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STUDENT PREFERENCE AND ACADEMIC PERFORMANCE IN TECHNOLOGY-ENRICHED E-LEARNING ENVIRONMENTS: AN EVALUATION OF THE TTeSN VIRTUAL E-SCHOOL NETWORK

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STUDENT PREFERENCE AND ACADEMIC PERFORMANCE IN TECHNOLOGY-ENRICHED E-LEARNING ENVIRONMENTS: AN EVALUATION OF THE TTeSN VIRTUAL E-SCHOOL NETWORK

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Abstract

This evaluation of the Tulsa Technology Center eSchool Network explored two years of empirical evidence where secondary students (*N*=382) took over 500 online virtual e-learning core academic courses in English II and III as well as Geometry and Algebra II. The study examined students' performance in these e-learning platforms by reviewing course completion grades, and the study compared the association of days to complete online virtual courses on earned course grades. The study revealed that there was high variation in the time to completion of virtual e-learning platform courses in comparison to a fixed school calendar. The study further indicated there was no association influence of time spent on a virtual e-learning course and grades earned for the course.

The study also compared performance levels on state mandated end of course exams for students that completed a virtual e-learning course to those that took the same course in a traditional face-to-face format. The findings of the study indicated that students who completed a virtual e-learning course scored at significantly lower proficiency rates on Oklahoma's English II and Algebra II exams when compared to end of course scores of traditionally trained students. Conversely, there was no statistically significant difference noted when conducting the same comparison for English III and Geometry end of course exams.

Lastly, the case study conducted a survey seeking Tulsa area students' feedback about learning platform preferences, and it was found that a larger portion of students indicated a preference for virtual e-learning platforms over the traditional face-to-face school design. The survey responses regarding preference for a customized e-learning platform aligns with the data trends that have emerged throughout the past decade in Oklahoma.

The findings of this evaluation study provide some support for the assertion that virtual and blended e-learning platforms can provide Oklahoma's secondary students with viable and relevant learning options which support expectations for high school graduation as well as support efforts to score proficiently on state mandated tests. Yet, the study demonstrates that for Oklahoma e-platforms to meet their promise and potential, greater attention needs to be paid to how stakeholders ensure that participating students perform on-par academically with their traditional course taking peers.

Key words: Technology enhanced, technology enriched, virtual e-learning, techno-centric, distance education, blended and online learning.

Chapter 1: Introduction

In the past decade, virtual e-learning has come of age. The increased popularity and presence of such opportunities has led researchers and practitioners to pause and decry the lack of research-based frameworks to guide policy, design, and implementation of virtual e-learning programs (McCombs & Vakili, 2005). Traditional school calendar and matriculation policies are being examined with the advent of on-line and virtual learning opportunities that are customized for individual students. The former executive director of the Southern Regional Education Board's Education Technology Cooperative touted during a Oklahoma Legislative hearing that "virtual learning is either the biggest problem facing education today or the biggest opportunity to transform education in our lifetime," and he further noted that virtual learning programs are being integrated into local districts throughout the country, in a movement driven by "demand, economics, competition for students and politics" (Garn, Oklahoma Legislative Interim Study, 2010). However, the challenge moving forward concerns how to design education systems where technology is in service to, values, and supports diverse learners and learning contexts (McCombs, 2000).

Virtual and technology enhanced learning is a growing national trend as evidenced by the "Speak Up" survey in which almost half of the 431,241 Kindergarten through 12th grade students that took part in an online survey indicated that they regularly used videos as part of their homework: either videos they found online or videos created by their teachers (Project Tomorrow, 2014**).** Christensen (2011) boldly projected that over half of all high school courses would be delivered online by 2019, and he cited the work of (Project Tomorrow, 2010) which indicated that 6^{th}-12^{th} grade students strongly preferred to use their own mobile devices and laptop computers for schoolwork and where over 40 percent express that they want and expect unlimited access to the internet while on campus while also being able to access school projects from any computer at home or at school (p. 98). The Aurora Institute (formerly known as iNACOL), America's largest non-profit organization focused on next generation learning models, reported in 2010 that 28 states had virtual charter schools with over 225,000 enrolled students, and the organization stated that over 82% of America's schools offered at least one online course (Patrick, 2010). Other reports counted a total of 311 virtual schools across the nation having enrolled an estimated 200,000 students in 2014 (Huerta & Rice, 2014). Higher education has also noted a marked increase in the number of students taking technologically enhanced virtual learning course work, and the U.S. Department of Education reported in 2018 that there were 6,932,074 students enrolled in distance education courses at degree granting post-secondary institutions (U.S. Department of Education, 2018).

A marked uptick in virtual school delivery is reflected in the more recent National Teacher Pulse Survey (Tyton Partners, 2020) of over 500 K-12 teachers from across 49 different states. It reports that 95 percent of teachers work in schools that are requiring or encouraging remote instruction through a virtual delivery platform, yet over 50 percent of these same teachers indicated that they felt unprepared to deliver the content especially at the elementary level (Mathewson, 2020). As schools across the country plan to re-open during the fall 2020 semester, most are expecting to need more and better remote options as a result of the world wide COVID-19 pandemic. The spread of the virus has forced partial and complete community and school shut-downs in the Spring 2020 semester, and some educators and parents are reflecting that they are not comfortable with returning to a traditional school setting in the Fall of 2020 (Sommers, 2020).

Virtual Learning in Oklahoma

Parallel to the nation's significant enrollment increases in virtual learning platforms over the past decade, Oklahoma found itself in 2018-2019 grappling with a groundswell of students and families that chose to abandon traditional face-to-face school settings to participate in four separate virtual charter school districts (see Figure 1). The Fall 2016 enrollment data retrieved from the Oklahoma State Virtual Charter School Board (OSVCB) website indicated there were 13,166 total statewide students being served in 4 separate virtual charter districts, yet the same website indicated exponential growth of one virtual charter school as its' 2018 enrollment of over 13,000 students eclipsed the total statewide 2016 enrollment numbers (OSVCB, 2019).

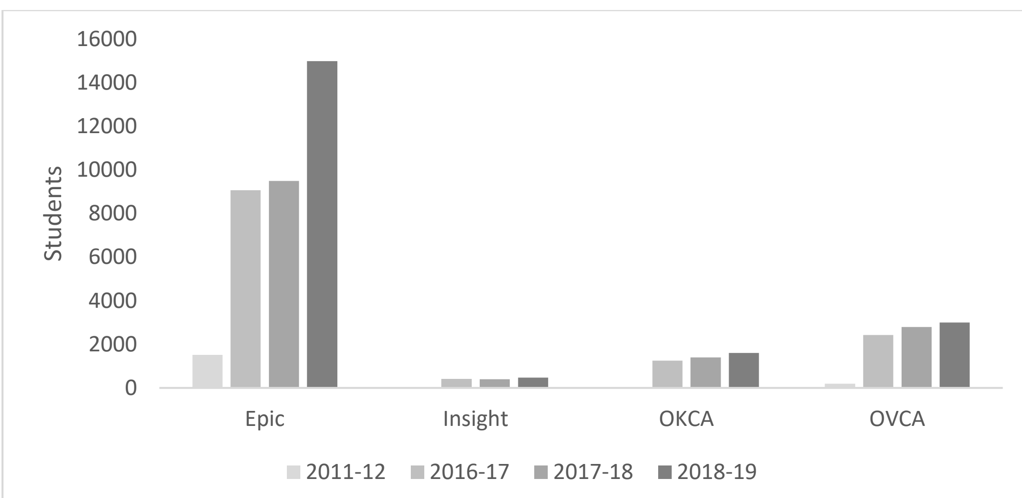

Figure 1. *Oklahoma Virtual Charter School Enrollment Growth.*

The unprecedented growth of one Oklahoma virtual charter school, EPIC Charter Schools, brought media attention as well as investigative allegations of fraudulent enrollment practices from state and federal law enforcement and accreditation agencies

(Eager, A., February 27, 2019). Consequently, the Cooperative Council for Oklahoma School Administration (CCOSA) convened a group of stakeholders to help design a strategic initiative for virtual e-learning called "Blended Learning Framework-CCOSA's Student-centered Solution for Blended and Virtual Learning" (CCOSA, 2019). The framework provided local public school leaders with a set of recommended guidelines that include governing policies and distinguishing characteristics of virtual e-learning which promote that highly qualified teachers drive the instruction and design the activities that supplement online coursework as opposed to relying on vendors to provide curricular content. Additionally, the CCOSA report recommended that students are offered a place to work and participate in extracurricular activities along with being able to take advantage of nutritional and counseling services from qualified professionals. The CCOSA framework highlights the importance of students taking advantage of local school support services that are characterized as blended virtual e-learning whereby they go onsite when they are struggling to master content while also being able to be a contributor to controlling the time, pace, and place of their learning. Ultimately, CCOSA's framework promotes a benchmark of full transparency related to attendance, and more importantly the introspection of financial expenditures of the district (CCOSA, 2019).

Statement of the Problem

The concept of innovation has been tied to the push for school choice, which has driven legislation and the advent of virtual charter schools in Oklahoma. Critics of traditional public schooling have played upon the idea that governance by districts stifles creativity and entrepreneurial ingenuity in schools, and such critiques note that a traditional public education neglects the needs of diverse communities and individual learners. Some scholars have boldly declared that existing schools and "institutions cannot solve the problem because they are the problem," and they further suggest that the "key to better schools is institutional reform" (Chubb & Moe, 1990, p. 3).

National best-selling book authors have echoed the claim that America's schools struggle as a result of poor design (Christensen, Horn, & Johnson, 2011). They contrast *monolithic technology,* or having a single instructional style designed for all students, with a *student-centric technology,* or a school design characterized by instruction tailored for individual students. *Student-centric technology* is broadly defined by Christensen as "the process by which an organization transforms inputs of labor, capital, materials, and information into products and services of greater value in an effort to customize how students learn" (p. 11). A teacher lecturing to a classroom of students from the same textbook is the most common form of a monolithic technological design. An individual tutor would be a form of student-centric technology. Christensen's (2011) acclaimed book *Disrupting Class* outlined the difference between simply placing computers in schools and the disruptive innovation that can take place when a student-centric model of school design is powered by a computer and online learning. He advocated using technology-enriched virtual e-learning as a mechanism for achieving student-centric learning and asserted that the very nature of software integrates achievement with the delivery of content in ways that help students feel successful while they learn (Christensen, 2011).

Contemporary thought leaders remind that the dominant approach to K-12 learning notably lacks needed differentiation and expects students to progress at the same time through the same content, regardless of their starting points or individual needs (Patrick, Truong, & Chambers, 2020). These researchers refer to the traditional face-to-face learning model as "outdated," and they highlight that educators are rapidly learning how to teach with the use of more personalized approaches such as online virtual delivery. Ultimately, they promote that policymakers can create enabling conditions and remove barriers that may inhibit these powerful innovations from taking hold at scale (p.1).

Advocates for innovation also propose that education should be organized under competitive models to nurture new and different instructional approaches, resulting in a range of alternatives for families (Lubienski, 2008). Innovation has often been cited as a reason to embrace school choice; however, the autonomy and competitive incentives proposed in innovative school choice designs can also lead to unanticipated consequences such as race and class inequities in access, opportunity to learn, and achievement. It is possible that competition can ramp effectiveness in schools and provide quality options for students for underserved students, but "it is also entirely possible that it might do precisely the reverse; competition might result in schools pursuing more effective marketing campaigns to attract already advantaged students" (Lubienski, 2008, p. 18).

The next decade holds much promise for changing "what gets done and where" as the model for learning shifts to a hybrid/virtual learning environment from the traditional face-to-face framework (Collins & Halverson, 2009). Traditional school models are managed such that learning content is delivered in class via the expertise of the instructor and practice and assessment is conducted at home. The traditional school model is in contrast to the *technologically enriched e-learning model* where content is delivered online and practice and assessment are conducted in class under the tutorial expertise of the instructor.

Expanding technology integration in school settings can also be described as a *techno-centric* model which is characterized as an approach to teaching and learning where computers become the vehicles for solving many of the problems in education (Picciano, 2011). A purely techno-centric school model would predict the rapid obsolescence of teachers, whose jobs could be done better by technology (Perelman, 1992). Yet, like all tools, the value of computers and other forms of technology varies depending on who uses them and how they are used. Perelman (1992) suggests that administrators should adopt technology integrated learning as enhanced instruction as opposed to exclusive techno-centric instruction: "Administrators should be supporting and developing teachers to capture and harness the power of technology so as to integrate it with other teaching and learning activities" (Picciano, 2011, p. 38).

Virtual learning got a "test drive" throughout the country in the Spring of 2020 as a result of the COVID-19 pandemic, and plenty of parents, teachers, and students came away with less than stellar experiences (Sommers, 2020). Sommers posits that remote and virtual learning is not just a digital version of traditional face-to-face instruction because parents, teachers, and students play different roles in each learning setting and whereby student ownership of their learning is essential; teacher instructional practices need to be reconsidered and reworked (p .2). As evident from the challenges and issues that plague the current e-learning landscape, much still remains to be understood about the effects of virtual learning platforms, particularly the virtual charter schools which have been burgeoning and operating in the State of Oklahoma.

Study Context and Purpose

In 2001, Tulsa Technology Center pioneered an effort to promote virtual learning opportunities—an effort that, as it turned out, would be nearly a decade ahead of its time in Oklahoma. The Tulsa Technology Center continued to provide technology integrated professional development activities related to virtual e-learning up until 2005 when virtual e-School programming was idled as a result of low student participation. After a brief hiatus, the original e-School project morphed in 2009 into a consortium dubbed the "Tulsa Tech eSchool Network" (TTeSN). The consortium preceded the state of Oklahoma's 2011 mandate that required public schools to provide virtual learning opportunities for their students. Following this legislative session, Oklahoma's State Department of Education also promulgated a set of rules related to virtual learning. At this time, the State department mandated that public schools provide virtual learning opportunities for all K-12th grade students, yet there were no financial supports for the mandate, and minimal professional guidance was provided to school leaders to design or deliver such virtual learning opportunities. Today, Oklahoma state school law requires that all school boards adopt a policy allowing students opportunities for up to five hours of online instruction when "appropriate" (Oklahoma Statue 70§1-111), however early on after this law was enacted, there were no templates or frameworks established to guide school boards in policy development related to virtual learning.

The TTeSN was an outgrowth of a year-long task force formed among 21 area schools that focused not only on impending legislation related to virtual learning, but also on the innovations of virtual e-learning. The interest and growth of public and private high school students accessing virtual e-learning courses under the direction of the

TTeSN doubled in size since the 2009-2010 school year: 380 distinctive students in 2009 compared to over 780 in 2018-19. Yet, even with this growth, there have been no studies of how the TTeSN has been performing in comparison to traditional schools and if the innovative practices they have put in place are resulting in improved performance and experiences for students.

Thus, the purpose of this study was to evaluate outcomes of the TTeSN virtual e-school which has been operational now for more than a decade. It is intended to shed light on important questions that are critical to understanding the potential of virtual schools as options for high school students. It is hoped that the study might provide secondary school leaders with additional insights as they consider the proposition that high school students working in virtual e-learning conditions may prefer and perform differently in virtual schools compared to students in a traditional monolithic learning environment. The hypothesis and conceptual supposition of this program review is that when students are involved in technology enriched e-learning activities that are tailored to meet individualized learning needs, and when electronic access to learning content and activities can take place any time and any place, they will prefer the e-learning model and demonstrate similar levels of academic performance to their peers who have participated in traditional learning settings. The following questions framed the evaluation study:

1. Do students in a virtual e-learning courses prefer these learning experiences over their previous traditional school setting experiences?
2. Is there a difference in course completion rates in e-learning learning platforms compared to traditional face-to face approaches?

3. Is the number of days spent on completing e-learning courses related to performance levels on end of course grades?
4. Do students perform at similar levels on state instructional exams after completing an e-learning course as their peers who have completed the same course content in a traditional school setting?

This program evaluation study examines high school students who completed a technology-enriched e-learning academic course in English 10, English 11, Geometry and 2nd year Algebra. Data sources analyzed to answer the study's research questions were: (1) student survey preferences related to traditional face-to-face learning design compared to experiences in a technology-enriched e-learning platform, (2) empirical and historical evidence for end of course grades (A-F) and the number of days spent to complete e-learning courses, and (3) student performance on Oklahoma state mandated end of instruction (EOI) exams after taking an academic course that was delivered in an online virtual e-learning format.

Conceptual Terms and Definitions

There are varied uses of terms used to throughout the literature to describe learning platforms that are enhanced and supported by technology. Distance Education is a broad U.S. Department of Education categorical term that is found throughout the literature (NWCCU, 2013):

> Distance Education uses one or more of the technologies listed below to deliver instruction to students who are separated from the instructor and to support regular and substantive interaction between the students and the instructor, either synchronously or asynchronously. The technologies may include-- (1) The

internet; (2) One-way and two-way transmissions through open broadcast, closed circuit, cable, microwave, broadband lines, fiber optics, satellite, or wireless communications devices; (3) Audio conferencing; or (4) Video cassettes, DVDs, and CD-ROMs, if the cassettes, DVDs, or CD-ROMs are used in a course in conjunction with any of the technologies listed in paragraphs (1) through (3).

The terms virtual learning, e-learning, blended learning, technology-enhanced learning and varied models of operational design within each of these platforms often blur the distinctive conditions of the learning platforms and designs. The California Learning Resource Network (CLRN) partnered with the Evergreen Education Group to create descriptors to help provide consistency and understanding of terms. The following definitions provide context and an overview of the terms used throughout this research report: (Bridges, 2014, p. 4):

Full-Time Virtual School. Students take all their courses online away from school. Students do not visit a physical campus, except on a limited basis. Also referred to as "Online Learning."

Blended Online Learning. Online learning that typically takes place at school, where students have some control over time, place, path, and/or pace.

E-Learning. Refers to any form of virtual, online, or blended learning.

Rotation Model. Students rotate on a fixed schedule between learning online and learning from a face-to-face teacher. Rotation includes teachers who "Flip" their individual class where part of the content is provided in an e-learning delivery, and then support and follow up is provided in face-to-face follow up.

Flex Model. Students take a majority of their courses online at school in an individually customized fluid schedule and on-site teachers or paraprofessionals provide support.

Enriched Virtual Model. Independent study students take all their online courses at home but visit a physical campus to meet with a teacher.

What is not Virtual or Blended Learning. Participation in supplemental electronic activities or technology–rich activities that don't fit the previous descriptors.

Study Significance

In a 2019 report commissioned by the Cooperative Council for Oklahoma School Administration (CCOSA, 2019), the Executive Director extolled the benefits of blended and fully-virtual e-learning technology to expand educational opportunities claiming that these models reshape, adapt, and evolve in response to the need to create more student-centered learning environments. However, she also reports having concerns with the proliferation of for-profit virtual charter schools with respect to inclusiveness and student learning. She cites a 2018 National Education Policy Center report that claims virtual education's best chance of success will likely be through implementation within a traditional community school framework (Dearing, 2019). Providing such learning options mirrors the innovations promoted by the Aurora Institute, (formerly known as International Association of OnLine Learning iNACOL) in an effort to meet growing workforce training demands. iNACOL reported that 30 percent of today's employers use e-learning for training their workforce (Patrick, 2009).

Annual research on primary and secondary virtual schooling has been undertaken by the National Education Policy Center (NEPC) and Western Michigan University since

2012-13. The NEPC has been examining the nation-wide expansion, the demographics of students served as well as the school performance of full-time virtual and blended learning models. Yet, the scholars qualify that their research has focused largely on legally-defined individual schools to the exclusion of programs that are housed in traditional brick-and-mortar schools or in districts. They urge scholars to do more research on the outcomes of virtual and blended programs (Miron, Shank & Davidson, 2018). This study hopes to contribute to the national discourse on the benefits and challenges of virtual learning.

The National Center for Educational Studies reported that in 2002, roughly 220,000 K-12 students took an online course, and by 2010 the NCES estimated over 1.8 million K-12 U.S. students were engaged in online and blended learning (Aud et al., 2012). The 2011 Oklahoma Legislative session mandated that public schools adopt policies allowing students up to five hours of virtual instruction, yet, presently there are no current studies or reports throughout the literature on the effectiveness of virtual e-learning designs that have been implemented in the state of Oklahoma. This study, it is hoped, will shed important light on the successes and challenges of one of Oklahoma's largest virtual learning programs, which can help shape future policy and practice improvements of benefit to the students and families of Oklahoma.

Chapter 2: Literature Review

This review is divided into five primary sections: (1) industry trends and strategies for improving virtual e-learning outcomes, (2) findings from empirical research reports about learning outcomes from student-centric design as well as research related to the structure and learning settings of technology-enriched virtual learning models, (3) designing a framework for technology enhanced learning in Oklahoma's public schools, (4) Findings on the outcomes of Oklahoma's statewide virtual charter schools, and (5) a conceptual framework which advances a theory of action grounded in empirical research on the mediating conditions and effects on learning outcomes in virtual online settings. Four separate meta-analysis research reports were selected to give a historical perspective to the linkages of technology-enhanced learning platforms compared to traditional learning models.

Industry Trends and Strategies for Improving Virtual e-Learning Outcomes

The US Department of Education (2010) drafted the National Education Technology Plan which outlines an education model for the 21st century focusing on five essential areas: learning, assessment, teaching, infrastructure, and productivity. The plan endorses the view that a global economy dictates what learners need to know. Online learning platforms are beginning to proliferate throughout the country. Online student enrollments in higher education are growing faster than overall enrollments (17 percent for online versus 1.2 percent overall). Additionally, more than 25 percent of higher education students now take at least one course in an online format (Allen & Seaman, 2010). The growth seen in the K-12 market is even more dramatic according to iNACOL, the International Association for K-12 Online Learning. In 2008, thirty states and over half of the U.S. school districts provided online offerings for students with an estimated annual growth of 30 percent expected (Watson, 2008). California's State Department of Education, counted 174,632 virtual and blended students in 2013-14. This was a 39 percent increase since the previous year's survey census which further revealed that the State's full time virtual student population remained relatively stable since 2012, but the number of blended students increased by 49 percent since 2013 and by 74 percent since 2012 (Bridges, 2014).

The NEPC reported (see Figure 2) there were fewer than 20,000 students across the nation participating in full-time virtual school models in the early decade of 2000 (Miron & Urschel, 2012). The same research center noted there were 278,000 student enrollments in 2015-16 (Molnar et al., 2017) and the center's research relayed that the number of students in full-time virtual school settings in 2017-18 school year rose to 297,712 along with another 132,960 students participating in blended school settings (Molnar et al., 2019).

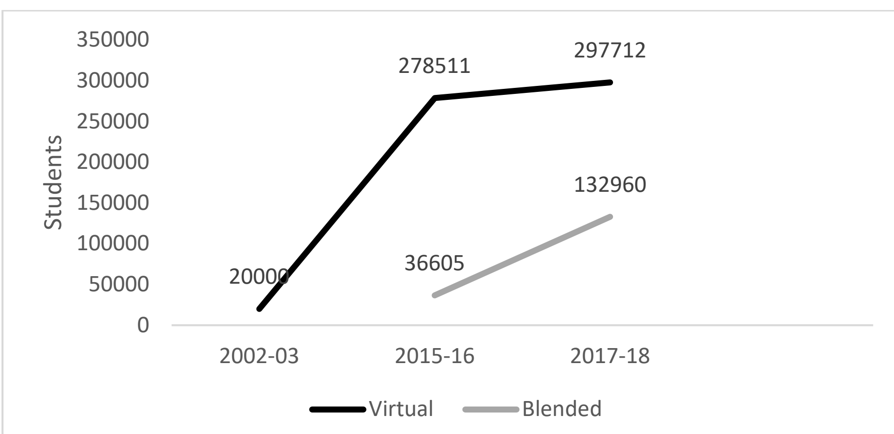

Figure 2. *NEPC-National Student Enrollment Growth in Virtual Schools.*

Yet, it has been claimed that research on the effectiveness of virtual school designs and outcomes is not keeping pace with the rapid expansion of such school delivery models as the NEPC researchers noted that many states have frozen their accountability systems or have implemented new systems that do not contribute to overall ratings. The scholars indicate that of the 39 states reported as having full time virtual or full time blended models only 21 had school performance ratings available, and over 50 percent of these virtual models had no ratings assigned to them (Molnar et al., 2019).

Another indicator of the widespread acceptance of e-learning is highlighted in the K-12 Horizon Report. The annual 2010 Horizon Report, a collaborative effort of the New Media Consortium and EDUCAUSE Learning Initiative, cites key trends in emerging technologies and practices expected to affect students, teachers, and learning entities in the next five years. The 2010 report anticipated two trends for adoption by post-secondary institutions: mobile computing and open content. The report cited four key drivers: (1) the abundance of resources made easily accessible via the internet challenge educators to consider coaching styles and credentialing versus typical grading practices, (2) people expect to be able to work, learn and study wherever and whenever they want, (3) the technologies we use are increasingly cloud based and IT support is becoming decentralized, and (4) students can more readily collaborate throughout schools and regions with both students and work related professionals. The 2010 Horizon Report suggested that no longer does the research detail online-learning specifically, rather the assumption is that education institutions have mainstreamed the concept and practice of learning and teaching virtually. Hence, the focus is on the appropriate use of technologies and strategies that hold promise for widespread adoption (Johnson, Smith, Levine, & Haywood, 2010).

A more recent 2017 Horizon Report speaks to the new teaching pedagogies that are being leveraged through technology and physical design spaces. Leaders are being challenged to design spaces for small-group work and hands-on computing devices. The 2017 report highlights that innovative schools are creating designs to allow for students to move about with their laptops throughout the day while accessing the school's wireless networks. The report challenges and promotes that school libraries and media centers should be organized and designed to accommodate 3-D printing, robotics construction and testing, and virtual reality labs (Freeman et al., 2017, p. 18).

Project Tomorrow (2010) published a research report *Speak Up* which indicated that online learning would flourish in the 21st Century; it would be structured so that "learning is socially-based, un-tethered, and digitally rich" (p. 1). The report cautioned that teachers still lack understanding of the underlying pedagogy for successful online learning and how to effectively use online learning for student achievement and personal productivity. Additional and more recent findings were described in the Project Tomorrow's "2017 Digital Learning Report" from Blackboard and *Speak Up* where several key findings related to building teacher's capacity and competency to create new learning experiences for students was outlined. The report supported cautionary concerns about teachers using technology as a transformational tool, citing that more training for teachers is needed. Additionally, 67 percent of surveyed technology leaders indicated the greatest challenge for implementing digital learning for students was being moderated by traditional instructional practices. A large majority of the surveyed teachers indicated that they were able to more effectively differentiate and individualize instruction for students, but they expressed concerns about limited professional development opportunities, planning time for technology integration within the classroom, and ultimately teachers indicated they had concerns about limited and consistent internet and hardware access and IT support within their classrooms (Project Tomorrow, 2017).

Empirical Support for Technology-Enriched Virtual Learning Designs

This section focuses on the influence that technology-enriched e-learning has on student achievement and student preferences, which includes earlier technologies such as correspondence courses, educational television and videoconferencing. Before proceeding, it is worth noting that there is empirical research on the relationship between the learning platforms described as technology-enriched virtual e-learning and academic performance in virtual school and higher education settings (Shachar & Neumann, 2010; Steiner & Hyman, 2010; Robyler, Davis, Mills, Marshall & Pape, 2008), yet there is a dearth of theory and empirical evidence demonstrating the causal relationship between the design of virtual e-school settings and student connectedness and student preferences in K-12 public school settings.

Some policymakers have reasoned that if technology enhanced instruction is no worse than traditional instruction in terms of student outcomes, then online education initiatives could be justified on the basis of cost efficiency or need to provide access to learners in settings where face-to-face instruction is not feasible. The question of the relative efficacy of online and face-to-face instruction needs to be revisited as a result of the wide range of Web resources, including not only multimedia but also Web-based applications and new collaboration technologies. These forms of online learning are much advanced from the televised broadcasts and videoconferencing that characterized earlier generations of distance education. Interest in student-centric technology approaches that blend in-class and online activities are increasing, and policymakers and practitioners need to be informed about the effectiveness of the learning platforms that are powered by interactive online learning approaches (Means et al., 2009). It is noteworthy that the advent of these learning platforms in the K-12 setting is relatively recent, thus there are few longitudinal studies to solidify claims about causation and/or effectiveness of these models. The following literature summarizes the conditions under which technology enriched virtual e-learning has been studied.

Final course grades have traditionally been used to measure and predict future success in all courses and at all levels of school programming. Shachar and Neumann, (2010) conducted a meta-analysis that spanned the research of final course grades over a 20-year period, specifically focused on comparing the differences between academic performances of students enrolled in distance education courses relative to those enrolled in traditional settings. Their meta-analysis was based on 125 qualifying studies and using learning outcome data from over 20,800 students. The data revealed that 70 percent of the students taking courses by distance education outperformed their counterparts in traditionally instructed courses thus the null hypothesis that there would be no difference between the final academic grades of students enrolled in distance education programs than those enrolled in traditional programs was rejected.

Reading is an essential skill that provides the foundation for most academic learning. Throughout the past decade, new technologies have flooded the promotion of literacy. Pearson, Ferdig, Blomeyer and Moran (2005) conducted a meta-analysis of technology effects on literacy of middle school students. The 20 article meta-analysis answered questions about the effect that technology has on five literacy areas: Strategy use, Metacognition, Reading motivation, Reading engagement, Reading Comprehension. The findings indicate that a wide range of digital technologies appear to enhance reading performance of middle school students. The study also indicated that the effect sizes were greater for interventions aimed at the general population than at students with specific needs (Pearson et al., 2005).

Lui and Cavanaugh (2011) investigated the influence of various factors on K-12 student science achievement. Data was collected during the 2007-08 academic year from one Midwestern state's virtual school. Students were drawn from traditional public schools, private schools, and home schools. A single learning system was utilized to manage all course materials and deliver the instruction. Students across the state who completed biology (first half, N = 211) and biology (second half, N = 94) in the virtual school during 2007-08 participated in the study. The final scores that students earned in the courses completed during 2007-08 were used as the performance indicator.

Researchers measured three additional variables: teacher comments, total logins, and total minutes logged onto the virtual learning management system LMS. Lui and Cavanaugh (2011) found the number of times a student logged into the LMS and the time students stayed on the LMS had a positive and significant influence on their scores; echoing the call for sustained time on task for cognitive learning (Gallagher, 2009). Lui and Cavanaugh (2011) advocate the significance of developing user-friendly LMS with interfaces that motivate students to spend more time in the system engaging in academic activities delivered via the LMS. They concluded that learning environment characteristics are influential to the success of students in online science courses; accordingly, the researchers encouraged administrators and coordinators of virtual learning program to be sensitive to the needs of low-SES students and take measures to assist them with gaps in resources that might influence their achievement.

Robyler, Davis, Mills, Marshall and Pape (2008) set out to find models and factors that could discriminate between successful and unsuccessful online students with the intent of identifying those likely to succeed. This was important because in early development of distance learning, dropout and failure rates tended to be significantly higher than with conventional instruction (Bernard & Amundsen, 1989; Cyrs, 1997; Dille & Mezack, 1991). Robyler and his colleagues noted that there was considerable diversity of opinion about factors hypothesized to contribute to student success with online learning. They revised the measure used in the Roblyer and Marshall (2002-03) study: *Educational Success Prediction Instrument* (ESPRI). The revised version, ESPRI-V2, was a sixty-item Likert scale that asked students to rate their agreement or disagreement with hypothesized contributions to student success: organization, achievement beliefs, responsibility, risk-taking, and technology skills/access. Robyler et al. (2008) examined the Virtual High School Global Consortium (VHS), which included over 400 high schools in 28 states and 23 countries. VHS used a cooperative model in which instructors were released by their schools for one period a day to teach a VHS course. In exchange, the school was able to register 25 students in any of the over 200 VHS “NetCourses” or Web-based courses. During the 05-06 school year, 7,604 students were registered in VHS courses. Average class size was 18.9 students per section. This specific study was conducted with the 4,110 students who were enrolled in 19 VHS courses during the spring 2006 semester. The study revealed that approximately two-thirds of the students were taking virtual courses for the first time. Over three-fourths of the students were aged 16-19; 50 percent were in their senior year; most were above-average students; and 76 percent reported an A or B average in school. The majority of the students were female, and almost all of the students indicated that they had internet access at home, and about 80 percent of the students had an assigned class period in school in which to work on their virtual courses.

Furthermore, the Robyler et al. (2008) study found that student past ability, as reflected in GPA, was a significant predictor of success in online classes. It also found that cognitive characteristics such as self-efficacy and achievement and organization beliefs made a significant contribution to online success. The study recommended that learning conditions such as allowing time at school to complete an online course and having a computer at home can be combined with the prior achievement and individual cognitive student characteristics to develop a successful predictive model for success in an online VHS course. They emphasize the importance of creating a supporting school structure for promoting virtual learning success rates. The scholars point to previous evidence (Robyler, 2006; Wojciechowski & Palmer, 2005) which claimed that providing a pre-course orientation for first-time virtual students is a valuable strategy to improve learning outcomes. The researchers recommend that such an orientation should be a requirement in all virtual schools (Robyler et al., 2008).

Virtual learning and virtual simulation have been used in technical and skill development for decades. Driving and flight simulation are familiar examples of technology enhanced training activities that have been used pervasively throughout industry sectors as evidenced by flight simulation which was developed by Edwin Link in 1929 (National Aviation Hall of Fame, n.d.). A technology enhanced paradigm was also proposed by Richard M. Satava, M.D. in an effort to facilitate training surgical skills in a virtual reality (VR) setting. Satava's proposal was the nexus of a 2002 study conducted at Yale University School of Medicine. Sixteen medical students were randomly assigned to either a study group that received VR training in addition to the standard programmatic training or a control group that received only standard face-to-face training. All residents in both groups completed a series of previously validated tests to assess fundamental abilities. Four attending surgeons, all having extensive prior experience with laparoscopic procedures, completed 10 trials on the VR tasks to establish performance criterion levels. The procedures were videotaped with voice audio for further examination. No statistical differences were found between VR trained and non-VR trained groups involved in gallbladder dissection. The VR-trained residents were 29 percent faster than their non-VR peers, and the use of VR surgical simulation to reach target criteria significantly improved the operating room performance of residents during the laparoscopic cholecystectomy (Seymour et al., 2002).

A meta-analysis of online learning research was conducted by SRI International for the Policy and Program Studies Service of the U.S. Department of Education (Means, et al., 2009). The analysis included studies conducted in K–12 educational settings, career technology, medical and higher education, as well as corporate and military training. The report reviewed 1,132 abstracts and 176 online research studies derived for the most part from studies in other settings (e.g., medical training, higher education). The meta-analysis report distinguished between instruction that is offered entirely online and instruction that combines online and face-to-face elements. Only five experimental and quasi-experimental research designs involved K-12 learners. The summary of the US

Department of Education (USDE) 2010 report concluded that blended and purely online learning conditions generally result in similar learning outcomes. The USDE report suggested that adding elements such as video or online quizzes in an effort to promote additional learning is not more important or influential than assigning homework that does not include such features. The report also indicates that providing guidance for groups of students is less successful than doing such with individual learners, and when groups of students are interacting together online with such activities as guided questions then such activities tend to only influence the way students interact, but such activities do not seem to influence the amount that students learn. Lastly, the USDE report indicated that giving learners control of their interactions with media and reflection influences on how much they internalize and learn. The report concludes that triggering individual student engagement in online activity and self-reflection and self-monitoring are effective strategies for online learning platforms (p. 16).

A study by Ahn and McEachin (2017) of the state of Ohio's online charter schools attempted to answer two foundational questions about students in virtual e-schools versus traditional public schools: a) how enrollment patterns vary by subgroups and geography and b) how academic outcomes differ between the two. The findings of this research suggest that students in e-schools are not learning at the same rate as their peers in traditional public schools and charter schools (Ahn & McEachin, 2017). They conclude that students' prior achievement influences outcomes in e-school settings as well as in traditional school settings in that higher achieving students do better in e-schools than their lower achieving e-school peers. Yet, the study purports that some high-performing high school students in e-schools are passing their Ohio Graduation Test assessments at the same rate as their traditional public school peers. The study claims that what really matters is understanding how the introduction of technology impacts who chooses to participate in particular learning environments and what they experience that result in learning outcomes (Ahn & McEachin, 2017).

Finally, The National Education Policy Center (NEPC) has been documenting the growth and features of virtual school design throughout the United States since 2012. Their 2019 report indicated an examination of 501 full-time virtual schools that enrolled 297,712 students and a total of 300 blended schools serving 132,960 students. The scholars essentially reviewed 21 state public report cards and accountability reports whereby full-time virtual schools were described as a design where all instruction was delivered electronically and online and blended instruction was defined as a school design that combined virtual and face-to-face instruction. NEPC scholars developed a classification system to aggregate results across state reports such that school features were coded as "academically acceptable," "academically unacceptable," or "not rated." Performance ratings were codified for 501 full time virtual schools and 131 blended learning schools and they reported that 48.5 percent of full-time virtual schools and 44.6 percent blended schools were rated "acceptable."

However, the 2019 NEPC report also decried the substantially inferior on-time graduation rates of such school designs at 50.1 percent for full-time virtual and 61.5 percent for blended design models compared to the national on-time graduation rate of 84 percent (Molnar et.al., 2019). The report also outlined concerns related to large student-teacher ratios where they reported the full-time virtual national school mean was 43.9 students per teacher, and the national blended model of delivery had an average ratio of

33.9 students to one teacher. Additionally, they reported that the national full-time virtual service rate of students identified as special education was at 15.1 percent which exceeded the national average of 13.1 percent for traditional school programming, and they raise concerns about the fidelity of meeting individualized special education students needs by full-time virtual schools as they cite findings which "suggest that additional revenues for students with disabilities were not translating into increased spending on special education" (Crouse, Rice & Mellard, 2016, p. 20).

The NEPC report focused only on full-time virtual and full-time blended learning schools, but the center acknowledges that districts and individual schools are also creating e-learning "programs" and these programs merit further study. In light of these findings, they recommended slowing or stopping the growth in the number of virtual and blended learning schools and the size of their enrollments until such time that the reasons for poor performance can be identified and addressed. A second recommendation included implementing measures that require virtual and blended schools to reduce the ratios between students and teachers. The third key recommendation was to enforce sanctions when virtual and blended schools perform inadequately, and the final recommendation was for states and agencies to "sponsor research on virtual and blended learning programs and classroom innovations within traditional public schools and districts" (Molnar et al., 2019, p. 37).

Oklahoma Virtual Charter Schools Performance

At present, Oklahoma has five approved virtual charter school districts that are accountable and sponsored via a contract by the Oklahoma Statewide Virtual Charter School Board (OSVCB). Each of the virtual schools are considered public schools and are subject to state laws and regulations and to the reporting requirements of the Oklahoma State Department of Education (OSDE), including financial accountability and accreditation requirements. Oklahoma's virtual charter schools are also accountable to their own governing bodies. Virtual charter school accountability report cards and outcomes were available on the Oklahoma Statewide Virtual Charter School Board website (Oklahoma Statewide Virtual Charter School Board, 2019).

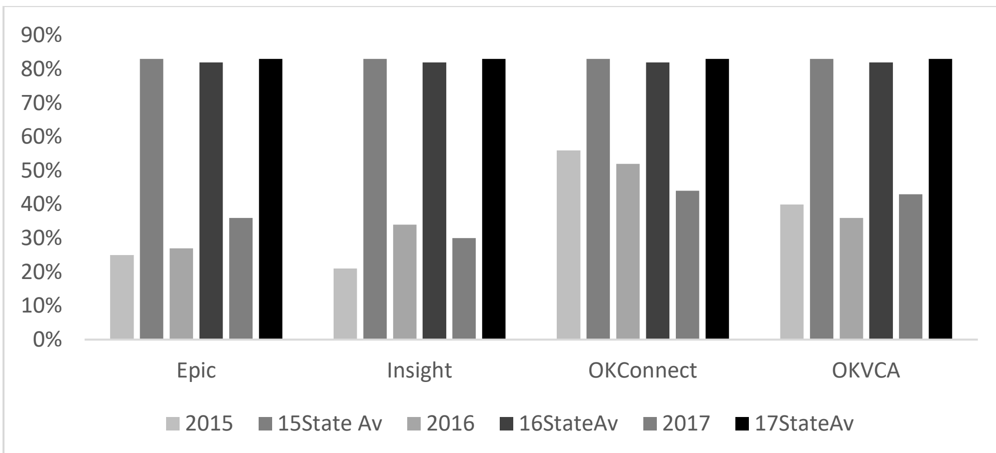

Figure 3. *Oklahoma On-Time Grad Rates: Virtual Charters Compared to State-Wide Rates.*

The OSDE public accountability reports documented that for three consecutive years (2015-2017) all four approved virtual charter schools produced a substantially lower graduation rate, and the 2017 report indicated that the highest graduation rate produced by a virtual charter school was 40 percent below the state's on-time graduation rate of 83 percent (see Figure 3). The 2017 state report card data of the four virtual charter secondary schools provided fodder for critics of virtual school especially on such foundational guideposts as graduation rates which were lagging well behind the state traditional school rates.

Additionally, the latest 2017-18 OSDE state testing program accountability report revealed that only one virtual charter school outpaced the state's average proficiency rate on English Language Arts II (see Figure 4).

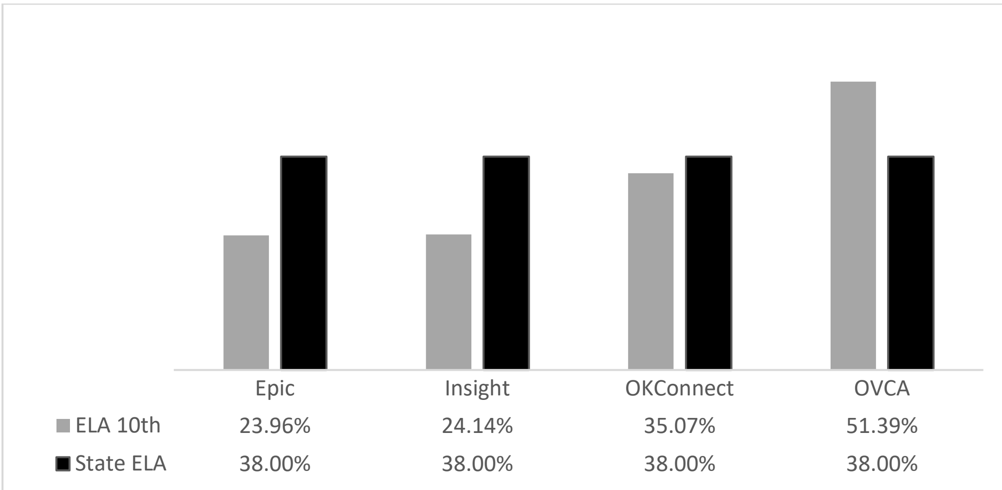

Figure 4**.** *OK Virtual Charter Schools 2018 OSTP Proficient & Above Compared to Statewide-English Language Arts.*

Finally, the 2018 OSDE state testing accountability report indicated that every virtual charter high school proficiency rate on the high school math sub score lagged behind the state average of 22 percent (see Figure 5).

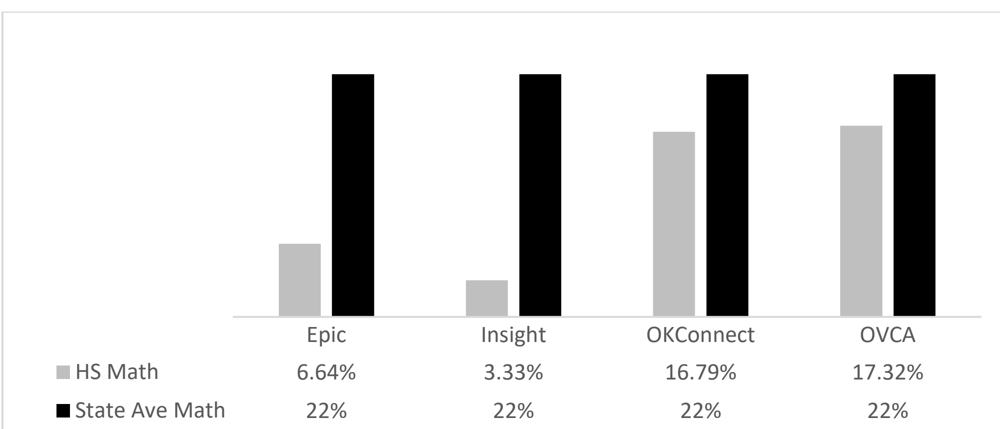

Figure 5. OK Virtual Charter Schools 2018 OSTP Proficient & Above Compared to Statewide High School Math.

Student and Family Experiences with Oklahoma Virtual Schools

The Oklahoma Statewide Virtual Charter School Board (OSVCB) commissioned a 2017 study of the state's four virtual charter schools in an effort to investigate student and family experiences related to participating in virtual school settings. The executive summary included findings that align with prior literature and which illustrate the mediating conditions of influence associated with local virtual learning. Oklahoma parents and guardians responded to survey questions and 41 percent indicated that they chose virtual charter schools to avoid bullying or threats from classmates, and 34 percent indicated that they were choosing this school platform to avoid overcrowding and limited resources in traditional schools. The survey also revealed that 31 percent chose virtual charters to support acceleration or remediation and similarly the parents indicated that there was a particular learning need that their child presented that would best be served in a virtual charter one-on-one setting. Essentially parents ranked the top three reasons for choosing virtual school in coded categories related to individualized learning needs, medical needs, and health and safety.

Parents also responded that they appreciated the flexibility in school schedules which allowed their families to pursue other non-academic interest such as travel and participation in sporting and adventure related activities. The majority of the survey respondents' felt that virtual charter schools offer a safer school environment than the traditional face-to-face neighborhood school settings, and 68 percent felt their children were more engaged after enrolling in the virtual schools. Virtual school parents expressed overwhelmingly that children had more choices about electives and courses than they had in the traditional school design, and 63 percent responded that virtual schools were “significantly better” in academic quality compared to their local school districts. A small percentage of respondents expressed concerns about their virtual experience by indicated that their children struggled academically and 5 percent indicated they were challenged by workload. Respondents also suggested that virtual charters could work on improving their technical interfaces and work to develop more social opportunities for students that facilitates engaging with other peers (Miller & Associates, 2017, pp. 4-5).

A survey of Oklahomans engaged in virtual charter schools was conducted by the office of Oklahoma Education Quality and Accountability (OEQA, 2016). The survey noted that 86 percent of parents indicated their child had been enrolled in a virtual charter school for two years or less, and 31 percent indicated they were choosing to enroll their child in a virtual charter because they needed the flexibility for school schedules as a result of conditions such as health, sports, and traveling. Fifty-six percent of these Oklahoma parents indicated they “strongly agreed,” and 32 percent “agreed” the virtual teachers provided a curriculum that met the child’s individualized learning needs.

The OEQA also reviewed the experiences of students engaged in a virtual charter school, and 73 percent of the students responded they had been involved in virtual charter school setting for two years or less. The students responded to a question about how much time they spent each day attending virtual classes or completing assignments and 40 percent responded three hours or less while 46 percent answered between four and six hours per day. The full-time virtual charter school students were asked to respond to a question related to how much the e-learning activities and assignments interested or engaged them, and the two largest percentages marked as “some” and “very much” were categorized as “individual/independent readings” and “analyzing ideas,”, and the two lowest responses were categorized as “giving speeches through electronic platforms and “group projects through online technology” (OEQA report, 2016).

Student-centric Learning and its Effect on Technology-Enriched Virtual Learning

Student-centric learning has been described as an educational approach that focuses on the needs of the students, rather than those of others, such as teachers and administrators (Blumberg, 2008). This educational approach has many implications for the design of curriculum, course content, and interactivity of courses (O’Neil & McMahon, 2005). Major tenets of student-centered (student-centric) learning models include: understanding of the learning material, active learning and increased student responsibilities, increased instructor responsibilities to create an environment that facilitates learning, shared decision making responsibilities on the part of the instructor and the students, and integrating assessment feedback on a consistent basis (Blumberg, 2008; Lea, Stephenson, & Troy, 2003).

Evergreen Education Group produced an annual report in 2011 entitled “Keeping Pace with K-12 Online Learning: Annual Review of Policy and Practice” (Watson, Murin, Vashaw, Gemin, & Rapp, 2011). The report indicated that K-12 online learning is growing and evolving in many directions, and the evolution is often merging with face-to-face instruction, which they dub “blended learning.” A host of terms have emerged to describe such varied school structures such as cyber schools, e-Schools, e-learning schools, virtual schools, blended learning, hybrid learning, and online learning. The report defined online learning as “teacher–led instruction that takes place over the Internet, with the teacher and student separated geographically-at the starting point”

(2011, p.8). The 2011 Keeping Pace annual report added clarity to the confusing terms connected to virtual school structures who often use software to provide structure and codify lessons by noting that some educational opportunities can be *synchronous* whereby communication between teacher and student are in real time or *asynchronous* whereby communication is separated by time. The report describes that "*blended learning* combines online learning with other modes of instructional delivery" (p. 8).

The Council of Chief State School Officers (CCSSO, 2017) codified the essential attributes and conditions of *Next Generation Learning* (NxGL) that support a learner-centered pedagogy. The following six principles provide a framework for building future educational e-Learning models: (1) Planning for personalized learning, (2) Comprehensive systems of supports which supports a continuum of services availing cognitive, social, and emotional opportunities and services for all students, (3) World-class knowledge and skills which require achievement goals to succeed in a global oriented society, (4) Performance-based learning which puts students at the center of the learning based on mastery of clearly outlined high expectations, (5) Anytime, everywhere opportunities whereby constructive learning experiences can take place geographically anywhere and where reliable and responsive internet connectivity is ubiquitous, and (6) Authentic student voice where deep engagement of students in directing and owning their individual learning and shaping the nature of the education experience (Patrick, 2010).

Visionary technology planning requires a detailed analysis of a host of factors, and it is critical that the overall technology planning fit within the context of a school district's overall strategic plan. Computer expenditures are often based on what has been occurring rather than what is needed; school leaders should be urged to plan wisely to meet the funding requirements for technology and to make sure that they have the resources to maintain technology-based programs (Piccano, 2011). Papa (2011) argued that it is essential to design personalized learning and to communicate the overall school technology planning that is grounded through the National Education Technology Standards (NETS-A standards, 2009): Visionary Leadership, a culture of Digital-Age-Learning, Excellence in Professional Practice, Systematic Improvement, and Digital Citizenship. Such a focus on personalized learning in a technological learning environment is in accord with the pedagogy of technology-enriched and student-centric. McCombs and Vakalie (2005) claim that a learner-centered framework that is technologically-enriched through virtual e-learning should be aligned with the American Psychological Association's (APA, 1993) research validated learner-centered principles. The APA reports that learning is enhanced in contexts where learners have supportive relationships, where students have a sense of ownership and control over the learning process (locus of control), and where learners can learn with and from each other in safe and trusting learning environments (McCombs, 2003; McCombs & Whisler, 1997).

Dunleavy, Dexter, and Heinecke (2007) reported that a one-to-one student to networked laptop ratio can provide added value to the learning experience. Learning activities supported by such technology can be represented by an enhanced ability to find and retrieve relevant information via the web, increased levels of real-time formative assessment enabling individualized and differentiated instruction, and the creation of virtual networks such as wikis, blogs, and web pages in an effort to extend the boundaries of learning outside the typical school walls and outside the scope of the typical school day. Their 2007 report acknowledged that the mere presence of a technology-rich environment is not sufficient for enhanced teaching and learning or added value. Dunleavy et al. (2007) promote that professional development is a key to helping teachers adapt instruction to leverage unique pedagogical capabilities within one-to-one environments.

A meta-analysis was conducted to analyze the influence of four instructional scaffolds which could be delivered to educators in online professional development settings. A scaffold can be described as a guidance or support from educators which facilitates student learning activities. The researchers were interested in how educators most readily learned to instruct students by using online learning platforms to support their own professional online teaching efforts. Essentially, the scholars identified four types of scaffolding that were best suited to be delivered to educators in an online learning environment: (1) conceptual scaffolding: which helps students decide what to consider in learning, (2) procedural scaffolding: assists students in using available tools and resources, (3) strategic scaffolding: suggests alternative ways to tackle problems in learning, and (4) metacognitive scaffolding: guides students on what to think during learning. The study indicated that trainers most readily explored and used metacognitive scaffolding when training educators in an online environment as it tended to be the strategy that emphasized higher order thinking. The scholars posited that proper instructional supports influence the success of online learning for educators to help design and scaffold online learning activities for their students (Jumaat & Tasir, 2014).

The contributions of professional development and scaffolding support the tenets of the NxGL framework which encourage the technology-enhanced student-centered constructs of (a) performance based learning, (b) anytime-everywhere opportunities, as well as the constructs of (c) comprehensive systems of support for students, and (d) world-class knowledge and skills.

Summary of Literature Review

The literature indicates that new forms of virtual e-learning have come of age in the past decade, and the increased popularity and presence of such student-centric learning opportunities are leading researchers and practitioners to pause and decry the lack of a research-validated framework to guide school policies and design (McCombs & Vakili, 2005). Traditional school calendar and matriculation policies are being challenged with the advent of on-line and virtual learning opportunities that are customized for individualized learning, thus the challenge becomes about how to design education systems where technology is in service to, values, and supports diverse learners and learning contexts (McCombs, 2000). There is some evidence in support of technology-rich e-learning, but certainly more work to be done, particularly as schools and districts implement their own models. However, the evidence for the performance of these models within the State of Oklahoma is less encouraging, however, and begs the question of how these models continue to perform as states, schools, and districts increase their use of these models.

Collins and Halverson (2009) suggest that, as we rethink education in the age of technology, it is essential to remember that "what gets done and where" holds great promise in the coming decade as the model for learning shifts from a traditional model to a virtual e-learning and blended learning environment. They encourage school leaders to design schools that shift learning to a more customized student-centric approach where learners have more control of what they learn. Such customized models of student-centric virtual learning would encourage students to seek a wide range of resources to develop and demonstrate knowledge and understanding and would rely less on instructors to provide answers to questions.

Dunleavy, Dexter and Heinecke (2007) report that a one-to-one student to networked laptop ratio can provide added value to the learning experience. Learning activities supported by such technology can be represented by an enhanced ability to find and retrieve relevant information via the web, increased levels of real-time formative assessment enabling individualized and differentiated instruction, and the creation of virtual networks such as wikis, blogs, and web pages in an effort to extend the boundaries of learning outside the typical school walls and outside the scope of the typical school day. However, the mere presence of a technology-rich environment is not sufficient for enhanced teaching and learning or added value. Dunleavy and his colleagues (2007) found that professional development is the key to helping teachers adapt instruction to leverage unique pedagogical capabilities within one-to-one environments.

Implementing personalized learning environments allows educators to leverage equity and access for all students-especially for vulnerable populations. The Council of Chief State School Officers (CCSSO, 2017) identified essential attributes and conditions that support a learner-centered pedagogy. The policy brief of 2017 reports that students need personalized and competency-based learning that puts students at the center of the learning process and that enables them to demonstrate mastery based on clearly defined and commonly-shared expectations. These personalized learning systems should provide any time, everywhere opportunities beyond a geographic location or setting. Accordingly, student learning should not be time-based where the amount of seat time in a classroom measures success; rather, student learning should be individualized where students receive timely and differentiated support to achieve competency and mastery of clearly defined skills and expectations. The policy brief concluded that students should move on when ready instead of when a clock or calendar says it's time, and the brief concluded that this learning model ensures that more students have deep and meaningful learning outcomes.

Student centered learning strategies could broadly be described as personalized learning. Key principles of personalized learning can be characterized by three conceptual frames: 1) learning must be organized with the learner at the center; 2) learning objectives, approaches, content, pace, and tools are tailored and optimized for each learner; and 3) learners take ownership of their learning, having more choice and a greater voice in what, how, when, and where they learn (Pape & VanderArk, 2018). In summary, four broad strategies and activities for designing a student-centric virtual e-learning model emerge from this literature:

1. *Planning for personalized learning in a one-to-one student to computer ratio*: (Collins & Halverson, 2009; Patrick, 2010),
2. Comprehensive systems of support that address the physical, social, emotional, and cognitive development of students (McCombs & Vakalie, 2005; Watson, et al., 2011),
3. *Anytime, everywhere opportunities for learning that are connected through networked technology:* (Patrick, 2010),

4. *Authentic student voice where students are directing, shaping, and owning their individualized learning experiences*: (Piaget, 1952; Hannafin & Land, 1997; Blumberg, 2008; Lea, Stephenson & Troy, 2003; Patrick, 2010).

Next-generation student-centric learning models promote competency-based pathways where students advance based upon mastery of objectives that are not constrained by prescribed time on task and definitive clock hours. Virtual e-learning advancements are re-engineering educational opportunities that emphasize personalized, student-centered, performance-based, anytime, anywhere educational opportunities (Sturgis & Patrick, 2010). The literature indicates that designing non-traditional competency-based models are important features for school leaders to consider as anytime, everywhere opportunities are providing constructive learning experiences in all aspects of students' lives through the internet-connected community.

At the heart of virtual e-learning is individualized instruction (LaFrance, Beck, 2014). To serve as instructional leaders and evaluate effective pedagogy in virtual settings, leaders must have knowledge of online learning theory (p. 168). School leaders also need to be trained and develop confidence through experience to connect via social networking, blogging, videoconferencing, and podcasting which provide stakeholders new ways to engage in dialogue and disseminating information. These scholars report that most current educational leadership training related to virtual learning could be characterized as "knee-jerk" or reactive, which puts the reins of innovation in the hands of legislative leaders and regulators. They note that principals and assistant principals who are trained today may serve in school leadership positions for the next 20 years, so they posit that leaders must be immersed in learning the essential elements to effectively lead online operations, learning management systems, and instructional pedagogy (p. 182). The scholars remark that 21st century debate continues about how to prepare 21st-century leaders, and they conclude that a growing body of research suggests authentic course and field-based learning experiences are necessary for quality school leadership preparation (p. 184).

Chapter 3: Conceptual Framework

Twentieth century social scientists and behaviorists theorized that learning activities and educational training opportunities that encourage students to develop their own learning process would encourage students to develop stronger divergent reasoning, problem solving, and critical thinking (Hannafin & Land, 1997). John Dewey's Democracy and Education (1916) promoted the value of such a student-centered (student-centric) learning model. Dewey theorized that formalized education was enhanced by involving the learner in the process. Dewey argued that setting up conditions to stimulate visible and tangible ways of interaction help learners to become a "sharer or partner" in the associated activity such that the student "feels success as his success, and failure as his failure" (pp. 16-17). Dewey described that this connection helps students become "possessed by the emotional attitude" of the lessons and of the group so that students will be alert to recognize the "special ends at which it aims and the means employed to secure success" (p. 17).

Student-centered learning environments have been touted for decades as a means to encourage divergent reasoning, problem solving, and critical thinking (Hannafin & Land, 1997). Hannafin (1992) explained that computer-enhanced learning environments promote engagement through student-centered activities. These scholars argue that technology-enriched student-centered learning environments organize interrelated learning themes into meaningful contexts, often in the form of a problem to be solved or an orienting goal. Such features and activities provide interactive, complimentary activities that enable individuals to address unique learning interests and needs while often studying varied levels of complexity which enrich thinking and learning.

Piaget (1952) suggested that children innately build and alter understanding through everyday interactions with their environments. He argued that the goal of education, in effect, is to provide a stimulating environment to support the child's natural epistemic curiosity. Piaget's ideas are consistent with emerging interactive multimedia environments that are student-centered. Such systems constitute rich contexts and interactive environments to support self-directed inquiry and information seeking and retrieval, as well as individual decision making (Land & Hannafin, 1996). Learners are not only at the center of the environments; they are integral to it. Universal outcomes, activities, and assessments often cannot be established *a priori*, but must be derived through the efforts of individuals. Student-centered learning environments afford opportunities, but do not impose explicit conditions for learning (Hannafin & Land, 1997).

Ownership of goals and activities is a cornerstone of a student-centered approach, because students make decisions about their work and take actions to meet goals that are personally meaningful. Goal setting in turn encourages deep understanding and intrinsic motivation. The findings of a study of teachers' perceptions of their classes in terms of the student-centered learning dimensions of time, place, infrastructure and psycho-social student engagement (Cubukcu, 2012) found that teachers valued the psycho-social domain more than the domain of time, place, and environment. Essentially, the study reported that teachers can most readily influence student psycho-social learning activities versus influencing the administrative factors and decisions such as building design and time schedules. The study concluded that students who can reach and synthesize information are advancing their learning and cognition moreover than students who memorize information (Cubukcu, 2012).

Providing students with opportunities to experience an internal locus of control is a seminal concept that is referenced throughout literature reviews related to student-centered school design. Julian Rotter (1954) theorized that a person's actions are predicted on the basis of his values, his expectations, and the situations in which he finds himself. Rotter's "Social Learning Theory" was reduced to a formula that described the potentiality of occurrence of a set of behaviors. Behaviors that lead to the satisfaction of some need (need potential), is a function of both the expectancies that these behaviors will lead to these reinforcements (freedom of movement) and the strength or value of these reinforcements (need value). Rotter (1990) characterized the relationship between internal versus external control as: "the degree to which persons expect that a reinforcement or an outcome of their behavior is contingent on their own behavior or personal characteristics versus the degree to which persons expect that the reinforcement outcome is a function of chance, luck, or fate, is under the control of powerful others, or is simply unpredictable, such expectancies may general along a gradient based on the degree of semantic similarity of the situational cues" (p. 489).

Leftcourt (1976) wrote that it is "not the simple registering of success and failure experiences that is pertinent to the generalized expectancy of internal versus external control, but rather it is the interpretation of the cause of those experiences" (p. 28). Lefcourt (1976) hypothesized that certain cognitive activities were more characteristic of an individual with internal rather than external control orientations, and he further generalized that locus of control is an *"epiphenomenon,"* a mere diagnostic indicator of a person's natural capacities for achievement. He suggested that it is overly simplistic to link a one-to-one relationship between locus of control and academic achievement, but the scholar argued that locus of control certainly plays a mediating role in determining whether a person becomes involved in the pursuit of achievement.

Over two decades of empirical study of self-determination theory (Deci & Ryan, 1987) researchers have come to two foundational conclusions: (1) autonomously motivated students thrive in educational settings, and (2) students benefit when instructors support their autonomy (Reeve, 2002). Self-Determination Theory (SDT) begins with the assumption that people are naturally active and have an evolved tendency to "engage the environment, assimilate new knowledge and skills, and integrate them into a coherent psychological structure" (Reeve, Ryan, Deci, Jang, as cited in Schunk & Zimmerman, 2008, p. 225). One of the mini-theories of SDT, Basic Psychological Needs Theory, hypothesizes that intrinsic motivation arises from social contexts that are supportive of autonomy, competence, and relatedness, which are found to foster greater internalization and integration than contexts that thwart satisfaction of these needs (Ryan & Deci, 2000). Reeve (2002) reported that students mostly feel competent when they perform well in school, and they feel "increasingly competent when teachers provide opportunities or independent work, opportunities to talk, timely hints, and perspective-taking statements: students felt increasingly incompetent when teachers hogged instructional materials, gave answers, and solved problems for the students" (p. 189). Designing a technology-enriched student-centered learning framework is predicated on not only how active and responsible the student is involved in the learning process, but also by how much latitude and shared decision making responsibilities is shared between the instructor and the student.

Mediating Conditions that Influence Technologically Enriched Virtual e-Learning

Cavanaugh, Gillan, Kromrey, Hess, and Blomeyer (2004) conducted a meta-analysis of 116 effect sizes from 14 web-delivered distance education programs studied from 1999-2004. The study compared academic achievement in traditional instruction and web-delivered or "distance education." Their findings indicated that the primary characteristic that sets successful distance learners apart from their classroom-based counterparts is greater student autonomy (Keegan 1996), and responsibility (Wedemeyer, 1981). The meta-analysis also found that successful distance learners have a stronger internal locus of control leading them to persist in the educational endeavor (Rotter, 1989). As distance education is currently practiced, educators can reasonably expect learning in a well-designed distance education environment to be equivalent to learning in a well-designed classroom environment (Cavanaugh et al., 2004).

Steiner and Hyman (2010) conducted research on student performance and how students articulated preferences about taking a three-hour credit Marketing Research course. They found that “one size does not fit all” when designing school structures for undergraduate students who were taking required courses as a part of an articulated marketing degree plan. They compared an online learning format to a face-to-face school structure and found similar grade distributions between the two school models, which indicated no statistically significant difference in student achievement. Conversely, student satisfaction, as revealed by formal end-of-course evaluations, improved under the dual delivery system. Student comments suggested that both courses were well organized and rigorous. The end of evaluation data for the face-to-face instruction indicated that overall instructor's quality improved minimally (0.3) on a five-point scale, but the open-ended responses revealed enhanced satisfaction on the evaluation form. The authors contend that the similar between-option grade distributions were attributable to the range of students attracted to each option. Personal choice of the school structure, and personal life circumstances seemed to lead to improved retention rates and higher levels of student satisfaction.

Student academic achievement and perceptions of the learning environment in virtual and traditional secondary algebra classrooms were compared by Hughes, McLeod, Brown, Maeda and Choi (2007). They gathered data from three different states comparing student performance from three different virtual schools and three traditional schools. The empirical review concluded that online courses can provide successful, alternative learning opportunities for algebra students while maintaining similar academic standards and achievement levels as found in traditional face-to-face classroom settings, even for students who are on less rigorous academic paths (Hughes et al., 2007). Virtual students performed higher on each of the subscales of the "Assessment of Algebraic Understanding" test compared to their peers in traditional school settings. Students in traditional settings were more likely to have higher averages on the Student Cohesiveness, Involvement, and Cooperation subscales of the "What is happening in this Class?" instrument that was intended to measure the psychosocial dimensions of high school classrooms (Doorman 2003). Online students were more likely to rate higher on the Teachers Support subscale on the same psychosocial instrument. Hughes et al. (2007) encourage school leaders to design virtual learning environments that are attentive to outreach efforts, ensuring that cohesiveness is not overlooked as a tool to help students persist. This strategic paradigm aligns closely to a student-centered (student-centric) framework that emphasizes the importance of deeply engaging students in directing and owning their individual learning and shaping the nature of the educational experience among their peers.

School connectedness and authentic student voice have also been shown to influence such student outcomes as retention and persistence. Drexel University developed an online support course called Online Human Touch (OHT) as a part of its online Master of Science in Higher Education (MSHE) graduate studies program. The university developed the OHT course in an effort to strategically bolster student retention, because the online attrition rates could range as high as 70 to 80 percent (Dagger & Wade, 2004; Flood, 2002). The OHT approach assumed that students were more likely to persist in an online program if fully engaged in a holistic approach involving participating in the online courses that include personalized experience (Betts, 2008). Betts reported on 3 years of data collected from MSHE students, faculty, adjunct, and staff, reporting on policy, procedures, and guidelines that supported the OHT concept. He noted that the 83 percent student retention rate over three years was higher than most on campus programs offered at Drexel. The OHT instruction and programming conceptual framework highlighted five key areas of research: student engagement, community development, personalized communication, work-integrated learning, and data driven decision-making. The collected surveys and qualitative feedback indicated that Drexel's OHT programming improved student engagement, connectivity, and retention over a 3-year period from 2005-2008 (Betts, 2008).

It is a noble ambition for educators to guide students toward self-actualization, and design school structures that bolster student satisfaction and preference. Lawson and Stackpole (2006) collaborated on research that investigated the effects on student achievement and student satisfaction with laboratory instruction in a virtual laboratory on computer network administration. Twenty-two students were randomly selected to participate in an experimental group that received their instructional activities and tasks in a virtual setting as opposed to their 68 control group peers who participated in a traditional face-to-face classroom. Both groups of college students were taught from the same syllabus: they covered the same topics with the same course objectives, number of assignments, and comparable assignment due dates. Both qualitative and quantitative data were gathered throughout the term using multiple methods for each research question. The students in this study perceived their online laboratory environment to be equivalent to the on-site laboratory and students were satisfied with their experience both technically and personally. When comparing the experimental and control groups, there was no significant difference in achievement. The average grade for both the online laboratory and the online lecture group was 5-8 percent higher than the traditional group (Lawson & Stackpole, 2006).

The mediating constructs of locus of control, authentic student voice, school connectedness, competence, and relatedness have been empirically examined in both core academic as well as elective type lab class settings. There is also evidence that such mediating factors also influence students who are involved in activity-based learning settings. Such an activity-based research project was designed to explore how to include technology for providing instant visual feedback to a large size physical activity class in a higher education institution (Wang, Myers, & Yanes, 2010). The study explored the value of building a student-centered learning experience by providing an instant visual re-play of student performance. The framework of student-centered learning in a physical skill related class was facilitated as students shared increased responsibilities by getting to know the content (what key elements to look for in their own golf swinging performance). Students sharing decision making and responsibility over their learning was designed by the instructor and included: discussions about how long can the replay be delayed, and shared discussions about the appropriate angle of the camera, etc. The method involved forty-five students, age range of 19-30 years, enrolled in a specific sports course. On an average, a 4.7 out of 5 possible points showed strong student support for the usefulness of the technology. An average of 4.63 out of 5 points showed strong student support for using technology when they become teachers after their graduations. Furthermore, students who participated in this intervention showed a strong intent to use more technology in developing their golf skills (Wang, Myers, & Yanes, 2010).

A 2015 study conducted by the Center for Research on Education Outcomes at Stanford University (Woodworth et al., 2015) provided additional insight into the learning outcomes and practices associated with students learning in online and e-school settings throughout the country. The study indicated that a major characteristic of online virtual education is the ability for curricula and learning content to be consumed in a self-paced platform. Their statistical models showed increasing the percentage of self-paced work had a negative relationship with academic growth in both reading and math, which the scholars purport may not seem logical, especially in reading where having access to self-paced courses has a significant positive effect size. However, the scholars uniquely describe that the "apparent inconsistency can be explained by the concept that just because a proper dose of something is good, it doesn't mean a larger dose is better" (Woodworth et al., 2015, p. 42).

Study Context and Theory of Action for the Evaluation of the TTeSN

Tulsa Technology Center pioneered an effort in 2001 to promote virtual learning opportunities, but the original design was nearly a decade ahead of its time in Oklahoma. Tulsa Technology Center continued to provide technology integrated professional development activities related to virtual e-learning, but the virtual e-School programming was idled from 2005-2009 as a result of low student participation. After a brief hiatus, the original e-School project morphed in 2009 into a consortium dubbed the "Tulsa Tech eSchool Network" (TTeSN). The consortium preceded the state of Oklahoma's 2011 mandate that required public schools to provide virtual learning opportunities for their students. The TTeSN was an outgrowth of a year-long task force formed among 21 area schools that focused not only on impending legislation related to virtual learning, but also on the innovations of virtual e-learning.

A theory of action guided the design and implementation of the TTeSN virtual learning labs (see Figure 6) in an attempt to support an effective virtual e-learning program model. Essentially, the theory of action claims that when students are involved in a technology-enriched set of virtual e-learning activities that are tailored to meet individualized learning needs, and when electronic access to learning content and activities can take place any time and any place, they will demonstrate similar levels of academic performance compared to peers that participate in a traditional learning setting.

The theory of action further claims that when students are provided with the autonomy to engage in blended virtual e-learning course work at their own pace and consume coursework at their convenience, then they will prefer the learning platform more than they did with a face-to-face traditional course delivery.

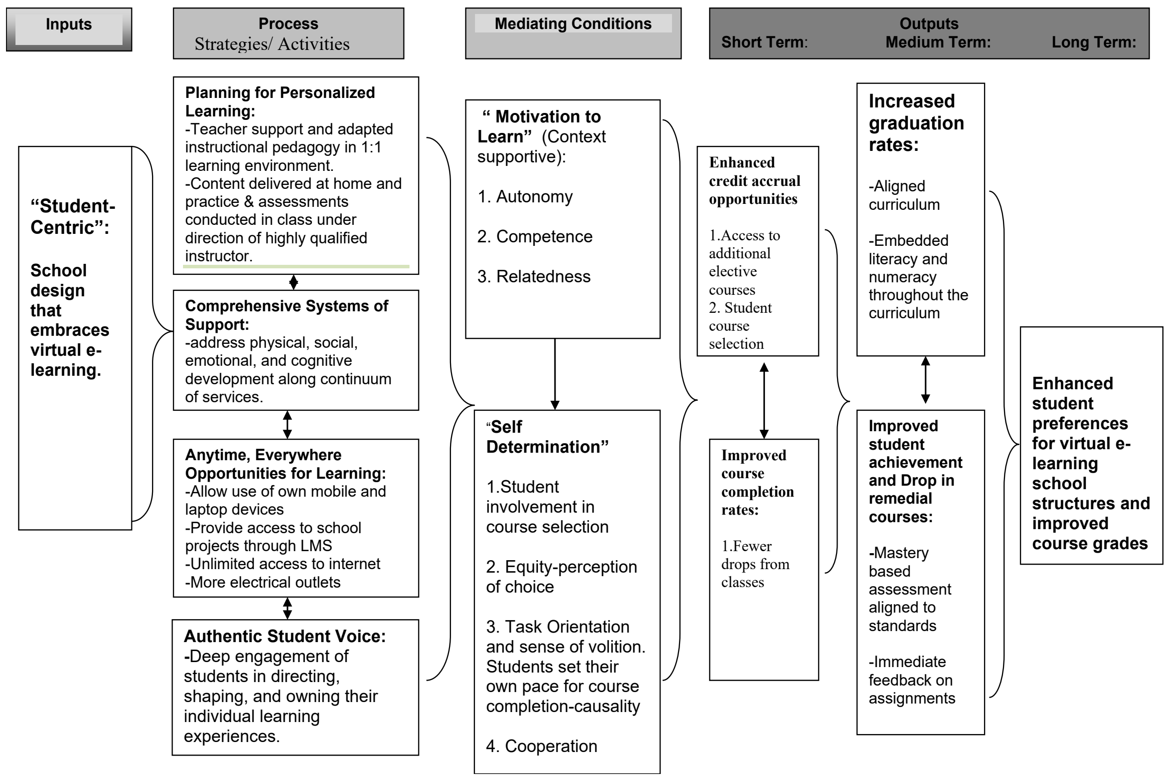

Figure 6. *Theory of Action- Student-Centric Virtual E-Learning.*

Currently there are five virtual e-learning labs located throughout Tulsa County, and they serve as the context for this program evaluation. Each of these sites implemented virtual e-learning programming with mirrored strategic design, training, and policy measures. Each of the labs were staffed by two highly qualified adjunct instructors and one counselor, and most of the staff had worked in the program for at least two years. The student/teacher ratio was less than 20:1 throughout the two school years under review.

The TTeSN e-learning labs provide personal, social service, and educational intake assessment at each Success Center to determine an individual's interests and abilities. Career counselors and certified teachers assist with strengthening academic skills, assessing career interests for learning and employment success. The labs operate year-round, late afternoon and evening in computerized learning centers at sites strategically located throughout Tulsa County. The staff collaborate and partner with area K-12 schools and with Tulsa metropolitan businesses to provide options for learning and career advancement. The counselors at the labs also coordinate a network of area social services when student needs present and they are referred to a variety of community, social and family service agencies. The academic blended e-learning supports and the additional facilitated counseling and outreach services provided at the TTeSN e-learning labs are designed to be both supportive and comprehensive, and since the labs have been operational for a decade, the time is ripe to conduct a thorough program review.

The Current Study

The purpose of this study was to evaluate outcomes of the TTeSN virtual e-school which has been operational now for more than a decade. It is intended to shed light on important questions that are critical to understanding the potential of virtual schools as options for high school students in the State of Oklahoma. It is hoped that the study might provide secondary school leaders with additional insights as they consider the proposition that high school students working in virtual e-learning conditions may prefer and perform differently in virtual schools compared to students in a traditional monolithic learning environment. The hypothesis and conceptual supposition of this program review is that when students are involved in technology enriched e-learning activities that are tailored to meet individualized learning needs, and when electronic access to learning content and activities can take place any time and any place, they will prefer the e-learning model and demonstrate similar levels of academic performance to their peers who have participated in traditional learning settings.

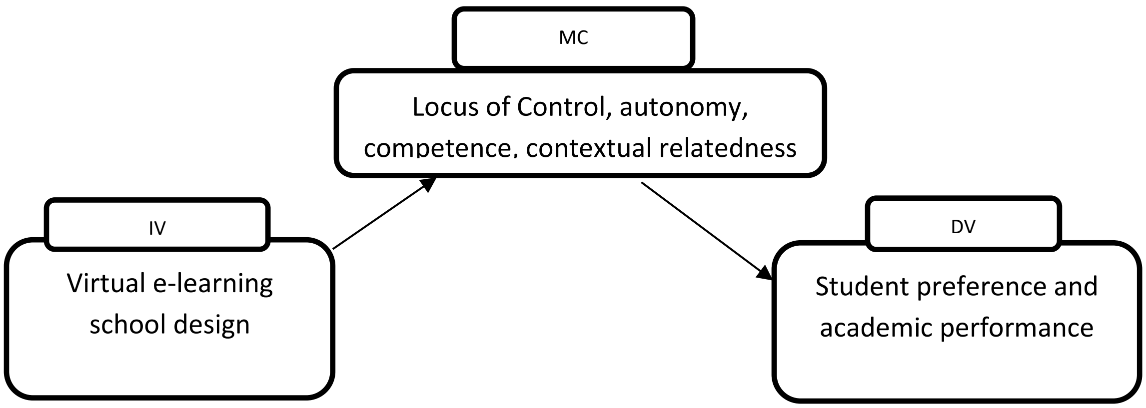

Figure 7. *Theoretical/Conceptual Model for the Evaluation Study.*

The model in Figure 7 provides a synopsis of the hypothesized relationships between key variables in the study that occupied the current evaluation study of TTeSN. In summary, technology-enriched student-centered virtual e-learning school design can be considered as an independent variable (IV), and student preference and academic progress can be viewed as the dependent variables (DV). Perceived levels of locus-of-control and self-regulation: (locus of control, autonomy, competence and contextual relatedness) should be considered as mediating conditions (MC) (see Figure 7).

In the next chapter, the method used to answer the study research questions is outlined. This is followed by a presentation of the results, and a discussion of the findings, the study limitations, and the implications of this research for policy and practice.

Chapter 4: Method

The purpose of this study was to evaluate outcomes of the TTeSN virtual e-school that has been operational for a decade. It is intended to shed light on important questions that are critical to understanding the potential of virtual schools as options for high school students. It is hoped that the study might provide secondary school leaders with additional insights as they consider the proposition that high school students working in virtual e-learning conditions may prefer and perform differently in virtual schools compared to students in a traditional monolithic learning environment. The hypothesis and conceptual supposition of this program review is that when students are involved in technology enriched e-learning activities that are tailored to meet individualized learning needs, and when electronic access to learning content and activities can take place any time and any place, they will prefer the e-learning model and demonstrate similar levels of academic performance to their peers who have participated in traditional learning settings. The following questions framed the evaluation study:

1. Do students in a virtual e-learning courses prefer these learning experiences over their previous traditional school setting experiences?
2. Is there a difference in course completion rates in e-learning learning platforms compared to a traditional face-to face approaches?
3. Is the number of days spent on completing e-learning courses related to performance levels on end of course grades?
4. Do students perform at similar levels on state instructional exams after completing an e-learning course as their peers who have completed the same course content in a traditional school setting?

Program Context

This program review takes place in the context of a virtual e-learning consortium consisting of 14 public and private (K-12th grade) school districts in the heartland of the country. The consortium launched in 2010 and preceded the state of Oklahoma's 2011 mandate requiring public schools to provide virtual learning opportunities for students. Tulsa Technology Center launched the e-School Network (TTeSN) as an outgrowth of a year-long task force formed among area public schools that focused not only on impending legislation related to virtual learning, but also on innovative provisions of virtual e-learning. TTeSN enrollment data for 2019 reflected that 780 high school students accessed technology enriched virtual e-learning courses through the e-learning labs referenced as Success Centers which is double the number of students served at the program's inception in 2009. The five virtual e-learning labs that were a part of this study are located throughout the region and sponsored by the TTeSN. To date, the labs have been serving high school students (9th-12th grade) for a decade; hence, it is timely to provide a comparative analysis of how students matriculate through the e-learning courses in comparison to how students perform in traditional face-to-face instructional design.

Each lab implemented virtual e-learning programming with mirrored strategic design and policy measures. The labs were operated in close fidelity with the same professional development model that was delivered. There were 25 highly qualified adjunct instructors and counselors who served students throughout the five centers, and most of the staff had worked in the program for at least two years. The staffing design of the labs included two highly qualified Oklahoma State Department of Education certified instructors as well as a certified school counselor. The student/teacher ratio for this report is calculated by the number of students served while completing a course served by ten instructors that served as faculty in five different learning labs throughout the Tulsa region. The student/teacher ratio was less than 20:1 throughout the two school years under review.

Students paid a nominal registration fee to participate in the program conducted during evenings and summer hours. The fee was waived for students that were eligible for free-reduced lunch. Students ranged in age from 15 to 20 years and lived throughout Tulsa County. Students were referred to the TTeSN e-learning labs by counselors and teachers from their local high schools. Students had the freedom to virtually access course content 24 hours per day. Students also had opportunity to access highly qualified teachers and counselor support at the e-learning labs in the evenings on a weekly basis. Students were not required to attend for a specific number of hours or days as they could access the learning content anywhere and anytime. Students were encouraged to attend and check into the labs on a weekly basis to insure they were tracking and pacing themselves toward course completion. Each of the students were also concurrently enrolled in traditional school settings at their respective local high schools.

Data Sources

This research report was informed in part by a survey of students that participated in TTeSN virtual e-learning labs (see Appendix A). This purposive, non-random sample survey primarily sought high school students' feedback of preferences and satisfaction as they reflected on their technology-enriched virtual e-learning experiences. Secondarily, the survey was intended to inform future research about how academic performance might be influenced by the constructs of autonomy and locus of control in an e-learning platform. The survey was used to help provide analysis of the first research question that asks: “Do students in a virtual e-learning course prefer the learning experiences more than they did in their previous traditional school setting?”

The fourteen-question purposive sample survey was distributed over a three-week period in March 2018 to all students (*N* = 150) that were accessing e-learning content at the five area TTeSN virtual labs at that point in time. It is noteworthy that the surveyed cohort group is not the same sample of students whose course performance and test scores are analyzed separately in a later part of this evaluation study.

Quantitative research specialists have noted that a purposive sample can serve as rationale for seeking feedback from students that represent an unusual group (Vogt, 2007, p. 82), and to date there are no known and similarly designed e-learning labs throughout the state of Oklahoma. The survey was designed to seek clarity about the hypothesis that when students are provided with the freedom to engage in blended virtual e-learning course at their own pace and consumed at their convenience, then they will prefer the learning platform more than they did with a face-to-face traditional course delivery. Scholars have reported that two informal purposive sampling methods can be helpful in facilitating generalizations: heterogeneous instances and purposive sampling; the former reflects diversity on important dimensions, and the latter aims to explicate specific observations (Shadish, Cook & Campbell, 2002, p. 23-24). Thus, the survey results should be interpreted cautiously, yet the survey was “representative in a purposeful sense” (Vogt, 2007, p. 81).

The survey's external validity was supported in part because it was given to all students participating in the TTeSN during a given point in time. Those surveyed were representative of previous TTeSN students over the past decade as the respondents were similarly representative and diversely distributed in accord to the Tulsa area demographics of the 14 area Tulsa area high schools served by TTeSN (see Table 1).

Instructors distributed paper and pencil surveys to all students attending the TTeSN labs during the month of March. Students were given opportunity to respond to the survey anonymously throughout a three-week period as they presented in person at the e-learning labs. A return rate of sixty-eight percent (N = 108) were gathered and forwarded to the researcher. Eight more females than males responded to the survey. Several students identified themselves in more than one race/ethnicity category, and approximately forty-two percent of the respondents indicated that their race/ethnicity was White/Caucasian and the remaining portion of the students were distributed in close accord to the demographics of Tulsa County. The exception to this regional comparison was with students who identified themselves as Black or African American which comparatively was approximately 14 percentage points higher than the Tulsa County demographic report (US Census, Vintage Estimate Population Program Report, 2018). The variables of prior knowledge and experience was tabulated by reviewing the participants' grade level in school and the number of e-learning courses they had experienced.

Table 1

Study Sample by Demographic Characteristics

Race/Ethnicity	American Indian/Alaskan Native	Asian/ Pacific Islander	Black/ African American	Hispanic/ Latino	White /Caucasian	Prefer not answer/ other
N=Number of students	N=18	N=2	N=31	N=15	N=52	N=6
Percent of Survey Respondents	15%	2%	25%	12%	42%	5%
Tulsa County/US Census Demographics	6.8%	3.4%	10.8%	13%	61.6%	6.1%
Gender	Female:	Male:	Other:	Total:		
N=Number of students	N=56	N=50	N=2	N=108		
Grade Level	9th	10th	11th	12th	Other	Total:
N=Number of Students	N=11	N=11	N=38	N=34	N=14	N=108
Number of e-learning classes	Zero courses:	One course:	Two courses:	Three courses:	Four or more:	
N=Number of students	N=4	N=48	N=29	N=15	N=12	

Measures and Instrumentation

The proprietary learning management system (LMS) that electronically managed and logged the content and progress for secondary students in the TTeSN e-learning labs provided data related to historical student progress and course completion which framed the research of the study's second question related to comparing course completion rates in an e-learning setting versus traditional school design. The researcher reviewed the LMS and logged the performance and completion data for over 500 courses during the

2012-13 and 2013-14 school years. Students were coded for anonymity, and data profiles of students (*N*=382) who completed one of four core academic courses were analyzed and compared according to the following:

- Number of days of persistence to complete a specific English and math virtual e-learning course.
- The influence of time spent on virtual e-learning course in English and math compared to course grade point averages.

Analytical Approach

Table 2 displays the analytical approach used to answer each of the four research questions and the data sources used to do so are outlined in table form (see Table 2 below). A Chi Square test was conducted to understand difference in student learning platform preferences (traditional, online, blended) and levels of satisfaction with the TTeSN e-learning program. Lastly, qualitative feedback was reviewed from the responses provided to an open-ended question about the TTeSN experience.

The analysis of the second research question related to course completion rates of virtual and traditional courses was conducted by analyzing LMS data. This allowed the researcher to generate a summative report comparing the number of days that it took each student to complete virtual e-learning English and math courses. The researcher used the report to compare the length of time that students spent on virtual e-learning courses to the same semester long courses delivered in a traditional face-to-face classroom setting. A two-tailed *t*-test was conducted to compare the *Mean* number of days needed to complete an e-learning TTeSN course as compared to traditional school calendar courses. Distribution tables for each of the four TTeSN courses were developed to

Table 2

Overview of Research Design.

	Research Question	Analytical Approach	Data Source
1	Do students in virtual e-learning courses prefer the learning experiences overt their previous traditional school experiences?	Descriptive Chi Square Qualitative review	-Student Survey -Survey Responses -Open-Ended responses
2	Is there a difference in course completion rates in e-learning learning platforms compared to traditional face-to face approaches?	2 tailed t-test Coefficient of Variance Central Tendencies Histograms	-Course means -Days to complete courses -Distribution tables -Days to complete courses
3	Is the number of days spent on completing courses related to performance levels on end of course grades?	Pearson's correlation Coefficient Cohen's *d* effect size	-Linear strength and association between variables of time spent on an e-learning courses and the influence on course grades. -Provide a standardized measure of confidence about the magnitude of the effect on grades earned for students in two separate groups.
4	Do students perform at similar levels on state instructional exams after completing an e-learning course as their peers who have completed the same course content in a traditional school setting?	Chi square Chi square ANOVA	-District EOI scores/Treatment group EOI proficiency results -Comparing FRL student group EOI results -Comparing influence of days on EOI performance results

provide statistical information on the central tendencies of these data. Additionally, calculating the *SD* helped to quantify the amount of variation in the number of days to complete the e-learning courses. A Coefficient of Variance *(CV)* was calculated by dividing the *SD* by the *Mean* to provide a comparison of the rates of variability of course completion in an e-learning lab to a face-to-face traditional course. The *CV* for the traditional face-to-face design provides a basis of basis of comparison for course completion of e-courses, since the traditional course *CV* equals 0—all students finish the course at end of an eighty-five-day semester; therefore, there is no variability in the amount of time to complete traditional courses. A histogram on course completion rates was generated based on 30-day time intervals as traditional schools often provide progress reports to students at six-week intervals.

The third research question focused on the relationship between the variables of time spent to complete e-learning courses and grades earned. The end of course grades of students who completed a virtual e-learning course (English II, English III, Geometry, Algebra II) were analyzed to determine the linear influence and the statistical magnitude of the effect on grades earned when comparing shorter and longer time spans to complete the expectations for the course. The GPA mean served as a dependent variable and was analyzed by creating two-banded ranges based on the number of days that students took to complete the e-learning courses: (1-65 days, 66 + days and beyond). The researcher chose to examine the influence of days spent on all four courses in two bands after reviewing the distribution tables which revealed that the *Mean* for both English III and Geometry was at 66 days to completion which was a shorter time span than English II and Algebra II. These banded ranges provided variables to statistically investigate the

(Cohen's *d*) effect size of days spent to complete an e-learning course and the influence or correlation on end of course grades. The Pearson's product moment correlation coefficients provided a statistical review to compare the linear relationship between the cohort and the two-banded groups of course grades. The groups were statistically analyzed in an effort to analyze if length of time spent on a course influenced the final course grades.

The fourth research question prompted inquiry about performance levels on Oklahoma's End of Instruction (EOI) exams, so the evaluation report compared the overall EOI state test proficiency rates of a treatment group to the proficiency scores of groups of a high school district comparison group. The treatment group for this research consisted of 102 students from three high schools who took at least one academic course (English II, English III, Geometry, Algebra II) via the TTeSN virtual and blended e-learning lab and who also took the accompanying mandated Oklahoma End of Instruction (EOI) exams with their high school cohort upon completion of the e-learning courses. The EOI scores for the treatment group were secured from the high schools via a Memorandum of Understanding agreement between the researcher and the districts which insured confidentiality and anonymity of student names. The EOI proficiency rates of the treatment group were compared to the school-wide proficiency rates for full-academic year students.

The proficiency rates were reported in percentage bands and reflect the publically reported OSDE state testing results for the years 2013 and 2014. The performance bands of each mandated EOI subject test were reported as Not-Proficient ("Unsatisfactory," "Limited Knowledge") and Proficient ("Proficient," "Advanced"). The researcher combined the subject test performance reports of three high schools where the Treatment Group students attended to be compared to the District Group; ultimately the data from each of the three high school proficiency score bands were combined and reported as one cohort group just as the treatment group of students were combined in a cohort to allow a comparative summary of performance on each subject test. A *Chi Square* analysis was conducted whereby the proficient and non-proficient results were compared between the Treatment Group and the District Group. Additionally, another *Chi Square* analysis was conducted to compare EOI proficiency rates of students identified as Free and reduced Lunch (FRL).

The final step of analysis involved conducting a one-way ANOVA test of independent measures to analyze the statistical significance of the influence of time spent to complete an e-learning course on EOI exam scaled scores. Each academic course was examined by considering the scaled EOI score as a dependent variable and the time spent to complete the courses as an independent variable.

Chapter 5: Results

Research Question 1

Do students in virtual e-learning courses prefer these learning experiences over their previous traditional school setting experiences?

Survey Analysis

Students were asked to respond to the 14-question survey related to perceptions about their participation and experiences in the TTeSN virtual e-learning labs as they worked on completing academic course work. Students were asked to respond to questions that probed levels of satisfaction with the virtual and blended e-learning model course design by responding on a five point Likert-type scale ranging from "strongly agree" to "strongly disagree" with a mid-range response of "neutral." Additional questions were surveyed to review learning platform preferences as well as preferred features of face-to-face compared to e-learning. A final question was open-ended and allowed for narrative responses about experiences in the TTeSN e-learning labs.

One scaled response question specifically targeted responses about course progress, expectations for the course, and if the course was a good experience, and 91 percent agreed or strongly agreed that they were satisfied with the TTeSN instructional delivery and assistance offered. Survey question six examined responses to preferences between traditional face-to-face, blended, and online virtual models of instructional content delivery. A chi-square statistical test of independence was performed to examine the relation between learning platform preferences (question six) and levels of satisfaction with the TTeSN e-learning program (question ten). The relationship between the variables of face-to-face, online and blended e-learning and satisfaction with the e-learning program was not statistically significant at the $p < .05$ level, χ^2 (2, N = 108) =

6.833, $p = .554$. Essentially, the variables of learning platform preferences were independent of one another and showed no significant influence on levels of satisfaction with the TTeSN e-learning program. Additionally, the majority of students expressed their preference for virtual and blended delivery models when asked to select their preference for content delivery: over half, 58.9 percent, of the students answered they preferred a blended learning platform (see Figure 8).

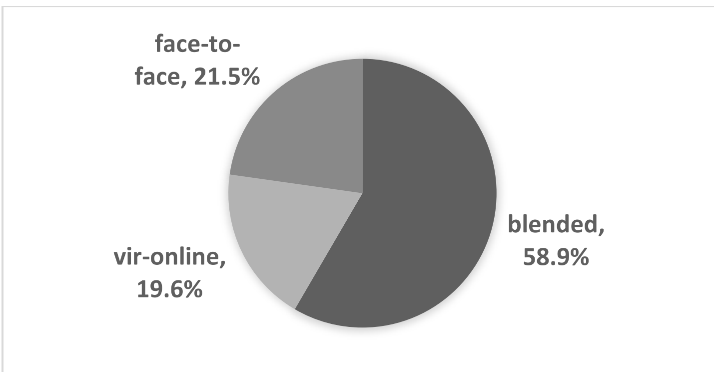

Figure 8. *Learning Platform Preference of TTeSN Students.*

A more granular question was posed regarding which instructional delivery platform most effectively supported their learning: 47 percent of the students reported that a blended e-learning environment that includes virtual and face-to-face support provided the best opportunity for them to do their work compared to 22 percent who selected fully virtual-online platforms as their preferred learning platform, and 30 percent who designated that face-to-face delivery provided the optimum learning environment (see Figure 9).

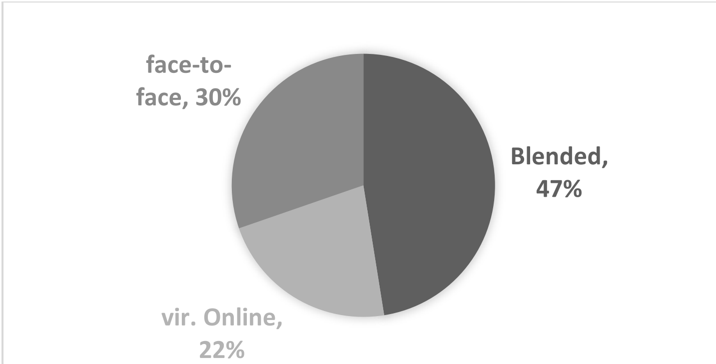

Figure 9. *Optimum Learning Environment Described by TTeSN Students*

Another survey question asked students to indicate on a 5 point Likert type scale how strongly they agreed with statements regarding experiences while taking the academic courses in the blended e-learning labs: 85 percent of the students felt the e-learning courses were a good experience, 86 percent reported that courses were meeting their expectations, and 82 percent responded they were satisfied with their academic progress.

The survey also asked students about advantages and disadvantages of traditional and virtual e-learning platforms. Students indicated the three top advantages to virtual e-learning options included:

1. flexibility of scheduling,
2. time given to complete assignments,
3. rate/speed by which a class can be completed.

This was in contrast to the three top advantages selected in face-to-face traditional class delivery which included:

1. hands-on options,
2. effective assistance,
3. feedback

The final survey question sought open-ended responses to comments, suggestions, and concerns about the e-learning lab delivery and design (see Appendix A). The responses were coded as positive or negative based on the narrative descriptors and adjectives used. Examples of positive feedback included the statement “This experience so far has been much better than my high school's credit recovery program,” and another positive sample included “I would love if this Success Center stay around for all people to get help from it.” Negative responses focused solely on concerns about younger students being allowed to participate and characterized by such statements as “The middle schoolers’ shouldn't be able to attend!!!” Yet, the positively coded responses outnumber the negative responses at a ratio of 13:3.

Summary: Question 1

Overall, the survey responses supported the hypothesis that a slightly larger proportion of students preferred the virtual e-learning lab format over a traditional face-to-face design. However, statistical differences in preferences and satisfaction were not found. The features of anytime and everywhere learning opportunities where thematic reasons that students preferred the e-learning options. Open-ended responses indicated a strongly positive experience for those participating in the e-learning labs.

Research Question 2

Is there a difference in course completion rates in e-learning learning platforms as compared to traditional face-to face approaches?

Tulsa area school districts’ routinely design their face-to-face academic calendars over a period of 175 instructional days broken into two semesters which span between

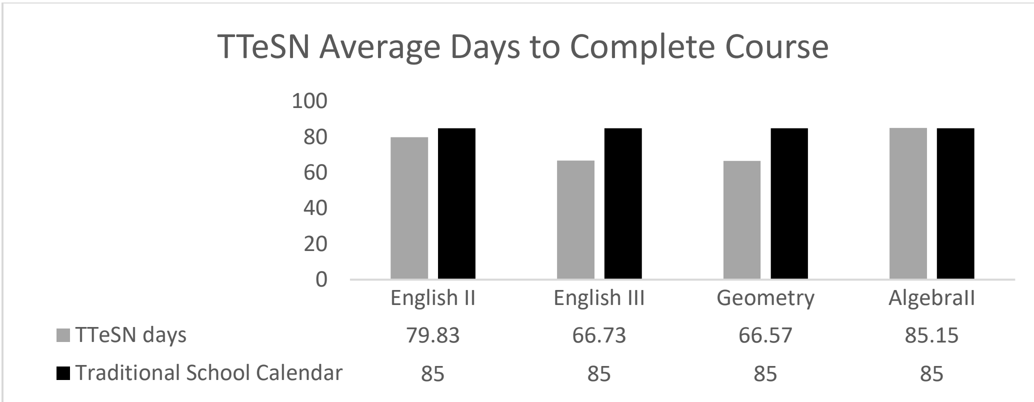

Figure 10. *TTeSN Average Days to Complete e-Learning Course Compared to Traditional School Calendar.*

83-87 (85 average) days for all students to complete. This is in contrast to the TTeSN design where students progress at their individual speed/pace to course completion. Thus, the mean of a traditional school semester course is known to be 85 days. A cursory review for two of the analyzed academic courses indicates there is evidence of a difference in the average number of days to complete a semester course in a virtual versus blended e-learning school model (see Figure 10). A single sample t-test was used to statistically compare the TTeSN course completion means of each course. This statistical analysis was conducted to test the null hypothesis that there would be no difference in the known traditional course completion mean and the sample mean of the TTeSN courses (see Table 3).

The t-test revealed that TTeSN students spent less time on average to complete English III coursework ($M = 66.73$, $SD = 52.81$) than their traditional face-to-face peers, $t(105) = -3.713$, $p < .05$. Similarly, TTeSN Geometry students spent less time on average completing their coursework ($M = 66.58$, $SD = 45.20$) than found in a traditionally delivered course, $t(82) = -3.713$, $p < .05$. Therefore, the null hypothesis that there was no statistical difference between the mean of a traditionally delivered course and a TTeSN

Table 3

Single t-test Results for TTeSN Days to Course Completion.

Course	***TTeSN Mean***	***SD***	***t-statistic (2tailed)***	***p-value***
English II	79.83	52.81	-.652	.516
English III	66.73	52.81	-3.562	.0005*
Geometry	66.58	45.20	-3.713	.0004*
Algebra 2	85.15	52.18	.141	.888

course was rejected for the English III and Geometry courses. Conversely, the null hypothesis was retained for both the English II and the Algebra 2 courses, leading to the conclusion that there was no statistically significant difference between the average completion times these two TTeSN courses as compared to the same courses delivered in a traditionally delivered setting.

Days to complete the e-learning TTeSN courses were widely dispersed around the mean for each course, so a comparison of the coefficient of variation was conducted to describe the spread of days about the mean. Days to complete courses served as independent variables (IV), and the data revealed there was 85 percent of variance in the mean for English II, 79 percent of variance in the mean for English III, 64 percent of variance for geometry, and a 57 percent variance in the mean for Algebra II (see Figure 11). This means that while e-learning students completed two of the four courses earlier on average than the traditional courses, many students were completing e-learning courses much more slowly than the traditional courses.

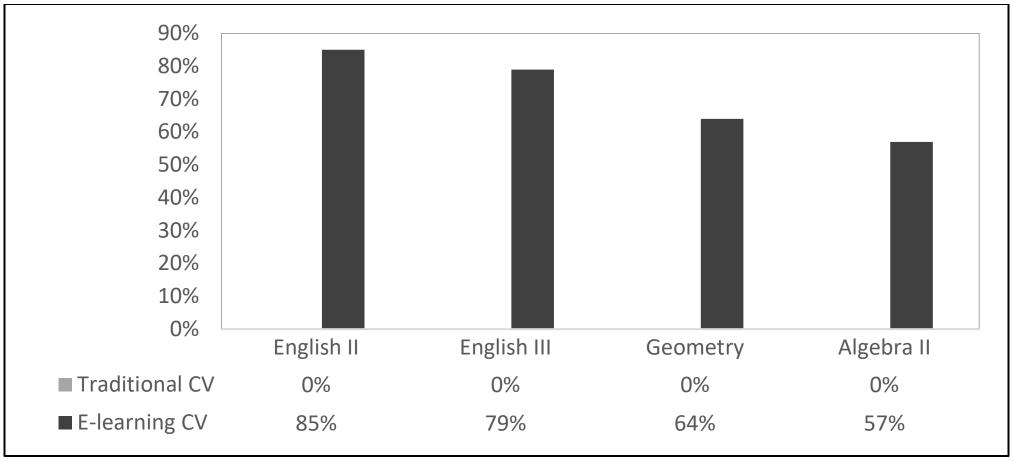

Figure 11. *TTeSN Correlation of Variance of Mean Course Completion: Comparing Traditional to TTeSN Platforms.*

A more intimate review of the LMS data logs confirm this. They revealed that, while a number of students completed core courses much faster than the reported mean, others took longer to complete course expectations. A series of histograms of each course completion rate by student were generated (see Figures 12-15). An extended review of the English II distribution shows there was a wide spread in the amount of time that it took students to complete with some substantial outliers. One outlying student completed the course in six days and another took 364 days to complete the same course, yet collectively 68 percent (*N*=62) completed the course in 85 days or less. The English III median of 53.5 was the lowest of the four e-learning courses reviewed. The distribution of English III scores was widely spread, yet approximately 72 percent of the students completed their e-learning course at a faster pace than their peers in traditional school settings. The Geometry distribution shows there was a distribution ranging from 7 days to 244 days with a median score of 56. Approximately 75 percent of the students completed their Geometry e-learning course work in fewer than 86 days indicating that the largest majority of students in the e-learning virtual platform completed geometry course work faster than peers in a traditional face-to-face school semester. The analysis for the TTeSN Algebra II e-learning course revealed the mean of completion rate mirrored that of the mean of a traditional face-to-face learning platform. Yet, the spread of variation for the e-learning platform showed that there was a range of 276 and a standard deviation of 52.18.

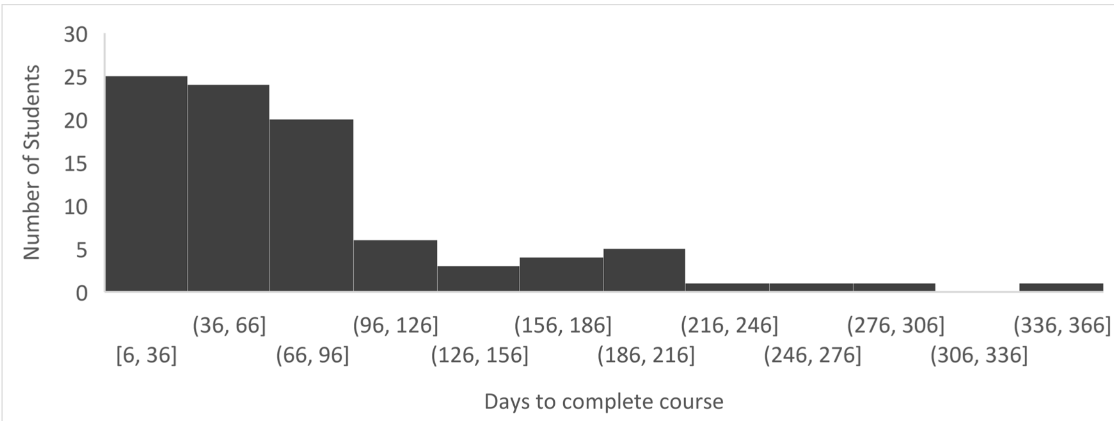

Figure 12. *TTeSN-English II Course Completion Histogram.*

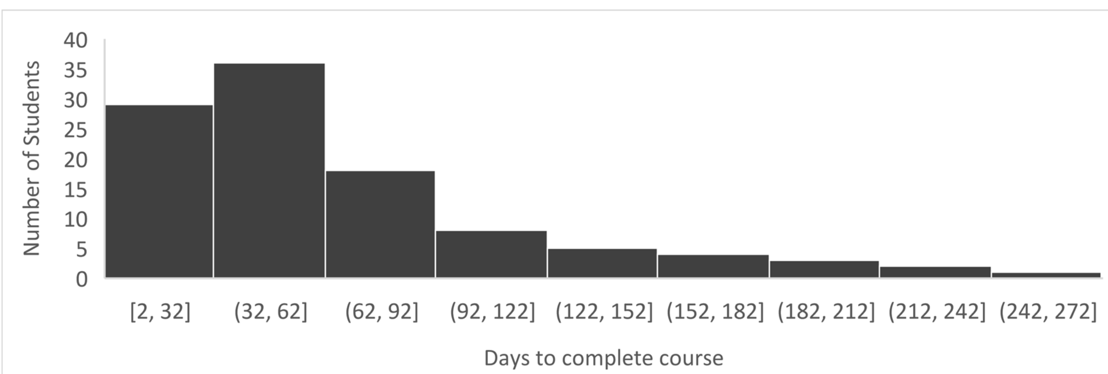

Figure 13. *TTeSN-English III Course Completion Histogram*

The LMS evidence ultimately revealed there were more than 60 percent of students completing English courses at a faster pace than the mean which was also at a faster pace than a traditional 85-day face-to-face delivery. Moreover, over 50 percent of Geometry and Algebra II students completed their e-learning math courses faster than the mean of

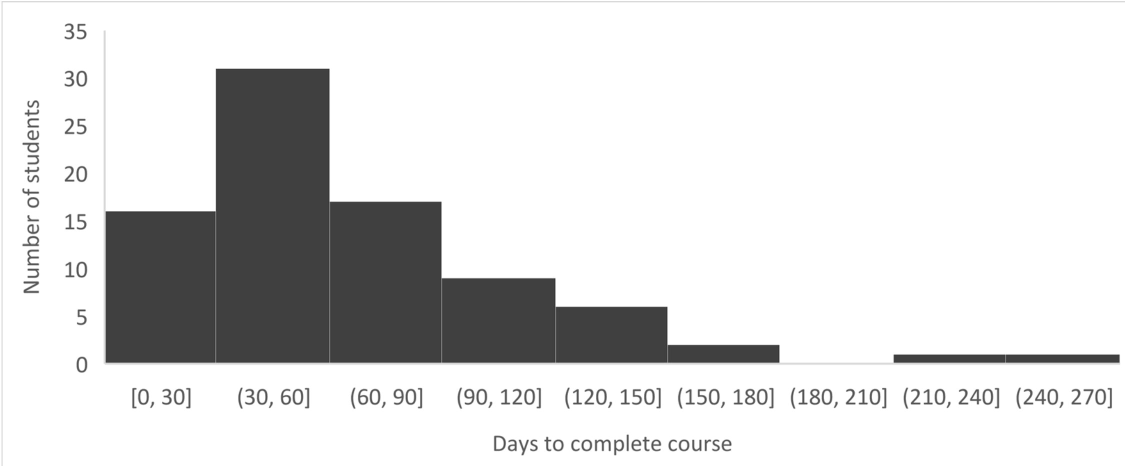

Figure 14. *TTeSN-Geometry Course Completion Histogram*

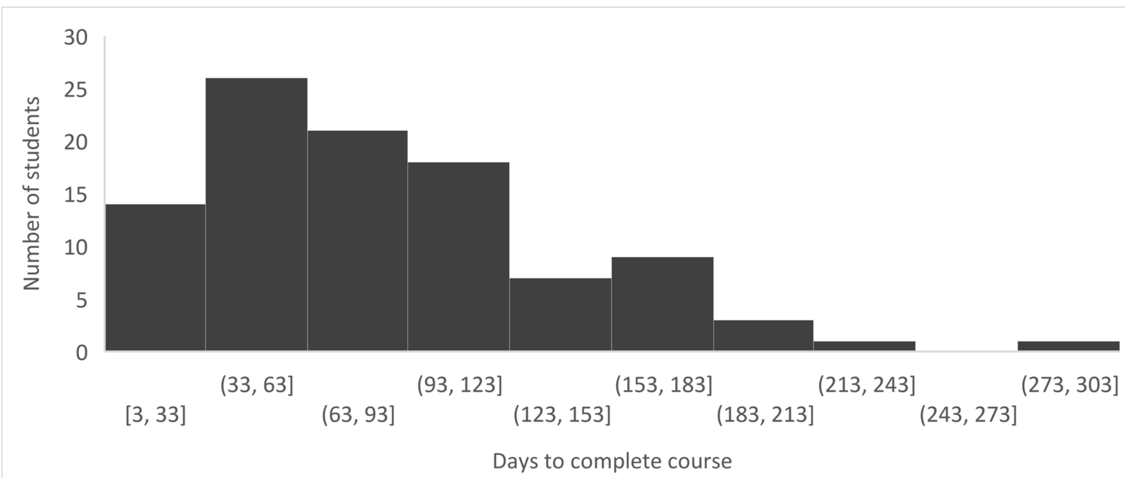

Figure 15. *TTeSN-Algebra II Course Completion Histogram*

the TTeSN cohort. Conversely, there were also students who lingered on all four e-learning courses which had an influence on the mean for each of the cohorts. The TTeSN policy provisions permitted the outlying individual students extended time to fully complete the expectations to earn a course grade. The 30-day histogram bins reflect the number of days to e-learning course completion. Thirty day bins could be compared to a six-week progress report in a traditional school setting, and the histograms provide a visual contrast in completion rates versus the traditional school 85-90 instructional day semester.

Summary: Question 2

The data analyzed from LMS logs supported the inquiry about the length of time that it took e-learning students to complete the expectations for their courses. There were some students that took longer to complete their high school English and math e-learning courses than their peers in a traditional face-to-face learning platform, but on average, TTeSN students in English III and Geometry completed their e-learning courses at a faster pace. Some TTeSN students took advantage of the extended learning options. It is likely that these students might have earned a lower or failing grade under the time constraints of the traditional course calendar completion expectations—a question the answer to which is at the heart of the next research question. What is clear from this analysis is that students in a virtual e-learning platform engage and complete their high school English and math courses an highly individualized pace which is different than the traditional monolithic face-to-face model where all students finish the course at the conclusion of a defined school calendar.

Research Question 3

Is the number of days spent on competing e-learning courses related to performance levels on end of course grades?

Statistically, this research question was framed by a null hypothesis that there is no statistically significant relationship between grades earned among students who spend more time on e-learning courses. The number of days to complete courses was considered an independent variable (x axis), and grades earned was considered as the dependent variable (y axis), and Grade Point Averages (GPA) were tabulated for the end of course grades earned in each of the four e-learning courses.

A test of correlation was calculated to determine the measure of linear strength and association between the variables of time spent on an e-learning courses and the influence on course grades (see Table 4). A Pearson's product moment correlation coefficient was calculated for each of the TTeSN e-learning courses in relationship to student GPA. The statistical analysis yielded no significant linear association for any of the four e-learning courses between the number of days spent and the overall earned course grades at the .05 level.

Table 4

TTeSN Pearson's Correlation Coefficient Results

TTeSN course	*r*(degrees of freedom)	Coefficient of determination=R^2	*p*-value
English II	*r*(90)= -.059	.004	*p*=.577
English III	*r*(102)= -.126	.016	*p*=.198
Geometry	*r*(81)= -.061	.004	*p*=.584
Algebra II	*r*(98)= -.123	.015	*p*=.222

Previous analysis indicated a wide spread in the number of days to course completion additionally it was determined that there was a large variance about the mean for each of the four studied course completion rates (see Figure 11). Ultimately, a model was chosen to compare the influence on GPA when e-learning students spent approximately 75 percent as much or more time as they would to complete a course in a traditional school model. Consequently, the researcher chose to analyze the GPA of two groups: one group represented students who spent 65 days or less to complete their courses and the comparison group represented students who spent more than 65 days to complete the same courses. Table 4 reports the differences in time spent on course completion and mean scores for earned letter grades (see Table 5).

Table 5

TTeSN Average Number of Days to Complete Course and GPA Means

GPA mean Course	GPA mean 1-65 days	GPA mean 66 + days
English II: 2.19	2.22 (*N*=51)	2.15 (*N*=41)
English III: 2.34	2.41 (*N*=68)	2.18 (*N*=36)
Geometry: 2.33	2.29 (*N*=51)	2.38 (*N*=32)
Algebra II: 2.22	2.43 (*N*=40)	2.08 (*N*=60)

Table 6 displays the results of the one-way ANOVA analysis of student grades by course completion under 65 days and above 65 days. The Cohen's *d* (1992) effect size was calculated to provide a standardized measure of confidence about the magnitude of the effect on grades earned for students in two separate groups. The analysis revealed students spending between one and sixty-five days to complete an e-learning course yielded a GPA mean higher than students grouped in the category that spent more than sixty-six days to complete in three courses, but this difference was not statistically significant. Similarly, the effect size was found to not exceed Cohen's *d* convention for a small effect: English II (d = .296), English III (d = .032). The magnitude of the influence of days spent to complete the Algebra II course was stronger than the English courses, but the effect size did not meet Cohen's threshold for medium effect: Algebra II (d = .406). Additionally, the spread of the mean between the two groups in the Algebra II course was higher than all other e-learning courses (F-ratio = 3.90) yet similar to the

English courses reviewed, the GPA mean for the students who spent longer to complete the course in group 2 was lower than that of group 1. The Geometry GPA mean was the exception of the four analyzed courses as students in group 2 who spent longer to complete the course had a higher GPA mean than those group 1 students who spent less time to complete the course. Yet, consistent with the findings for the other e-learning courses, the effect size between the two groups for the Geometry course was minimal (*d* = .093).

The null hypothesis was supported as the evidence yielded minimal measures of strength between the independent variable of time spent on course completion between Group 1 and Group 2 and the dependent variable of grades earned in each of the four TTeSN e-learning academic courses.

Table 6

TTeSN Statistical Effect Size Measures

Course	Number of Students	Mean (1-65days)	Mean (66 + days)	f-ratio	p value	Cohen's *d*
Eng II	*N*=92	2.22(.58)	2.15(.56)	.452	.50	.296, small
Eng III	*N*=106	2.41(.75)	2.18(.73)	2.257	.136	.032, min
Geometry	*N*=83	2.29(.96)	2.38(.97)	.137	.712	.093, min
AlgebraII	*N*=100	2.43(.93)	2.08(.78)	3.902	.051	.406, small

Summary: Question 3

Statistical analysis revealed there was no linear association between time spent on technologically enriched virtual blended e-learning courses and the grades earned for the courses. The null hypothesis was that there is no significant difference in the grades earned when spending more time on an e-learning course, and it was retained.

Research Question 4

Do students perform at similar levels on state instructional exams after completing an e-learning course as their peers who have completed the same course content in a traditional school setting?

This question was framed by organizing data for a treatment group and comparing banded group outcomes via a Chi-squared statistical analysis. The treatment group consisted of students from three high schools who took at least one academic course via the virtual and blended e-learning TTeSN. The treatment group also took the accompanying mandated Oklahoma End of Instruction (EOI) exams with their high school cohort upon completion of the technologically enriched virtual e-learning courses (English II: $N = 30$, English III: $N = 35$, Geometry: $N = 16$, Algebra II: $N = 22$). The treatment group's limited small sample size was a consequence of concerns from administrative officials about sharing confidential student testing information. There were three districts willing to contribute to the study by sharing student data after confidentiality agreements were agreed and signed. This analysis was designed to test the null hypothesis that there is no association in state mandated EOI performance outcomes when comparing student groups that have completed course content in a traditional face-to-face delivery and student groups that have completed the same course in TTeSN e-learning labs.

The proficiency rates were organized in percentage bands and reflect publicly-reported OSDE state testing scaled-score results for the year 2013 and 2014. The performance bands for each mandated EOI subject test were recorded as "Unsatisfactory," "Limited Knowledge," "Proficient," and "Advanced." The researcher combined two years of reported subject test performance data from the same three high schools where the treatment group students attended and who also took EOI tests at the high school where they attended. The treatment group students were originally included in the overall district results so those scores were removed from the overall calculation to develop a comparative percentage report. The treatment group sample size was small, so removing the scores from the District Group totals had little influence on the overall percentage comparison. The score bands from the three districts were aggregated and reported as one group cohort just as the treatment group of TTeSN students were combined in a distinct cohort to allow a comparative percentage performance summary on each subject test. Figure 16 displays the EOI proficiency rates for the District and Treatment groups.

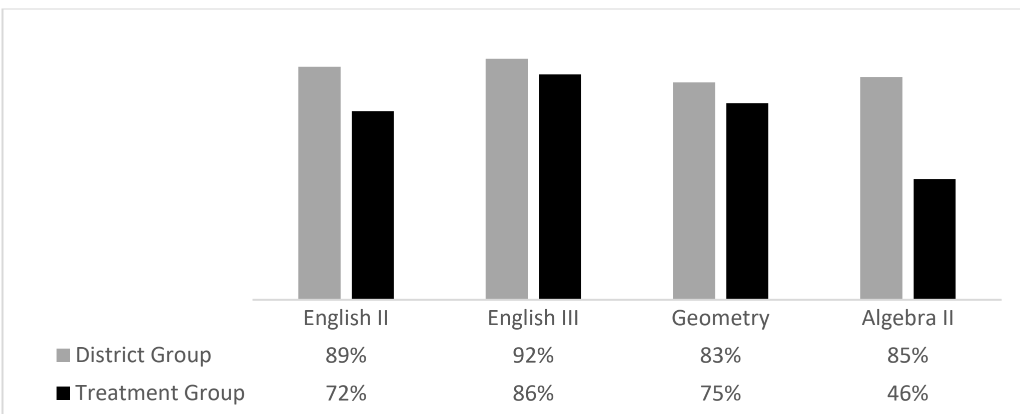

Figure 16. *EOI Scoring Percentages for Proficient and Advanced-Comparing District Group to TTeSN students.*

A Chi-square test of independence was performed to test the null hypothesis that there is no statistical difference of EOI categorical proficiency performance results between students who completed traditional face-to-face instruction (District Group) and those that completed their course of instruction through a technologically enriched virtual e-learning platform (Treatment TTeSN Group). The statistical relation between these variables was found to be significant for the following academic courses reviewed at the $p < .05$ level: English II, χ^2 *(1, N = 29)* = 7.159 , p = .0075, Algebra II, χ^2 *(1, N = 21)* = 28.773 , $p < .001$. Therefore, the null hypothesis was rejected, as the comparative analysis of the EOI exam results indicated a statistically significant difference in academic performance on EOI tests between students that took TTeSN e-learning English II and Algebra II courses and students who took the same academic course in a traditional face-to-face school design. More specifically, the two-year combined percentage of TTeSN students scoring Proficient and Advanced in every core EOI tested subject was significantly lower than those of peers in the traditional face-to-face school setting. Yet, there was not a statistically significant association between EOI proficiency exam scores for the other reviewed test results: English III, χ^2 *(1, N = 35)* = 2.109 , p = .1465, Geometry, χ^2 *(1, N = 16)* = .7204 , p = .3960. Accordingly, the null hypothesis was confirmed for these two courses as there was no significant statistical difference in the EOI proficiency results for students who completed an English III and Geometry course in a traditional course or an e-learning course.

A deeper analysis of EOI test results comparing outcomes of the traditional face-to-face District Group to the Treatment Group revealed *no students* from the English II Treatment Group scored in Unsatisfactory or Advanced categories, and there were no English III Treatment Group students scoring in the Unsatisfactory category. However, the Treatment Group percentage rates were higher than the District Group in the Proficient category for English II, English III and Geometry. Conversely, the District Group percentage rate in the Advanced category was higher than the treatment group percentages in every course reviewed. The largest gap between the District Group and the Treatment Group percentage of Proficiency occurred in Algebra II at a difference of 39 percent.

Further analysis of demographic differences between the treatment and traditional groups also revealed that the percentage of Treatment Group TTeSN free-and-reduced lunch (FRL) students was substantially higher than the District-FRL group ranging from as much as 74 percent in English II to over 190 percent in Algebra II (see Table 7).

Table 7

Comparison of EOI Tested Students Identified as FRL

Course	District : FRL percentage	Treatment: FRL percentage
English II	34%	59%
English III	30%	65%
Geometry	37%	75%
Algebra II	24%	70%

Another Chi Square 2 x 2 test of independence was conducted to examine the statistical relationship of proficiency rates between EOI exams for both FRL groups. The analysis of all four EOI exam results showed there was no significant association between the FRL-District students and the FRL-Treatment Group: English II, χ^2, *(1, N =17)* = .139 , p = .7085, English III, χ^2, *(1, N = 22)* = 1.696 , p = .1929, Geometry χ^2, *(1, N = 12)* = 2.344 , p = .1258, Algebra II, χ^2, *(1, N = 14)* = 1.516 , p = .2183. In other words, after controlling for free-and-reduced lunch status, the differences found earlier disappear—though it is worth noting that the sample sizes for this analysis were quite small and statistical power was low.

Despite not finding a statistically significant association between the EOI proficiency results for the FRL-Treatment Group and the District-FRL Group, the analysis revealed that the percentages of proficiency for the FRL-Treatment Group was less than the FRL-District Group percentages in all four courses. This disparity was most evident in math related courses (see Figure 17).

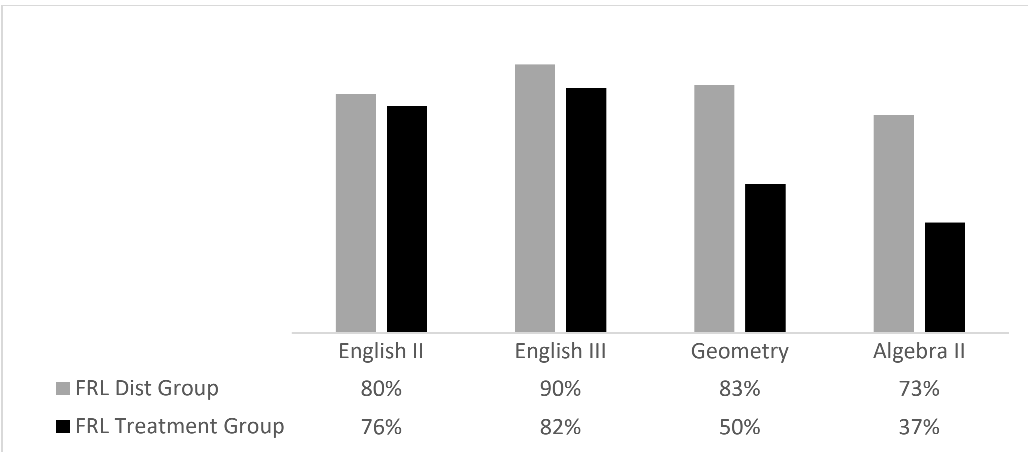

Figure 17. *EOI Scoring Percentages of FRL Students Scoring Proficient and Advanced, Comparing District Group to TTeSN Students*

A one-way ANOVA test of independent measures was conducted as a final inquiry about the relationship and influence of days spent to complete a TTeSN e-learning academic course and associated performance on EOI exams. The ANOVA was conducted to measure the effect of students spending 65 days or less on EOI scaled scores as compared to EOI scores and students spending more than 66 days to complete the same tests. The Treatment Group provided a small sample for the review (English II: $N = 30$, English III: $N = 35$, Geometry: $N = 16$, Algebra II: $N = 22$). No statistically significant relationships between time spent on completing a course and resulting EOI exam scaled scores were evidenced at the $p < .05$ level (see Table 8).

Table 8

ANOVA Table for TTeSN Treatment Group

English II	Sum of Squares	*df*	Mean Square	*F*	Sig
Between Groups	24.491	1	24.49	.012	.914
Within Groups	55174.68	27	2043.51		
Total	55199.17	28			
English III					
Between Groups	235.91	1	235.91	.068	.795
Within Groups	114030.38	33	3455.47		
Total	114266.29	34			
Geometry					
Between Groups	9238.00	1	9238.00	1.509	.240
Within Groups	85170.43	14	6122.17		
Total	94948.44	15			
Algebra II					
Between Groups	3205.01	1	3205.01	1.128	.301
Within Groups	56847.83	20	2842.39		
Total	60052.95	21			

Summary: Question 4

The null hypothesis that there is no statistical difference of EOI performance results between students who completed traditional face-to-face instruction and those that completed their course of instruction through a technologically enriched virtual e-learning platform was rejected for the English II and Algebra II courses; however, the same null hypothesis was retained for the English III and Geometry courses. The evaluation study hypothesized that when students are involved in a technologically-enriched set of virtual e-learning activities tailored to meet individualized learning needs, and when electronic access to learning content and activities can take place any time and any place, then they will demonstrate similar levels of academic performance as compared to peers that participate in the same academic course in a traditional learning setting. However, results from this analysis reveal that students learning in a traditional setting for English and math related courses demonstrated a higher percentage level of proficiency when compared to groups of students that participated in an e-learning lab. The disparity of compared performance levels on state EOI exams was more remarkable when reviewing performance in math related courses than in English related courses. When controlling for economic disadvantage, however, these differences, while remaining large, disappeared statistically perhaps due to lower statistical power.

This analysis further indicated there were no differences when comparing the amount of time spent completing an e-learning course and Oklahoma criterion referenced EOI exam results. Alternatively, there is evidence that some individual students scored at higher performance levels on statewide EOI exams after completing an e-learning course compared to other students who performed at lower levels after completing traditional face to face courses, and there is evidence that some e-learning students spent fewer than 65 days to complete their courses and scored in the Proficient and Advanced score band ranges.

Chapter 6: Discussion, Implications, and Suggestions for Future Research

The findings of the study reveal no definitive academic benefits that can be attributed to the Tulsa virtual e-learning network despite a majority of students participating in TTeSN preferring the e-learning format. In some courses, academic outcomes were poorer for those students participating in TTeSN, but these differences disappeared when controlling for economic disadvantage. However, in no cases were academic outcomes superior for students participating in TTeSN as compared to the traditional format. With virtual e-learning being a dominant learning platform moving forward, educators and policymakers have a responsibility to learn more about how students are faring in e-learning environments and how they might improve poor outcomes associated with such platforms.

Contemporary thought leaders propose that K-12 education is at the beginning of what many hope will be a systemic transformation toward personalized learning (Goss, Tuchman, & Patrick, 2018). From this perspective, this study is timely for several two important reasons. First, virtual enrollment trends both nationally and throughout Oklahoma are growing largely because families and students appreciate the flexibility and options that virtual e-learning platforms provide. Second, discussions related to the effectiveness of virtual e-learning platforms has been thrust to the forefront as a consequence of suspended face-to-face school operations resulting from the COVID-19 global pandemic. As schools prepare for re-starts, there are recurring concerns about the effectiveness of virtual e-learning compared to traditional learning designs. Those with concerns may find this study's findings useful, however they are still not enough; while distance education and virtual learning have been studied throughout the past decade, there are still capacious gaps in understanding about the conditions of effectiveness in virtual e-learning settings.

Currently across the nation, schools are experimenting with personalized learning to better meet each student's unique needs and ensure broader access to learning options, both in response to the pandemic, but also because of broader access to high-speed internet, and the increased sophistication and prevalence of technology options. Many of these experiments have been captured in individual case studies, but the field lacks a broad-based understanding of how personalized learning is emerging in classrooms across the United States. As a result, it is difficult to know the extent to which personalized learning is actually taking hold across the country. The lack of systematic data on personalized learning also makes it hard for advocates and others to identify the kinds of challenges policymakers and practitioners alike may need to address in the years ahead (p. 1).

Oklahoma's public policy makers passed legislation and rules in 2011 to provide elementary and secondary students with virtual e-learning options, and opportunities for K-12 students to engage and participate in virtual and blended e-learning experiences have continued to proliferate throughout the state. Yet, there have been no studies or reports on the effectiveness of virtual e-learning implementation designs in the state of Oklahoma. The 2011 Oklahoma Legislative session mandated that public schools adopt policies allowing students up to five hours of virtual instruction, and recently the federal and state support has been expanding to support this design in Oklahoma's virtual charter schools. Yet, there have been few definitive guidelines and limited professional development opportunities for traditional public school programs to implement such e-learning design features. Ultimately, this evaluation study hoped to add to the understanding and distinguishing characteristics that can be refined by public school and community leaders as virtual frameworks in school settings and consortiums continue to burgeon.

Detailed Summary of Findings

An initial aspect of the program evaluation involved conducting a purposive sample survey of approximately 150 e-learning secondary students in an attempt to more thoroughly assess preferences and perceived optimal learning conditions for learning platforms and options. The surveyed group of students were not the same students that were later analyzed in the empirical review.

A second aspect of the case study involved analyzing two years of historical empirical evidence of over 300 students who completed over 500 individual courses in an e-learning consortium of area public school districts dubbed TTeSN. The data for students that completed a core content course in English II, English III, Geometry and Algebra II was gathered from the Learning Management System that electronically managed and logged progress for students that participated in the five TTeSN e-learning labs. Student names were coded for anonymity.

The study also examined the post hoc influence of virtual e-learning course completion rates on earned end of course grades. The study further analyzed the relationship between the e-learning treatment group performance levels on state mandated End of Instruction exams to the results of a Treatment group. The e-learning treatment group of students also concurrently participated in traditional face-to-face instructional programming at the same district high schools that represented the control group.

The findings of this study align with the data from the U.S. Department of Education and with findings throughout the literature (Bridges, 2014; Watson, 2008) that indicate e-learning enrollments are outpacing traditional enrollments throughout the United States, Oklahoma, and in the Tulsa region. The findings of this study revealed that a larger portion of students indicate a preference for virtual e-learning platforms over the traditional face-to-face school design.

A second finding of this research was that students in a virtual e-learning platform engage and complete courses at a substantially wider range of pace (i.e., more individualized) as opposed to a fixed school calendar, and this customized approach supports course completion as opposed to the consequence of subdued or failing grades that can occur with constraints of time. The individualized self-regulated pace to course completion in a virtual e-learning format also allows for students to move more quickly to course completion than is supported in traditional school settings. This customized and individualized school design aligns with decades of empirical study related to self-determination and autonomy (Deci & Ryan, 1987; Leftcourt, 1976; Rotter, 1954) whereby it has been confirmed that students mostly feel competent when they perform well in school and they feel increasingly competent when teachers provide opportunities or independent work.

The third finding of this study was that there was no discernable linear relationship between time spent on a virtual e-learning course and grades earned for the courses. Additionally, the study yielded no significant evidence that would encourage students to spend more time on a course in order to improve overall end of course grades; however, the study did find that the policy of supporting individualized pace to course completion yielded no course failures. These findings seemingly align with previous findings of the U.S. Department of Education (2010) that reported that blended and purely online learning conditions generally result in similar learning outcomes. The current study's results seem to also confirm previous scholarly findings that found that student past ability, as reflected in GPA, was a significant predictor of success in online classes along with findings of self-efficacy having more of a significant contribution to online classes as opposed to more time (Robyler et al., 2008). Past studies have found that the number of times a student logged into the LMS and the actual minutes that students stayed on the LMS had a positive and significant influence on their scores, which echoes the call for sustained time on task for cognitive learning (Lui & Cavanaugh, 2011), (Gallagher, 2009). Yet, one of the limitations of the current study was that it did not actually analyze the number of minutes logged onto the LMS, rather the current study analyzed the number of days to course completion versus the actual minutes logged onto the course.

Finally, this study found that there was a statistically significant difference between the proficiency rates of students who were trained virtually versus traditionally on standardized end of course exams on Oklahoma's English II and Algebra II end of course exams. Traditional students on average scored higher on EOI tests than virtual students, though there is some evidence that, after controlling for economic disadvantage, these effects might disappear. Lastly, the current study indicated there is no linear relationship between the amount of time spent on completing an e-learning course and

Oklahoma's criterion EOI proficiency. As noted in previous sections of this research report there are no known research reviews related to comparing end of course test scores between virtual and traditional students, so this information is intended to contribute to the void in this topic of research while also serving as a call to action because of the growing number of students enrolling in e-learning school settings.

Limitations of the Study

While this study has broken ground in analysis of a prominent e-learning platform in Oklahoma, I would be remiss to not discuss some clear limitations to the study. One limitation of the study that it is correlational by design; therefore, no definitive claims about cause can be inferred between the program theory of action and the measured effects. Another limitation of the study is the small sample size of students that comprised the treatment group participating in the TTeSN technology enriched virtual e-learning labs. The limited sample size was a result of a small number of students that were advised and chose to access the virtual learning labs to complete their high school graduation requirements while also being required to take the end of instruction test and score proficiently to meet graduation requirements. Although, the state standards of the virtual courses were aligned by local curriculum leaders and in accord to the OSDE learning outcomes in preparation for state end of course exams. It was a choice that the students and their advisors made to take their high school graduation core courses through the TTeSN virtual labs. Additionally, the testing treatment group sample size was limited to three Tulsa County regional school districts that were willing to share student state test scores via a confidential Memorandum of Understanding with the researcher. Because this purposive sample was small for each of the state mandated tests

(English II: $N = 30$, English III: $N = 35$, Geometry: $N = 16$, Algebra II: $N = 22$) and compared to their peers in three high schools over a two school year period, it is not possible to generalize the study's findings beyond this regional consortium. Further research will be necessary to establish generalizability as well as correlation to the newly revised state standards and to the accompanying endorsed state end of instruction national standardized exams.

A third limitation of the study is that the surveys were given to a purposive, non-random group of students ($N = 150$) that were currently taking a virtual e-learning course as opposed to providing responses to the survey questions at the conclusion of the course. Thus, some students may have changed their responses once they had fully completed the courses that were delivered in the virtual platform. A final limitation is the study does not fully examine the number of minutes that a student actually logged onto the content management software to engage in the assignments. Rather, the study examines the number of days that it took for students to complete an academic course as compared to the traditional face-to-face school delivery model. Further research could more deeply review the aspects of this time on task variable.

Suggestions for Future Research

As previously noted in this concluding chapter, the study serves as a call to action for policy makers and education leaders to invest in further research of virtual e-learning designs, given that a growing number of students and families are choosing or being thrust into virtual e-learning platforms. There are many policy and practice interventions which past research suggest might improve the academic outcomes and experiences of students participating in virtual e-learning platforms. In light of the study findings, the following are recommendations for future research as we continue to develop a clearer picture of students' experiences with and academic performance as a result of participating in e-learning school models.

An important question at the heart of future research is ironically the question of what the role of technology is in supporting and enhancing e-learning outcomes. More research is needed on how leaders and school administrators can work collaboratively to design and support school wide computer networks that allow anywhere and anytime digital content delivery and access. Relatedly, we need more research on the effect of digital access and how stakeholders and policy makers play a role in supporting equitable digital community connectivity options for students at their homes, libraries, buses, and throughout their communities. One-to-one student to networked laptop ratios are becoming more common in secondary school settings, and this design might also provide added value to the learning experience. Learning activities supported by such technology can be represented by an enhanced ability to find and retrieve relevant information via the web, increased levels of real-time formative assessment enabling individualized and differentiated instruction, and the creation of virtual networks such as wikis, blogs, and web pages in an effort to extend the boundaries of learning outside the typical school walls and outside the scope of the typical school day (Dunleavy, Dexter, & Heinecke, 2007).

Yet, scholars purport that the mere presence of a technology-rich environment is not sufficient for enhanced teaching and learning or added value. Dunleavy et al. (2007) posit that professional development is a key to helping teachers adapt instruction to leverage unique pedagogical capabilities within one-to-one environments. Thus, more research is needed on whether or not providing more and better targeted professional development to educators in designing and managing personalized learning working in e-learning environments can improve outcomes.

Third, we need to study the effect that more individualized education plans can have on student e-learning academic outcomes. Virtual and blended e-learning is a relatively recent school design model that is gaining popularity as a result of customization and modified learning options. Individualized Education Plans were legislatively mandated over five decades ago for students with disabilities, yet educators have been slow to embrace an individualized learning plan for all students. At present, it is not inconceivable to advocate for a customized and individual learning plan for every secondary high school student. The advent of technologically enriched virtual and blended e-learning options provide a framework to support such individualized customization and this framework is currently changing the way Oklahoma students matriculate through high school, thus additional investigation of the mediating conditions of e-learning in a public school setting are important to add to the growing body of evidence related to such learning platforms.

Collins and Halverson (2009) suggest that, as we rethink education in the age of technology, it is essential to remember that "what gets done and where" holds great promise in the coming decade as the model for learning shifts from a traditional model to a virtual e-learning and blended learning environment. These scholars encourage school leaders to design schools that shift from uniform and/or monolithic learning approaches to a more customized student-centered approach where learners have more autonomy and a genuine locus of control. Promoting such school transformation should also include authentic learning opportunities where extended learning experiences enhance student learning experiences by including project-based learning, thinking-maker learning, internships, service learning, and student internships. This extended learning beyond the school bell and beyond the walls of traditional school calendars will provide opportunity for students to select or modify topics, approaches, products, and presentations of their learning—essentially, engaging students in a culture of designing their own learning path supports learner autonomy and contextual relatedness. This approach helps students gain deep subject area knowledge and develop the skills necessary to thrive in an ever-changing world (Pape & Vander Ark, 2018). These types of models of student-centric virtual e-learning and customization encourages students to use diverse resources to demonstrate knowledge and understanding and rely less on instructors to provide answers to questions. Yet, there is little empirical research into the role that student-centric models have on important academic outcomes for e-learning participants.

What seems clear in light of the study's findings is that establishing stronger linkages between the promise of student-centered e-learning and improved academic performance is needed. One aspect that bears further scrutiny is in how students completing e-learning courses do so at highly-variable and/or individualized rates. Students should be closely monitored in virtual and blended e-learning settings in an effort to promote steady pacing throughout a course of study. Further study is warranted to learn more about designing distinctive learning activities that facilitate positive academic outcomes as opposed to adding and designing activities that simply add to the time it takes to complete a semester of course work. This line of investigation, referenced as competency-based, is further warranted because student attendance rates are a part of the Oklahoma State Department of Education's overall accountability performance outcomes for individual schools and districts.

Lastly, scholars need to conduct many more rigorous studies of the effectiveness of technology-enhanced virtual e-learning frameworks for elementary and pre-school level students. Formative elementary foundational learning skills should not give rise to fate or chance, so school leaders should be cautious and judicious as they design and advise youthful learners to advantage virtual and blended e-learning options.

Conclusions

Oklahoma's public policy makers have passed legislation and rules to provide elementary and secondary students with virtual e-learning options. Consequently, it is important for school leaders to promote instructional inquiry and professional collaboration while designing and implementing effective e-learning in an effort to enhance technical and academic skills and reflective thinking opportunities for students. It is also incumbent upon public high schools to examine their matriculation policies with a clear vision of the influences of e-school design as individualized pace and course completion are determined more by mastery of content than by time in a course.

The literature review and the findings of this evaluation study provide little support for the assertion that virtual and blended e-learning platforms can provide Oklahoma's secondary students with viable and relevant learning options which support expectations for high school graduation as well as support efforts to score proficiently on state mandated tests. Moving forward, for Oklahoma e-learning platforms to meet their promise and potential, greater attention needs to be paid to how stakeholders ensure that participating students perform on-par academically with their traditional course taking peers.

Oklahoma will likely see a steady and continuing growth trend of students preferring virtual and blended e-learning options over the traditional face-to-face learning models as they matriculate through high school. Thus, the need to address these concerns is all that more important. A large number of students both nationally and within Oklahoma are gravitating toward this model of school design, and while the push to provide such technologically enriched e-learning options is growing, school leaders and students should be cognizant that the mere influence of technologically enriched e-learning options are not sufficient and predictable to insure academic success. This study should serve as a note of caution that merely providing e-learning options does not guarantee good learning outcomes.

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Appendix A: Success Center Student Survey

TTeSN Center Student Survey

1. Which campus's TTeSN Center do you attend?

- ○ Broken Arrow
- ○ Lemley
- ○ Owasso
- ○ Peoria
- ○ Riverside
- ○ Sand Springs
- ○ Other (please specify)

2. How much do you agree or disagree with the following statements.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I am satisfied with the quality of **instruction** provided by the TTeSN Center instructors.	○	○	○	○	○
I am satisfied with the quality of **assistance** provided by the TTeSN Center instructors.	○	○	○	○	○
I am satisfied with the help and support that I have received from The TTeSN Center counselors.	○	○	○	○	○

3. Typically, the TTeSN Center instructors responded to my questions in a manner that was: (Select all that apply)

- ☐ Respectful
- ☐ Patient
- ☐ Reasonable
- ☐ Impatient
- ☐ Inappropriate
- ☐ Other (please specify)

4. How many E-Learning courses have you taken?

- ○ 0
- ○ 1
- ○ 2
- ○ 3
- ○ 4 or more

5. How much do you agree or disagree with the following statements.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I am satisfied and pleased with my progress in TTeSN courses.	○	○	○	○	○
My TTeSN courses are meeting my expectations.	○	○	○	○	○
Taking E-Learning courses was a good experience for me.	○	○	○	○	○

6. From your experience, which instructional delivery method do you prefer?

- ○ Face-to-face instruction
- ○ Online instruction
- ○ Both: face-to-face instruction and online instruction

7. From your experience, which instructional delivery methods allows you to do your best work?

- ◯ Face-to-face instruction
- ◯ Online instruction
- ◯ Both: face-toface instruction and online instruction

8. From your experience at TTeSN, what do you consider to be the advantages of**face-to-face instruction**? (Check all that apply.)

- ☐ Hands-on assignments
- ☐ The speed of the instruction
- ☐ The time given to complete assignments
- ☐ Effective assistance with assignments
- ☐ Having a routine schedule
- ☐ Having a flexible schedule
- ☐ The teacher answers my questions in a timely manner
- ☐ Lessons are engaging and interesting
- ☐ The teacher's feedback is useful

9. From your experience at TTeSN, what do you consider to be the advantages of**online instruction**? (Check all that apply.)

- ☐ Hands-on assignments
- ☐ The speed of the instruction
- ☐ The time given to complete assignments
- ☐ Effective assistance with assignments
- ☐ Having a routine schedule
- ☐ Having a flexible schedule
- ☐ The teacher answers my questions in a timely manner
- ☐ Lessons are engaging and interesting
- ☐ The teacher's feedback is useful

10. How much do you agree or disagree with the following statements.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I am satisfied with the TTeSN Center program.	◯	◯	◯	◯	◯
I would recommend TTeSN Center to others.	◯	◯	◯	◯	◯

Demographic and Other Questions:

11. What is your gender?

- ◯ Female
- ◯ Male

12. What is your race/ethnicity?

- American Indian/Alaskan Native
- Asian or Pacific Islander
- Black or African American
- Hispanic or Latino
- White/Caucasian
- Prefer not to answer
- Other (please specify)

13. What is your grade level?

- Grade 9
- Grade 10
- Grade 11
- Grade 12

14. Please share any other comments, suggestions, or concerns.

END OF SURVEY

Thank you for taking this survey!

Press the red button that says: Done.

Appendix B: IRB Approval

The UNIVERSITY of OKLAHOMA

Institutional Review Board for the Protection of Human Subjects

Approval of Initial Submission – Exempt from IRB Review – AP01

Date: July 29, 2015 **IRB#:** 5715

Principal Investigator: Robert M. Franklin, Ed.D **Approval Date:** 07/29/2015

Exempt Category: 4

Study Title: Technology-Enhanced Virtual e-Learning and Student Performance

On behalf of the Institutional Review Board (IRB), I have reviewed the above-referenced research study and determined that it meets the criteria for exemption from IRB review. To view the documents approved for this submission, open this study from the *My Studies* option, go to *Submission History*, go to *Completed Submissions* tab and then click the *Details* icon.

As principal investigator of this research study, you are responsible to:

- Conduct the research study in a manner consistent with the requirements of the IRB and federal regulations 45 CFR 46.
- Request approval from the IRB prior to implementing any/all modifications as changes could affect the exempt status determination.
- Maintain accurate and complete study records for evaluation by the HRPP Quality Improvement Program and, if applicable, inspection by regulatory agencies and/or the study sponsor.
- Notify the IRB at the completion of the project.

If you have questions about this notification or using iRIS, contact the IRB @ 405-325-8110 or irb@ou.edu.

Cordially,

Lara Mayeux

Lara Mayeux, Ph.D.
Vice Chair, Institutional Review Board