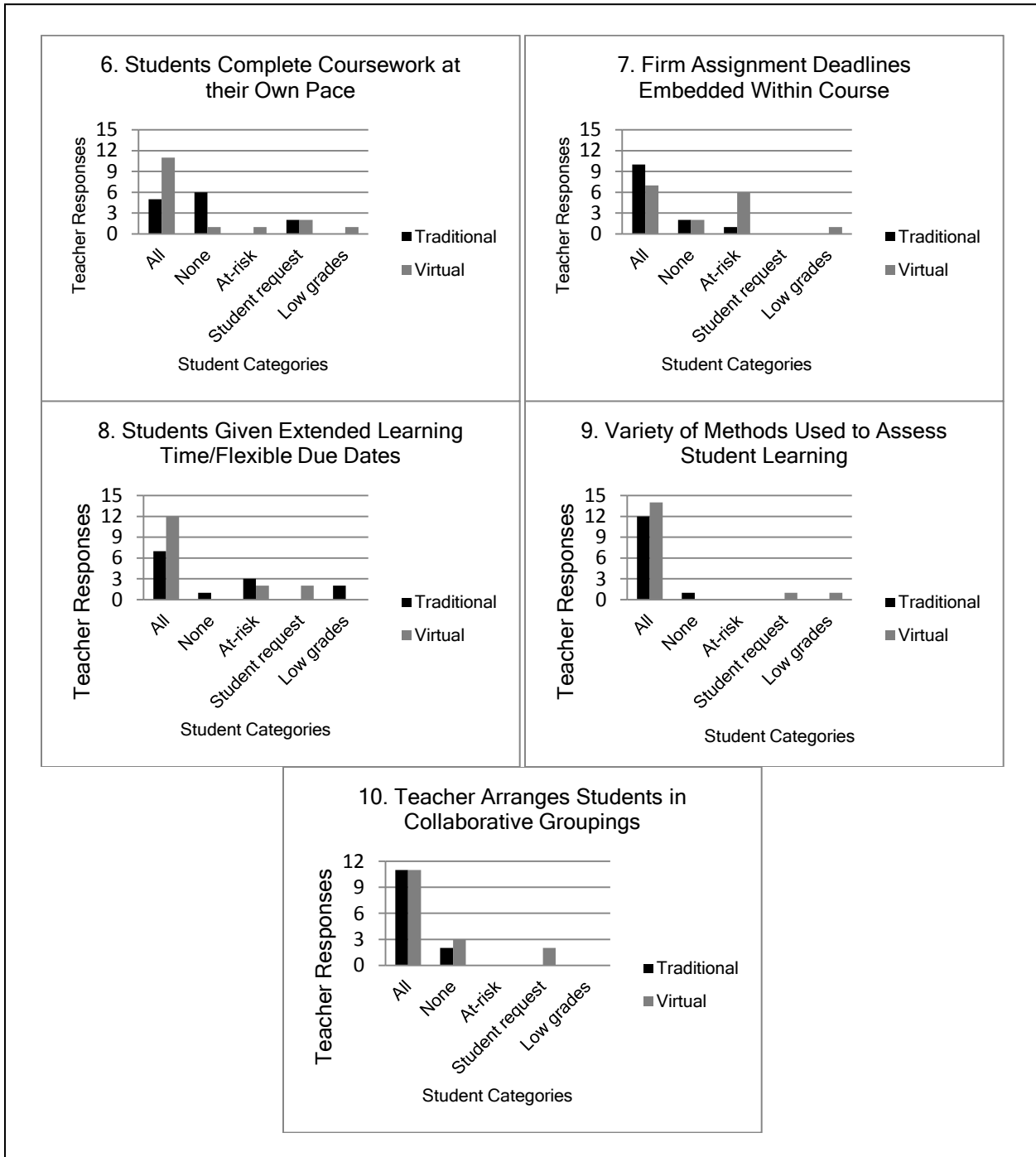


Figure 2. Teacher survey responses from survey Section 2, items 6 through 10, “Course Structure/Scheduling”.

As seen in Figure 2, intervention/support strategies grouped under Course Structure/Scheduling were provided to all students by a majority of virtual teachers. The strategy in survey item 7, Firm Assignment Deadlines Embedded within the Course, was one of only two interventions which showed a wide variance between traditional and virtual teachers in relation to at-risk students. While seven virtual teachers provided the intervention to all students, six indicated they offered it to at-risk students. This compares to ten traditional teachers providing the intervention to all students and one offering it to at-risk students only.

Figure 3 presents survey responses for intervention/support strategies grouped as Resources. The categories of students receiving these supports varied more by intervention than by type of teacher. On survey item 11, Students Provided with Mentors from Community, a majority of teachers in both settings indicated that no students were provided that intervention. Three traditional classroom teachers indicated that at-risk students received the intervention, while no virtual teachers indicated providing that support to at-risk students. Item 11 was the only intervention/support strategy under Resources that varied more than two points between teacher types in relation to at-risk students.

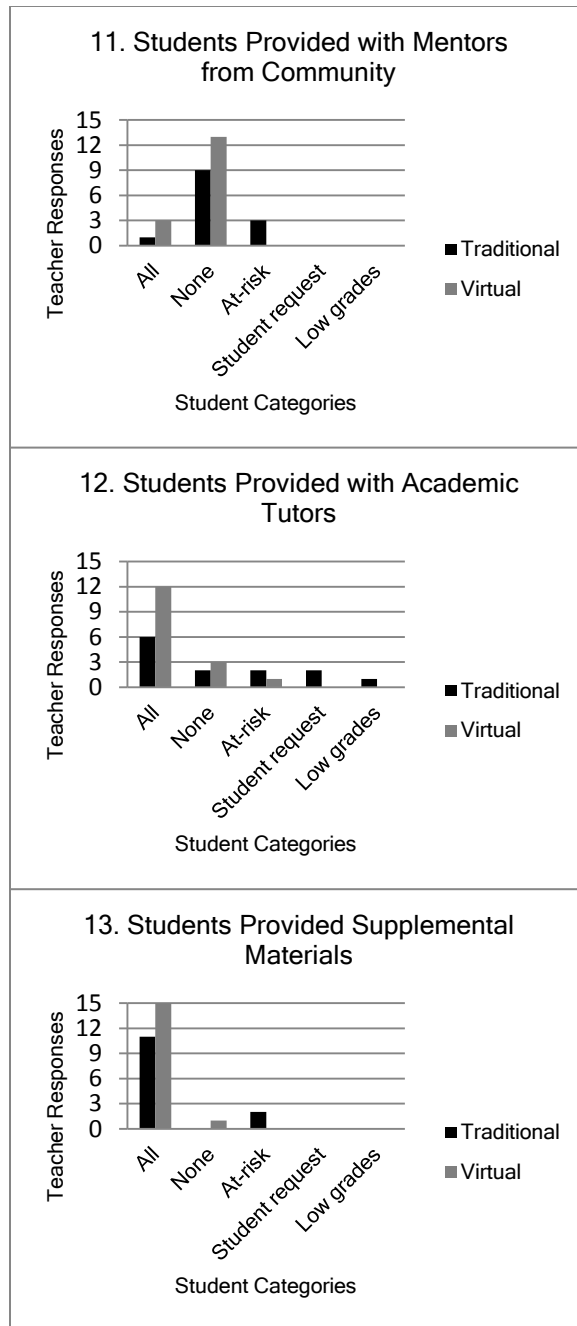


Figure 3. Teacher survey responses from survey Section 2, items 11 through 13, “Resources”.

Other Interventions – Teacher Narrative Responses

Responses from teachers in traditional settings:

- Lunch tutoring
- Tutoring is available at lunches, before and after school with consultation teachers along with the mathematics core teacher
- Peer tutoring, class seating, collaborative groups, less problems to do, good notes, speaking clearly, constant student involvement in the lessons, boardwork, dry erase boards.
- With the ALL category, every student was given access to each of the interventions marked.

Responses from teachers in virtual settings:

- Online tutoring sessions, student work samples
- Students who are struggling with consistent work or understanding information are provided personal tutoring or success plans to help.
- Students are encouraged to call the instructor for questions. Emails are sent out reminding about resources. Resources are also put into the weekly update sent to parents/students.

Figure 4. Teacher narrative responses when asked which educational interventions/support strategies they provided to students not previously listed in the survey.

Teacher respondents were provided the opportunity to list any interventions not included in the survey. All narrative responses received on this item are shown in Figure 4. Responses from teachers in traditional classroom settings include supports such as tutoring, peer support strategies, reducing the number of problems assigned, and tools such as dry erase boards. In the four responses received, tutoring was listed three times, with tutoring offered either at lunch, before or after school; with the classroom teacher, another teacher, or peers mentioned as tutors. One respondent included alternate seating arrangements and peer collaboration. Other supports mentioned by this respondent focused on teacher behavior such as providing good notes and speaking clearly, along with assigning fewer problems, encouraging student involvement in the lesson and using dry erase boards. Responses from teachers in virtual settings include online tutoring, student work samples, encouragement for students to contact the instructor, email reminders about available resources, and weekly updates for parents including information about resources. Tutoring is mentioned twice, with each of the other interventions listed once each.

In Section 3 of the survey, respondents rated the overall effectiveness of the educational interventions/support strategies they provided. For each item, teachers were presented with five response choices: Almost never effective, Seldom effective, Sometimes effective, Often effective, and Almost always effective. Teacher responses were converted to numerical values ranging from 1 through 5 matched to each response choice (Almost never effective = 1, Almost always effective = 5). Mean effectiveness values and standard deviations were then calculated.

Table 8 displays the mean effectiveness of the educational interventions/support strategies grouped by type. The total response value for items within an intervention type was divided by the number of respondents, providing a mean effectiveness rating for each group of interventions. Traditional teachers perceived Course Structure ($M = 16.4, SD = 3.84$) to be most effective, while virtual teachers indicated Communication ($M = 19.4, SD = 3.35$) to be most effective in their setting. The effectiveness ratings given by virtual teachers for all intervention types were higher than those indicated by traditional teachers. Teachers in both settings perceived Resources as the least effective support type.

Table 8

Mean Effectiveness Rating by Educational Intervention/Support Type

Intervention / Support Type	Traditional (N=13)		Virtual (N=16)	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Communication	15.20	3.94	19.40	3.35
Course Structure	16.40	3.84	18.60	3.20
Resources	8.30	3.09	10.50	2.10

The mean effectiveness rating for individual educational intervention/support strategies is presented in Table 9. Traditional brick-and-mortar teachers rated Varied Assessment Methods ($M = 4.1, SD = 0.86$) as the most effective strategy and providing a Mentor as the least effective

($M = 2.5$, $SD = 1.20$). Virtual teachers also identified Mentor as the least effective ($M = 2.9$, $SD = 1.26$), while rating Teacher Contacts Student ($M = 4.2$, $SD = 0.83$) as the most effective educational intervention/support strategy.

Table 9

Mean Effectiveness Rating by Item

Grade	Traditional (N=13)		Virtual (N=16)	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Communication				
Pre-Course Orientation	2.6	0.96	3.4	1.09
Teacher Contacts Student	2.9	1.89	4.2	0.83
Teacher Contacts Parent	3.2	0.83	4.1	0.85
Student Contacts Teacher	3.1	1.26	4.1	0.77
Encourage Collaboration	3.4	0.87	3.8	1.00
Course Structure/Scheduling				
Self-Paced	2.7	0.95	3.8	0.98
Firm Deadlines	3.2	1.21	3.1	1.06
Varied Assessment Methods	4.1	0.86	4.1	0.89
Collaborative Groups	3.5	1.20	3.7	0.95
Extended Learning	3.0	1.00	3.9	0.77
Resources				
Mentor	2.5	1.20	2.9	1.26
Tutors	2.7	1.18	3.7	0.70
Materials	3.2	0.99	3.9	0.77

Effectiveness of Other Interventions – Teacher Narrative Responses

Responses from teachers in traditional settings:

- Lunch tutoring- almost always effective
- Project from the Internet, real world activities, analyzing (dissecting) word problems, making class enjoyable, use of PBS, teacher tube, your tube, Pinterest

Responses from teachers in virtual settings:

- Students are given resources. I wish that I was able to see if they were using them. Often times they tell me they are, but when I ask questions I get the feeling they are not. I would like to be able to share that with parents.

Figure 5. Narrative responses of teachers when asked to indicate the effectiveness of strategies not previously listed in the survey.

Teacher respondents were provided the opportunity to provide an open-ended response at the end of Section 3, in a similar fashion to the final narrative item in Section 2. Teachers were asked to rate the effectiveness of any intervention they listed in their narrative response in Section 2. Figure 5 presents the responses to this item. Of the two responses received from traditional-setting teachers, one response relates to effectiveness, rating lunchtime tutoring as almost always effective. The second traditional teacher listed additional resources without rating them. The one response received from a virtual-setting teacher expressed a desire to know whether students were accessing provided resources, and did not rate the resources' effectiveness.

The teacher responses presented in this chapter varied by intervention type, student category, and course setting. There was little difference in the type of educational intervention / support strategy offered to students classified at-risk, with the exception of two items: survey item 7, Firm Assignment Deadlines Embedded within the Course and survey item 11, Students Provided with Mentors from Community. Teachers in virtual settings provided embedded assignment deadlines in greater numbers to at-risk students, while a larger number of teachers in traditional settings than teachers in virtual settings indicated that mentors were provided to at-risk students.

Summary

This chapter started with a presentation of the analysis of data gathered for this study. An overview of the study's purpose and tables of the population's descriptive statistics were presented. Data gathered to answer the two research questions of this study were presented and analyzed. The results of the one-sample *t*-test performed to compare Algebra 1 End-of-Course achievement of students in traditional classrooms with those in a virtual setting were presented and discussed. Teacher survey results were displayed with accompanying analyses.

Chapter 5 contains a summary of the study, a discussion of the findings and implications for practice, and recommendations for further study.

CHAPTER 5 SUMMARY, DISCUSSION, AND RECOMMENDATIONS

Introduction

This chapter provides an overview of the study, a discussion of its findings, implications for practice, and recommendations for future research. The findings drawn from the data analysis of student achievement and teacher surveys provide a context for suggesting further investigation of educational interventions which can be provided to promote student success in K-12 virtual coursework.

Summary of the Study

This study compared achievement results on the Florida Algebra 1 End of Course exam (EOC) between School District of Volusia County students enrolled in traditional brick-and-mortar and virtual classes, and investigated differences in the educational interventions provided to struggling students by teachers in each setting. A total of 5,716 students were included in this study: 5,622 in traditional classrooms and 93 enrolled in virtual Algebra 1 courses. A total of 29 Algebra 1 teacher respondents participated in a survey on educational interventions: 13 in School District of Volusia County traditional classrooms and 16 in the virtual setting.

A one-sample t-test was used to determine if there was a significant difference in achievement on the Algebra 1 EOC between students in traditional and virtual settings. The students in traditional classrooms were considered the population and students in virtual courses were considered the sample for the one-sample t-test. The results were used to answer Research

Question 1. Algebra 1 teacher responses to a web-based survey were presented using descriptive statistics, which were used to answer Research Question 2.

Discussion of the Findings

The research sought to measure differences in achievement on the Florida Algebra 1 End of Course exam between students in traditional brick-and-mortar and virtual class settings, and to determine if there were differences in the use of intervention strategies for struggling students by teachers in each setting. This section is a discussion of the findings for the two research questions.

Research Question 1

What difference, if any, is there in student performance on the Florida Algebra 1 End-of-Course Exam for students who participated in traditional public school settings and those who participated in virtual school instructional settings?

For Research Question 1, the results of the one-sample t -test indicate a statistically significant difference in achievement in Algebra 1 EOC scores of students enrolled in traditional brick-and-mortar and virtual courses, $t(92) = -2.23, p = .03$. The population mean of 394.13 was greater than the sample mean of 387.63. Due to its small sample size, the results of the current study should be interpreted with caution and not be considered conclusive evidence that students in traditional brick-and-mortar courses outperform their peers in Algebra 1. Prior studies have found a lack of conclusive evidence that students perform better in either traditional or virtual

class settings. (Cavanaugh et al., 2009; Glass, Welner & University of Colorado at Boulder, 2011; Huett et al., 2008; U.S. Department of Education, 2009). Although the achievement data collected for this study did not identify which students were enrolled in an online setting for their Algebra 1 class, all students included in this study attended at least part-time on a School District of Volusia County brick-and-mortar campus. None of the students were full-time virtual school students, and therefore the results cannot be interpreted as typical of students enrolled in virtual school full-time.

The demographic data revealed that the virtual group consisted of those enrolled in higher grade levels, on average, than the traditional classroom students. This may indicate more virtual students attempted Algebra 1 in a previous year, were repeating the course online, and may already be at-risk for failure prior to enrolling in the virtual course. The data collected for this study did not indicate which students were first-time enrollees and which were repeating the course. Also, the virtual group consisted of a higher percentage of ethnic minority students and students eligible for free or reduced-price school lunch, both indicators for being academically at-risk (Cavanaugh et al., 2009b; Roblyer et al., 2008). These findings are supported by previous research, which indicates that research should move from student achievement comparisons to examination of best practices, focusing on at-risk students, and designing appropriate supports for students likely to struggle in an online environment (Cavanaugh et al., 2009b; Huett et al., 2008; Rice, 2006).

Research Question 2

What educational interventions are provided to at-risk Algebra 1 students in traditional public school settings versus virtual school instructional settings?

For Research Question 2, survey responses indicate little variation in educational interventions provided to at-risk students by brick-and-mortar and virtual school Algebra 1 teachers. Teacher responses by setting varied widely on only two support strategies: item 7, Firm Assignment Deadlines Embedded within the Course, and item 11, Students Provided Mentors from Community. On item 7, almost half of the virtual teachers reserved embedded deadlines for at-risk students, while the rest provided it to all students. All but one of the traditional setting teachers provided that strategy for all students, regardless of status. On item 11, a majority of teachers in both settings responded that no students received mentors. Three traditional classroom teachers provided mentors to at-risk students, while no virtual teachers provided this intervention.

Teachers in traditional classrooms rated Course Structure interventions as most effective, with Varied Assessment Methods and Collaborative Groups earning the highest mean effectiveness ratings. Teachers in virtual settings favored Communication strategies, particularly Teacher-Student and Teacher-Parent contact. The low effectiveness ratings given by teachers in both settings to the interventions grouped under the Resources category, including Mentors from the Community, is noteworthy because it runs counter to previous research indicating the particular effectiveness of in-person support from caring adults (Archambault et al., 2010; Frid,

2002). This finding may illustrate the complex and challenging nature of providing in-person supports to students in either learning environment.

Implications for Practice

The findings of this study signal areas for exploration by the School District of Volusia County in the design and implementation of educational interventions for at-risk learners in a virtual classroom setting. The small but statistically significant difference in achievement between students in traditional and virtual Algebra 1 courses point to a need for developing a deeper understanding of the characteristics of students enrolled in the virtual setting, and investigating supports which can address their needs. The following recommendations for practice are offered:

1. Develop a pre-course survey such as the Educational Success Prediction Instrument, or ESPRI (Roblyer & Marshall, 2002) which could be administered by guidance counselors to students who express an interest in registering for virtual coursework. The resulting student profile would assist counselors and instructors in identifying student characteristics indicative of low performance in a virtual course.
2. Create a menu of intervention options for teachers, matched to student need as expressed through the pre-course survey above or student performance during the course.
3. Explore ways to connect virtual school teachers with guidance counselors, administrators, or other appropriate personnel at School District of Volusia County brick-and-mortar sites to share student-specific information and suggestions for supports.

4. Develop strategies for on-site school personnel to provide effective in-person supports such as trained mentors, tutors, and supplemental resources for struggling part-time virtual students, and provide appropriate funding for these strategies.
5. Expand blended-model and hybrid virtual course offerings for challenging, graduation-requirement academic courses which require a passing score on an EOC to earn course credit such as Algebra 1. This recommendation is especially pertinent for students with prior course failure who are retaking the course online. The physical presence of a teacher in the classroom, combined with access to virtual course content, may provide an additional level of support needed by at-risk students in the secondary school level.

Recommendations for Further Research

This study provides a context for future research on student achievement and support strategies for students in virtual education settings. The following recommendations for further research are offered:

1. Conduct a similar study of student achievement and teacher intervention strategies in other virtual courses.
2. Conduct a similar follow-up study of student achievement and teacher intervention strategies in Algebra 1 courses after several years, allowing the virtual program to mature and gain additional participants.
3. Increase the scope of the study to include a larger sample population from other school districts within Florida for comparison.

4. Increase the scope of the study to include sample populations from other states. As virtual education continues to expand, it increasingly crosses state boundaries with students in one state learning from a teacher in another state, with curriculum provided by an enterprise in a third state (Glass, 2011; Holstead et al., 2008).
5. Gather data on student prior performance in mathematics or measures of pre-existing student aptitude and include it in the data analysis.
6. Administer a pre-course survey such as the ESPRI to identify student characteristics associated with virtual course success and include that data in the analysis to control for pre-existing student factors.
7. Conduct separate analyses on student performance for those taking the course and exam for the first time as compared to those with prior failure retaking the course and exam.
8. Conduct separate analyses on student performance for those enrolled in virtual school settings full-time as compared to those enrolled in traditional school settings full time.
9. Match student and teacher participant samples to identify which students received particular interventions, and use pre- and post-test results to measure student achievement gains of each group.
10. Isolate an individual support strategy identified by teachers as particularly effective (Teacher-Student Communication) or ineffective (Mentors from the Community) and measure that strategy's effects on a sample population's actual achievement.

APPENDIX A
INSTITUTIONAL REVIEW BOARD APPROVAL



University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

Approval of Exempt Human Research

From: UCF Institutional Review Board #1
FWA00000351, IRB00001138
To: Paul M. Nehrig
Date: November 07, 2012

Dear Researcher:

On 11/7/2012, the IRB approved the following activity as human participant research that is exempt from regulation:

Type of Review: Exempt Determination
Project Title: A Study of Student Achievement and Educational Intervention Strategies in Virtual and Traditional Format Algebra 1 Courses within Volusia County School District
Investigator: Paul M. Nehrig
IRB Number: SBE-12-08761
Funding Agency:
Grant Title:
Research ID: N/A

This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made and there are questions about whether these changes affect the exempt status of the human research, please contact the IRB. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

In the conduct of this research, you are responsible to follow the requirements of the Investigator Manual.

On behalf of Sophia Dziegielewski, Ph.D., L.C.S.W., UCF IRB Chair, this letter is signed by:

Signature applied by Patria Davis on 11/07/2012 11:04:03 AM EST

A handwritten signature in black ink, appearing to read "Patria Davis".

IRB Coordinator

APPENDIX B
SCHOOL DISTRICT OF VOLUSIA COUNTY APPROVAL TO CONDUCT RESEARCH



Dr. Margaret A. Smith
Superintendent of Schools

P.O. Box 2118 • 200 North Clara Avenue • DeLand, Florida 32721-2118
DeLand (386) 734-7190 Daytona Beach (386) 255-6475 New Smyrna Beach (386) 427-5223 Osteen (386) 860-3322

School Board of Volusia County

Dr. Al Williams, Chairman
Ms. Judy Conte, Vice-Chairman
Mr. Stan Schmidt
Ms. Candace Lankford
Mrs. Diane Smith

October 9, 2012

Mr. Paul M. Nehrig
416 S. Boundary Avenue
DeLand, FL 32720

Mr. Nehrig,

I have received your request to conduct research within Volusia County Schools and approved your topic of "A Comparison of Student Achievement and Intervention Strategies in Virtual and Traditional Algebra I Courses."

As with all requests to do research; participation is at the sole discretion of the principals, teachers and parents of all students involved. Parent Consent Forms will be necessary for all data gathered from the students of Volusia County Schools.

By copy of this letter, you may contact the school principals who allow this research to be conducted with their faculty and students. We request that you conduct your survey with as little disruption to the instruction day as possible.

I would appreciate receiving a copy of your findings upon completion of the study.

Sincerely,

Bambi J. Lockman, LL.D.
Deputy Superintendent, Instructional Services

BJL/mh

APPENDIX C
SURVEY INVITATION LETTER TO TEACHER PARTICIPANTS

May 10, 2013

Dear Algebra 1 Teacher,

You are invited to participate in a research study on Algebra 1 classes taught in traditional brick-and-mortar or virtual education settings. As an Algebra 1 teacher, your perspective is important to this study. The anonymous survey responses will help provide valuable information regarding the educational intervention / support strategies currently in use to support student achievement, and teacher perception of each intervention's effectiveness. This electronic survey should take you approximately 15 minutes to complete.

Participation in this study is voluntary. You may decline to participate without any repercussion. There is no anticipated professional or financial risk associated with completing this survey. The data collected and results of the study may be published in aggregate form, but no individual participants will be identified in any way. Because your survey responses are anonymous, your identity will be protected. Due to this survey's anonymity, follow-up communication and reminders will not be possible, so please complete the survey now. If you delay and neglect to respond prior to 6/5/2013, your input will not be included in the results.

If you have any questions or need additional information, feel free to contact me at pmnehrig@volusia.k12.fl.us or my faculty advisor at the University of Central Florida, Dr. Kenneth Murray, at (407) 823-1468 or at kenneth.murray@ucf.edu. The Institutional Review Board (IRB) oversees all research conducted at the University of Central Florida involving human participants. If you have questions or concerns regarding research participants' rights, please contact the UCF Institutional Review Board Office at:

University of Central Florida Office on Research and Commercialization
12201 Research Parkway
Suite 501
Orlando, FL 32826
(407) 823-3778
(407) 882-3299

Submission of the online survey indicates consent to participate in the study. The link to the survey is: <http://www.surveymethods.com/PN43013/>

Thank you in advance for your assistance with this study.

Sincerely,

Paul M. Nehrig, Doctoral Candidate, University of Central Florida
Assistant Principal, Atlantic High School, Volusia County Schools
pmnehrig@volusia.k12.fl.us
(386) 322-6100

APPENDIX D
TEACHER SURVEY

Educational Interventions in Algebra 1 Courses

Survey Instructions

The following questionnaire is intended to gather information about Algebra 1 teachers and the educational interventions / support strategies provided to students in traditional public school and virtual school Algebra 1 courses.

The questionnaire consists of 38 questions divided between 3 sections. Your responses will be saved whenever you move between sections, and they will be checked to ensure that all required items are answered before proceeding to the next section. This check, however, will not happen if you return to a previously completed section. When you complete and submit the survey, you will no longer be able to modify your responses.

Thank you for participating in this study.

[Begin Survey](#)



Educational Interventions in Algebra 1 Courses (Page 1 of 3)

Section 1 Directions: Please choose the response that best describes you and your teaching assignment by selecting the appropriate option or filling in the requested information.

1. I teach Algebra 1 during the current school year.

- Yes
 No

2. My primary current teaching assignment is in the following setting:

- Traditional public school
 Volusia Virtual School
 Florida Virtual School

3. I taught Algebra 1 during the previous school year.

- Yes
 No

4. I am:

- Female
 Male

5. I teach Algebra 1 during the current school year to the following:

of virtual school students active at any one time, on average: 0
of traditional public school classes: 0

6. I taught Algebra 1 during the previous school year to the following:

of virtual school students active at any one time, on average: 0
of traditional public school classes: 0

7. I belong to the following age group:

- 20-30
 31-40
 41-50
 51-60
 Over 60

8. I currently teach Algebra 1 to students in the following grade level(s) (may mark more than one choice):

- 6
 7
 8
 9
 10
 11
 12
 I am not currently teaching Algebra 1

9. I taught Algebra 1 to students in the following grade level(s) during the previous school year (may mark more than one choice):

- 6
 7
 8
 9
 10
 11
 12
 I did not teach Algebra 1 last year

10. Including the current school year, I have ____ years of experience teaching Algebra 1.

- 0-5
 6-10
 11-15
 16-20
 More than 20

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Educational Interventions in Algebra 1 Courses (Page 2 of 3)

Section 2 Directions: Please indicate which students in your class receive the interventions / support strategies below by selecting the option under the category which best describes those students. If more than one category applies, please select the choice which corresponds with the largest number of students served.

Student Group:

- All = Every student enrolled in the course
- None = No students receive this intervention / support strategy
- At-risk = Students with prior low grades or other characteristics predictive of poor performance
- Student request = Students who seek the help on their own
- Low grades = Students performing poorly during the course

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Communication	All	None	Identified as at risk	Student request	Low grades in course
1. Teacher or school provides pre-course orientation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. Teacher contacts student to encourage or assist (phone/email)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. Teacher contacts parent to inform / share concerns (phone/email)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. Student able to contact teacher outside of class time for help	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. Teacher encourages student-to-student collaboration / assistance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Course Structure / Scheduling	All	None	Identified as at risk	Student request	Low grades in course
6. Students are able to complete coursework at their own pace	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. Teacher establishes firm assignment deadlines embedded within course	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. Teacher uses a variety of methods to assess student learning	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9. Teacher arranges students in collaborative groupings	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10. Students are given extended learning time / flexible due dates	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Resources:	All	None	Identified as at risk	Student request	Low grades in course
11. Students provided with mentors from community	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12. Students provided with academic tutors	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13. Students provided supplemental materials (videos, websites, tutorial software)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Other Educational Interventions: (please list any interventions you provide not previously cited and who receives them)

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Educational Interventions in Algebra 1 Courses (Page 3 of 3)

Section 3 Directions: Please rate the overall effectiveness of the educational interventions / support strategies you utilize by selecting the option under the corresponding rating.

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	Almost never effective	Seldom effective	Sometimes effective	Often effective	Almost always effective
Communication					
1. Teacher or school provides pre-course orientation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. Teacher contacts student to encourage or assist (phone/email)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. Teacher contacts parent to inform / share concerns (phone/email)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. Student able to contact teacher outside of class time for help	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. Teacher encourages student-to-student collaboration / assistance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Course Structure / Scheduling					
6. Students are able to complete coursework at their own pace	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. Teacher establishes firm assignment deadlines embedded within course	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. Teacher uses a variety of methods to assess student learning	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9. Teacher arranges students in collaborative groupings	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10. Students are given extended learning time / flexible due dates	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Resources					
11. Students provided with mentors from community	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12. Students provided with academic tutors	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13. Students provided supplemental materials (videos, websites, tutorial software)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Other Educational Interventions (please rate the interventions you listed in section 2)

[Save and Finish](#)

Thank You!

<https://survey.surveymethods.com/PN43013/Complete.php>

Survey Complete

Thank you once again for choosing to use your time to complete this survey and assist with my dissertation research. If you have any questions, concerns, or comments regarding this survey, or wish to receive final results, please feel free to email me at pmnelson@volusia.k12.fl.us.

Have a great day!

[Return to login page](#)

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