GAMING IN THE CLASSROOM: A MIXED-METHODS INVESTIGATION OF MINECRAFTEDU IN A RURAL CAREER AND TECHNICAL EDUCATION COURSE

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by

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by

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ABSTRACT

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Rural school districts all over the state of Texas are looking for ways to prepare students to become college and career ready. However, rural districts face challenges with the lack of qualified and certified career and technical education teachers, a decrease in offered endorsement electives and the lack of nearby industry and college partners. The purpose of this study was to determine if MinecraftEdu implemented in a career and technical education course could increase academic achievement. As well as, examine student's perceptions of MinecraftEdu being used as an instructional tool.

This study used a mixed-methods research design completed in two phases. Phase I used a pre-and post-assessment to determine if MinecraftEdu had a significant effect on academic achievement. Phase II used focus group interviews to understand how the participants in a rural high school perceive using MinecraftEdu in a career and technical education course. The analysis indicated there was not statistically significant data due to the small sample size. The focus group interviews found students were overwhelming interested in implementing MinecraftEdu into future courses. However, students lack of experience using MinecraftEdu played a vital role on student response and self-efficacy. Additional research replicating this study on a large sale at multiple rural high schools and other CTE courses is recommended for future research.

KEY WORDS: Career and Technical Education (CTE), MinecraftEdu, College Readiness, Career Readiness, Pathways, Endorsements, Skills Gap.

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"Whoever gives thought to the Word will discover good, and blessed is he who trusts in the Lord." Proverbs 16:20

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CHAPTER I

Introduction

At the end of each year, the counselor in a small rural school district meets with all 8th grade students to discuss high school graduation requirements and assists in planning a schedule tailored to their individual needs, interests, and aspirations. The counselor spends two full days with 8th grade students, providing detailed information on graduation requirements and the different endorsements offered at the high school. At the end of the two days, the counselor distributes course selection forms to each student. These forms allow students to pick classes based on their career interests and classes offered within their district. Picking their pathway early will allow the counselor to see which endorsement students show interest in and provide ample time to prepare and schedule classes for the following year. As students begin looking at the classes offered on the course selection sheet, they notice a discrepancy between the courses listed on the Texas Education Agency website and what their small rural school district offers. As one student points out, "how come we don't have the same endorsements offered as those bigger districts?" With a disheartening look, the counselor responds, "this is currently what our district can offer based on qualified teachers and funding."

Statement of the Problem

This exchange between students and counselors is often played out in rural districts across the state of Texas. The lack of endorsement electives is creating a skills gap in which employers demand specific skill sets and knowledge upon hiring (U.S. Department of Education, 2012). According to the Partnership for 21st Century Skills (2010), executives need employees with skills beyond the basics of reading and writing;

they need employees who can think critically, communicate, collaborate, and are creative. Under the No Child Left Behind Act (NCLB), standards were developed and implemented to reflect the knowledge and skills students need to be college and career ready (U.S. Department of Education, 2018). However, rural districts face challenges when trying to prepare students to become college and career ready. These challenges include the lack of qualified and certified teachers for career and technical education (CTE) courses, a decrease in offered endorsement electives, and the lack of nearby industry and college partners (Gagnon & Mattingly, 2015; Texas Rural Schools Task Force, 2017).

The lack of qualified teachers affects the quality of education students receive. Principals who cannot find qualified teachers are forced to hire unqualified teachers, assign a teacher from another subject or field in which they may not be certified, or cancel the course. Gagnon and Mattingly (2015) stated that rural districts isolated from human resources drive teachers away from applying and/or staying in rural districts. According to Aragon (2016), rural districts with high poverty rates experience higher numbers of unqualified teachers. Furthermore, filling spots with underqualified teachers would continue to widen the gap in skills that employers demand upon hiring.

The lack of endorsement electives offered by small rural districts can be attributed to the lack of qualified teachers and the overall level of student interest within that field of study. Districts which serve a small population of students must be creative in providing the same opportunity as large districts. With the advancement of information and communication technology (ICT), teachers have turned to computerized instructional technology to improve the academic achievement of students, build on sound learning

principles, provide engagement for the learner, teach 21st century skills, provide personalized learning opportunities, and provide an environment for authentic and relevant assessment (McClarty, Orr, Frey, Dolan, Vassileva, & McVay, 2012). One program that is being used in a variety of educational settings is MinecraftEdu. Researchers have provided a considerable amount of research on the benefits of Minecraft in education (Ellison, Evans, & Pike, 2016; Morgan, 2015; Tromba, 2013) and CTE courses (Dougherty, Petrilli, & Zeehandelaar, 2016; Imperatone, 2016; Kirby, 2017). However, prior studies have failed to investigate if MinecraftEdu can improve academic achievement of students who are enrolled in CTE courses.

According to Symonds, Schwartz & Ferguson (2011), large companies such as Microsoft, Apple, and Cisco are seeing educational approaches are deficient in training students for the 21st century or providing them with real-world skills, especially in rural areas. Quality CTE programs which integrate academic and career education provide students with the skills needed for today's workforce, such as critical thinking, collaboration, problem solving, innovation, teamwork, and communication (Hanson, 2013).

The lack of nearby industry and college programs limit rural area districts from building partnerships to expand support, resources, and course offerings. Transportation to and from supporting industry and college programs may require students to travel across long distances, which puts a burden on rural districts by shifting money away from programs and resources to transporting students (Johnson, Showalter, Klein, & Lester, 2014). Distance learning has offset some of the issues tied to rural districts in remote areas by providing opportunities for more advanced coursework and credit recovery.

In response to this problem, this study proposes to investigate the use of MinecraftEdu in the career and technical education course Principles of Health Science by answering the following research questions: 1) Is there a significant difference in academic achievement between students who used MinecraftEdu and those who did not use MinecraftEdu and 2) How do rural high school students perceive using MinecraftEdu as a learning tool as part of the career and technical education course?

Background of the Study

Rural students are required to meet the same demands that urban and suburban school districts are required to meet, but they do so with limited staff and budget (Hanson, 2013). These demands were set forth by the No Child Left Behind (NCLB) act of 2001 (United States 107th Congress, 2001). The NCLB act aimed to ensure all students had the opportunity to obtain a great education (Chen, 2017). However, according to Chen (2017), the NCLB mandate was declared to be "flawed" and "ineffective." The act mandated all students in a school to be proficient by the 2013/2014 school year, and if the students were not proficient by the 2013/2014 school year, students would have the opportunity to attend one of at least two other schools in the district (United States 107th Congress, 2001). The problem for rural students is that they often have no other available public or private school in their area (Rural School and Community Trust, 2017).

The NCLB act also mandated all teachers to be "highly qualified" by the end of the 2005/2006 school year (United States 107th Congress, 2001). Highly qualified means that a teacher must meet the license and certification requirements of the state in which they teach, hold a bachelor's degree, and pass state testing criteria to be eligible to teach

beyond the 2005/2006 school year (Chen, 2017). However, the biggest controversy of the NCLB act was the issue of funding. A 2016 study conducted by the National Association of State Boards of Education (NASBE) estimated it would cost $7 billion over a seven-year period to fund. However, the NCLB act only authorized $400 million, leaving the schools responsible for more than $6 billion.

The idea of NCLB looks and sounds great from the outside but is simply unrealistic and unattainable, according to Dee and Jacob (2011). Many policies and initiatives have been proposed to increase college and career readiness, but students are usually shuffled through bureaucratized schools that do not adequately prepare them for anything, be it college, career, or both (Dougherty, Pertilli & Zeehandelaar, 2016).

The Carl D. Perkins Career and Technical Education Act of 2006 (Perkins Act) was developed to find solutions to ensure all students are ready for, have access to, and complete college-career pathways leading to 21st century jobs (Office of Vocational and Adult Education, 2012). In order to meet graduation requirements produced by the Perkins Act, the Texas 83rd Legislative session passed House Bill 5 (HB 5), which introduced a new system of graduation requirements in Texas. HB 5 restructured the state's graduation requirements, moving from the "4x4" graduation plan to a 22-credit Foundation High School Program that allows students to earn endorsements in specific areas of study by completing four additional credits. The endorsements include Science, Technology, Engineering, and Math (STEM); Business and Industry; Public Service; Arts and Humanities; and Multidisciplinary Studies (Texas Association of School Administrators, 2013). This bill was designed to allow students more flexibility in the selection of their high school courses to prepare them to either pursue a traditional path

into colleges and universities or move directly into the workforce (Terry, Gammon, Mullen, Dearmon, Alexander, & Morrison, 2015).

Multiple researchers found career and technical education courses instrumental in closing the gap in both college and career readiness (Dougherty, Petrilli, & Zeehandelaar, 2016; Imperatone, 2016; Kirby, 2017). However, according to the Texas Education Agency (2018), students are required to have 2.5 CTE credit hours to receive a high school diploma. If CTE is proven to provide the skills necessary to close the skills gap, why are students only required to have 2.5 credits?

Games inside the classroom is another area with extensive research. Researchers found video games can provide students with learning in real-time adaptation, self-explanation, and distributed learning (Gee & Shaffer, 2010; Tromba, 2013). However, few teachers incorporate gaming into the curriculum, and research has provided little evidence of gaming in CTE courses. Thus, there is a need to investigate the role of gaming in CTE courses in rural school districts.

Given the task to educate all students, rural districts must be creative in how they provide students with the same opportunities large districts provide in order to prepare them to be college and career ready. While rural district participation may look good from the outside with smaller class sizes and higher graduation rates, the challenges faced in hiring qualified teachers, the lack of endorsement electives, and the lack of industry or college partners nearby can contribute to the overall skills gap and provide reasoning into why rural students are not staying in college (Rural School and Community Trust, 2017; Showalter, Klein, Johnson & Hartman, 2017).

Purpose of the Study

The purpose of this study is two-fold: 1) to determine if the use of MinecraftEdu in a CTE course can increase student achievement and 2) to examine students' perceptions of MinecraftEdu being used as an educational tool in a rural high school CTE course. The purpose of this study is to examine information regarding MinecraftEdu's ability to provide students in rural districts a flexible delivery model that supports student learning and engagement. The study explored if implementing MinecraftEdu into a rural high school CTE course would be worth the effort, time, and money put forth based on student perceptions. Furthermore, this study provided additional research on the benefits of MinecraftEdu in the classroom as well as its ability to achieve college and career readiness through gaming.

A number of recent studies found student participation in CTE courses produce skills necessary for students to be college and career ready. Dougherty, Petrilli, and Zeehandelaar (2016) found, "CTE provides the greatest boost to the kids who may need it most—boys, and students from low-income families" (p. 3). Dougherty et al. (2016) also stated, "the more CTE courses students take, the better their education and labor market outcomes" (p. 5). Imperatone (2016) found, "CTE holds the key to ensuring rural students achieve their full potential and to developing a prepared workforce" (p. 18). Kirby (2017) stated, "CTE helps learners gain the real-world skills they need to be successful in their chosen careers and is a powerful strategy to boost rural economies by closing critical skills gaps that harm the local employers" (para. 4). Likewise, research has produced similar findings in regard to student use of MinecraftEdu in the educational

setting. Callaghan (2016) found that MinecraftEdu enhanced classroom learning and suggested that MinecraftEdu may accommodate the varying learning abilities.

Significance of the Study

Rooted in concern for the teacher shortage, lack of endorsement electives and advanced courses, as well as nearby industry and college partnerships, this study hopes to contribute to the improvement of education in CTE courses and provide further evidence in MinecraftEdu's ability to improve student engagement and academic achievement. Additionally, this study provided information on whether or not students would be interested in more classes that incorporated MinecraftEdu. Furthermore, this study found there to be some benefit to small rural districts who are located in areas without industry and college partners nearby. The findings from this study can assist the Texas Education Agency by providing valuable information on the potential benefits of MinecraftEdu and its ability to expand CTE courses in small rural districts.

Research Questions

The following research questions were approached in this study to determine if there is a significant difference between students who use MinecraftEdu to learn the digestive system and students who do not use MinecraftEdu. The study was conducted in a career and technical education course called Principals of Health Science. The researcher also wanted to understand students' perceptions of using MinecraftEdu in CTE and gain insight to whether or not MinecraftEdu could be successful and provide an engaging alternative to learn CTE standards. The study investigated the following two questions:

Research question 1. The following research question was addressed in the study using a quantitative analysis:

Hypothesis 1: There is a significant difference in academic achievement between students who used MinecraftEdu for one unit in the Principles of Health Science course and those who did not use MinecraftEdu.

Null hypothesis 1: There is no significant difference in academic achievement between students who used MinecraftEdu for one unit in the Principles of Health Science course and those who did not use MinecraftEdu.

Research question 2. The following research question was addressed in the study using a qualitative analysis:

How do rural high school students perceive using MinecraftEdu as a learning tool as part of the career and technical education course Principles of Health Science?

Definition of Terms

Career readiness. Career readiness involves three major skill areas: core academic skills and the ability to apply those skills to concrete situations in order to function in the workplace and in routine daily activities; employability skills, such as critical thinking and responsibility, that are essential in any career area; and technical, job-specific skills related to a specific career pathway (Association of Career and Technical Education, 2018). Career readiness requires adaptability and a commitment to lifelong learning, along with mastery of key knowledge, skills, and dispositions that vary from one career to another and change over time as a person progresses along a developmental continuum. Knowledge, skills, and dispositions are interdependent and mutually reinforcing (Career Readiness Partner Council, 2012).

Career Technical Education (CTE). Career and technical education courses provide students of all ages with the academic and technical skills, knowledge, and training necessary to succeed in future careers and to become lifelong learners (Advance CTE, 2018).

College readiness. College readiness is defined as the level of preparation students need in order to enroll and succeed—without remediation—in a credit-bearing general education course at a postsecondary institution that offers a baccalaureate degree or transfer to a baccalaureate program (Conley, 2007).

Course credit. The award of credit for a course by a school district affirms that a student has satisfactorily met all state and local requirements (Texas Education Agency, 1998).

Endorsements. Endorsements are a series of related courses that are grouped together by interest or skill set. There are five endorsement areas, which include STEM, business and industry, public service, arts and humanities, and multidisciplinary studies (Texas Education Agency, 2018).

Minecraft Education Edition (MinecraftEdu). Minecraft Education Edition is an open-world game that promotes creativity, collaboration, and problem-solving in an immersive environment where the only limit is your imagination (Mojang, 2016).

Pathways. Pathways provide a framework that local education agencies (LEAs) use to work with postsecondary institutions, businesses, and industries to better understand the knowledge and resources needed to prepare students for life after high school. Pathways are not an add-on program or new reform but are instead designed to work within current systems, structures, and budgets. They are a strategy for aligning

and leveraging existing programs, including the Foundation High School Program (Texas Education Agency, 2017).

Skills gap. Defined "as the difference between the markets need (demand) and the current skills supplied by local education institutes (supply)" (Alsafadi & Abunafesa, 2012, p. 2).

Delimitations

The study was confined to one small rural district in the state of Texas. This study used a convenience sample, which allowed for access to one teacher who taught two sections of the Principle of Health Science course. The study was restricted to only those students who were in the course Principles of Health Science. Students were chosen based on the researcher's need and the only CTE course to offer two sections. Furthermore, students who turned in the assent and consent forms to participate were the only participants in this study.

Limitations

One limitation of the study was the sample of the study, which included only students within the CTE course Principles of Health Science. Due to the study taken in a rural district, the sample size was another limitation. Future investigations need to expand to more CTE courses in more rural districts to ensure a representative distribution of the population and to be considered representative of groups of people to whom the results will be generalized. The sample was collected from only freshman, sophomore, and junior students.

Petrov (2014) stated that teachers feel inadequate on various technological tools in the classroom. Teachers who are not confident in technology are not going to use it

(Brown, 2014). Based on this limitation, the implementation of MinecraftEdu lessons will be in a class where the teacher is comfortable with the use of technology. While the teacher is comfortable with using technology, she had never played MinecraftEdu, which created a fear of the unknown and questions as to how she would be able to help students.

A further limitation included the cost of MinecraftEdu per user. The education edition costs $5 per user per year and requires students to use a Microsoft account. The researcher paid for the licenses at $5 per user out of pocket. The total cost to the researcher was $85. The Microsoft accounts took time to set up because the technology director did not want to create student Microsoft accounts because they are currently a Google district. The technology director used generic Minecraft1 through Minecraft17 to create users, then each username was assigned to a specific student for them to use each time they logged into MinecraftEdu.

Assumptions

This research study is anchored on the assumption that the participants answered the pre- and post-assessment questions in an honest and candid manner. The participants, who volunteered for the focus group, had a sincere interest in participating in the study and did not have other motives, such as getting a better grade or missing class. The intervention was appropriate for the participants' grade levels, and all participants were given the same directions for the study. The lessons were based on the state standards to make sure students were on grade level. If any of these assumptions were not satisfied, the data may not produce accurate information. The researcher gained trust by stressing the importance of confidentiality and reassuring participants there was no impact on their grades.

CHAPTER II

Review of Literature

During the last decade, Texas Career and Technical Education (CTE) has revamped its curriculum to integrate core academic and employability skills to adequately prepare students for success after high school. According to Dougherty, Petrilli, and Zeehandelaar (2016), "CTE courses entail skill building in fields like information technology, health science, and advanced manufacturing" (p. 2). Similar to CTE, researchers found MinecraftEdu to promote collaborative learning, critical thinking, and problem solving (Ellison, Evans & Pike, 2016). These skills are instrumental in closing the gap to college and career readiness and enhance the life skills employers seek. However, few teachers incorporate MinecraftEdu into CTE courses. Furthermore, rural districts face some challenges when preparing students for life after high school. These challenges include the lack of qualified and certified teachers for career and technical education courses, the lack of offered endorsement electives, and the lack of nearby industry and college partners (Gagnon & Mattingly, 2015; Texas Rural Schools Task Force, 2017).

According to Symonds, Schwartz, and Ferguson (2011), large companies such as Microsoft, Apple, and Cisco are seeing educational approaches deficient in training students for the 21st century and a lack of providing them with real-world skills, especially in rural areas. Hanson (2013) stated that public schools were systematically formed to resemble factories and not much has changed over the last 100 years. The implication of this is a skills gap in which many young adults lack skills and work ethic needed for middle class pay (Hanson, 2013). With the lack of qualified teachers,

endorsement electives, and nearby industries and colleges, rural areas must be creative and develop a system in which they provide the same opportunities to students as urban and suburban districts.

This study investigated if there was a significant difference in academic achievement between students who used MinecraftEdu in the career and technical education course and students who did not use MinecraftEdu. Further, the researcher examined students' perceptions of using MinecraftEdu as a learning tool as part of the CTE course Principles of Health Science.

The following literature review is a guide through the history of career and technical education, the role of career and technical education in college and career readiness, the challenges faced in rural districts educating students in career and technical education courses, Minecraft, and Minecraft in education.

Career and Technical Education

Career and Technical Education, sometimes referred to as vocational education, provides students with the academic and technical skills necessary to succeed in future careers and to become lifelong learners (Advance CTE, 2018). CTE programs have changed drastically during the last decade, steered by the competitive economy, technological changes, and the nation's workforce (Brewer, 2010). With the recent information technology (IT) advances and CTE's ability to offer new and potentially more widely accessible ways to access education, school districts are in a unique spot to see the change that is needed to close the skills gap and thrive in the 21st century. Numerous studies have determined CTE courses have a beneficial impact on students by bringing real-world scenarios into the classroom (Kirby, 2017; Smith, 2012). However,

"the education system will need to adapt to prepare individuals for the changing labor market" (National Academies of Sciences, Engineering & Medicine, 2017, p. 140). The following section will give a brief history of CTE, followed by the importance of CTE courses in rural high schools and specifically discuss the challenges rural districts face with CTE courses.

History of Career and Technical Education

Early vocational education was taught by family members to develop skills in farming and prepare children for entering factories after high school. As the nation entered into the industrial age, apprenticeships became a common standard of practice (Gordon, 2014). A typical apprenticeship required a skilled employer to train individuals in the trade in order to get help in the workplace (Barlow, 1974; Brewer, 2010). According to Barlow (1974), apprenticeships affected career and technical education in two ways: 1) "apprentices learned many more educational concepts other than just the skill being taught and 2) most occupations could be taught in school" (p. 16). Most skills taught in the apprenticeships were skills that any school could teach with the necessary equipment and staff. In order for apprentices to get both skills and general education knowledge, the Comprehensive Apprenticeship Law was passed in 1642, to ensure all students were learning not only a specific trade but also the colony's laws and religious views (Barlow, 1974).

The apprenticeship movement was an important part of modern-day career and technical education. However, at the turn of the 19th century, industrialization to powered machines, the cotton gin, and electricity played key roles in moving America away from a farm-based society to that of factories and machines (Barlow, 1974). This

era was referred to as the Industrial Revolution because it brought about a greater volume and variety of factory-produced goods and raised the standard of living for skilled workers. However, unskilled workers had horrendous working conditions and usually worked long hours with their children to get the job done (Rocteur, Jacquemin, & Neal, 2017). By the end of the 19th century, craftsmen were being replaced by machines, and the overcrowded, unsanitary living and working conditions caused he government to institute various labor reforms. The implications of this caused working conditions to improve as well as the development of trade schools (Brewer, 2010). Trade schools saw the need to train individuals in a skill, but most of the trade schools offered only skill training, leaving general education curriculum out.

Smith-Hughes Act of 1917

By the 20th century, Americans wanted the government to provide quality education to all citizens. Furthermore, World War I was beginning and the government needed skilled craftsman to supply and aide troops. These events led to the Smith-Hughes Act of 1917, which was the first authorization for the federal funding of vocational education (U.S. Department of Education, 2017). The Smith-Hughes Act of 1917 argued, "vocational education was vital in schools because it would provide training and education to the needs of the children and family, promote industrial efficiency, decrease unemployment, and increase standard of living" (Gordon, 2014, p. 105). In order to oversee the money provided from the federal government and grant programs, the Smith-Hughes Act created the Federal Board of Vocational Education to distribute funds and approve state plans. With federal funding being pushed into vocational programs, the act required states to provide detailed plans and ways in which they would

evaluate the vocational programs on a daily basis. The Smith-Hughes Act of 1917 paved the way for career and technical education because it was the first time the government showed concern in preparing youth for future careers.

Several acts came after the Smith Hughes Act of 1917, mostly to extend funds for vocational programs. The first act to come after the Smith Hughes Act was the George-Reed Act of 1929, which lobbied for additional funds for home economics and agricultural programs (McClure, Chrisman, & Mock, 1985). The second was the Servicemen's Readjustment Act of 1944, which provided funding to soldiers after World War II to obtain training and education in any field of choice (McClure, Chrisman, & Mock, 1985). However, as the Korean War of the 1950's and Vietnam War of the 1960's rolled around, the country once again had to focus on training Americans to build war materials and fill the employment gaps.

Vocational Act of 1963

In order for America to fill the employment gaps and provide materials to soldiers, the federal government refocused their attention on vocational education. The federal government evaluated the Smith-Hughes Act, George-Reed Act, and the Servicemen's Readjustment Act and expanded upon them because they were not broad or flexible enough to meet the needs of soldiers or to help in closing employment gaps. This led to the Vocational Act of 1963, which "was to assist the states in strengthening, improving, and expanding their existing programs of vocational education; in developing new ones; and in providing part-time employment for young persons who need to earn money" (U.S. Department of Health, Education & Welfare: Office of Education, 1965, p. 8). The federal government provided money to build area schools for vocational

education, occupational education, dropouts, and work-study programs (Gordon, 2014). Furthermore, the Vocational Act of 1963 provided lasting effects in CTE by creating an advisory committee to oversee training requirements, allowed states to transfer allotments to meet needs, and created an advisory council to investigate and present recommendations for improvement (Gordon, 2014). According to Mason, Husted, and Furtado (1989), it was the first time vocational education was focused on individual needs and not industry needs.

Several amendments followed the Vocational Act of 1963, beginning with an amendment in 1968 to emphasize post-secondary schools and redefine vocational education to bring it closer to general education (Brewer, 2010; Gordon, 2014). Another amendment came in 1976 to ensure the states were using all the resources made available to them and to increase funding to the vocational programs by adding vocational guidance and counseling, in-service training, and grants to overcome sex bias (Gordon, 2014). Each amendment, in its own right, created awareness by emphasizing the importance of teaching skills necessary for economic growth.

Carl D. Perkins Act

The Carl D. Perkins Vocational and Technical Education Act (Perkins Act) was first introduced in 1984 and reauthorized in 1998 and 2006 (Brewer, 2010). Like many of the previous acts, its purpose was to increase the quality of technical education. The reauthorization in 2006 had three major revisions: "1) replace vocational education with career and technical education, 2) maintain the technology prep as separate with federal funding within the legislation and 3) maintain state administrative funding at 5% of states allocation" (Brewer, 2010, p. 14).

The overall goal of the Perkins Act was to provide states with more state and local flexibility and hold students to a higher standard while providing them with the curriculum needed to be college and career ready. In 2012, the Obama Administration recognized the importance of CTE and proposed a blueprint for an economy built on manufacturing, energy, skilled workers, and American values (Office of Vocational and Adult Education, 2012). In the 2017 budget, "President Obama requested $4 billion for states to fund Computer Science for All. It's the opportunity for every student to learn what is increasingly becoming a new basic skill" (The White House: Office of the Press Secretary, 2016, para. 4). More than 600,000 high paying tech jobs went unfilled in 2016 and 51% of all STEM jobs are projected to be in computer science fields (The White House: Office of the Press Secretary, 2016). The advancement of technology during the last 10 years has impacted almost, if not all, fields of work. Due to the advancement in technology, CTE courses began integrating a core curriculum, and technology was seen throughout. This integration caused CTE courses to change at a rapid rate, but the goal to prepare students for the future remained the same.

House Bill 5

In order to meet graduation requirements produced by the Perkins Act, the Texas 83rd Legislative session passed House Bill 5 (HB 5), which introduced a new system of graduation requirements in Texas (Texas Education Agency, 2018). The goal of HB 5 is to promote college and career readiness by choosing a pathway based on the student's college and career aspirations (Texas Rural Schools Task Force, 2017). The bill was designed to provide students more flexibility in the selection of high school courses and prepare them to either pursue a traditional path into college and university or move

directly into the workforce (Terry et al., 2015). HB 5 made substantial changes to the state's graduation requirements.

Until the 2014-2015 school year, a majority of Texas students followed the Recommended High School Program, which mandated 26 credit hours by taking four math, four sciences, four English Language Arts, four social studies, two second language, one physical education, one fine art, one-half speech, and five and one-half electives in order to graduate, known as the 4x4 graduation plan. Students who had learning difficulties or wanted to graduate high school early could choose the Minimum High School Plan, which requires 22 credits. In order for students to choose the Minimum High School Plan, students must have either failed ninth grade or taken two credits in each of the four core subjects.

For the Foundation Plan, HB 5 mandated students to take 26 credit hours while choosing an academic track in one or more of five endorsement pathways. In other words, students now are required to take a coherent sequence of courses in one of five areas with the possibility of earning a diploma in that endorsement area. The endorsements include Arts and Humanities, Business and Industry, Multidisciplinary, Public Service, and STEM. Each high school must offer courses leading to one endorsement, but not every school offers every endorsement (Texas Education Agency, 2018). The Foundation Plan differs from the previous plans by allowing students to take fewer courses in some areas and make up the difference in courses that are of interest to the students.

The bill put a tremendous burden on schools and did not provide much guidance on how to implement the provisions required by the bill. In 2017, the Texas Education

Agency (TEA) issued a survey to 890 school districts across the state to collect data on the endorsements districts are able to offer, the options to complete the endorsements, and what communication tools districts were using to inform parents and students of the new requirements. What TEA found was mind boggling! More than 50% of the districts surveyed offered all five endorsements, but they did not offer all the courses listed under the endorsements. The study also learned the other half of the districts offered three or less of the endorsements, with 75% of the districts making no plans to change (Terry et al., 2015).

The report from TEA provided no guidance to districts on how to implement HB 5 requirements, allowing local districts to develop their own endorsements and pathways based on what is best for their district. To understand the decision districts are making to implement HB 5, we must understand the role CTE has in college and career readiness.

The Role of Career and Technical Education in College and Career Readiness

The role of career and technical education courses in high school is to educate and prepare all students for life beyond high school. According to Carnevale, Smith, and Strohl (2013), 65% of all jobs will require postsecondary education and training by 2020, and 35% of jobs will not require a high school degree. High-quality CTE programs are essential to the success of students in preparing them to be college and career ready. According to the Association for Career and Technical Education (2018), taking one CTE class for every two-academic classes minimizes the risk of students dropping out of high school. The link between one CTE class for every two-academic classes increases the average graduation rate for CTE students to 94% compared to the national average of 80%. Furthermore, Dougherty, Pertrilli, and Zeehandelaar (2016) explained, “just one

additional CTE course above average increases the probability of graduating from high school and being hired right after high school" (p. 23). What is more: CTE "concentrators"—that is, students who take at least three CTE courses—and who do not go on to obtain a college degree, certificate, or certification earn 90 cents more per hour than non-concentrators (Carnevale, Hanson, & Fasules, 2018; U.S. Department of Education Office of Planning, Evaluation and Policy Development Policy and Program Studies Service, 2014).

It is imperative for rural schools to have access to high quality CTE programs in the state of Texas. Students who are enrolled in CTE courses experience academic rigor, cultivate career skills, and earn credit toward college while in high school (Bradley, 2016). The experience learned from CTE courses provides students with the ability and skills to finish college or succeed at their career.

Arkansas was one of the first states to align labor market skills to CTE courses, requiring students to take six career-focused classes to graduate. They found the more CTE courses students take, the better their education and labor market outcomes (Dougherty et al., 2016). Furthermore, students who concentrate in CTE courses are 21% more likely to graduate from high school.

In 2012, President Obama expressed the need for education institutions to equip students to be skilled, adaptable, and creative by giving them a more rigorous, tailored education to acquire the needed skills for the 21st century workforce (U.S. Department of Education, 2012). According to the U.S. Department of Education (2012), the Obama administration created a blueprint to reauthorize the Perkins Act in four areas:

> 1) Alignment - Ensuring that the skills taught in CTE programs reflect the actual needs of the labor market so that CTE students acquire the 21st century skills necessary for in-demand occupations within high-growth industry sectors, 2) Collaboration - Incentivizing secondary schools, institutions of higher education, employers, and industry partners to work together to ensure that all CTE programs offer students high-quality learning opportunities, 3) Accountability - require CTE programs to show, through common definitions and related performance measures, that they are improving academic outcomes and enabling students to build technical and job skills and 4) Innovation – promoting systemic reform of state-level policies to support effective CTE implementation and innovation at the local level (para. 5).

Employers need employees equipped with more than just reading, writing, and arithmetic; they need employees who can think critically, communicate effectively, collaborate efficiently, and can be creative (Freifeld, 2013).

In order for students to be college and career ready, students must obtain the appropriate knowledge and skill sets while in the K-12 setting. According to Conley (2007), students who are college ready enroll and successfully complete postsecondary courses without taking remedial courses. College ready students have mastered rigorous content and apply this knowledge in real life situations. Park, Pearson, and Richardson (2017) stated, “effective math, literacy and science instruction, when embedded into high quality CTE programs of study, create unique opportunities for students to develop the knowledge and skills necessary to effectively engage with CTE content, achieve high levels and transition into viable progressive careers” (p. 193).

Much like college ready students, students who are career ready must have core academic skills and be able to apply those skills to real life situations. Students who are career ready must also obtain employability skills in the four c's: 1) critical thinking, 2) collaboration, 3) communication, and 4) creativity (Partnership for 21st Century Skills, 2010). More importantly, students should be able to problem solve. Problem solving is the process of identifying something that can be changed for the better and is the basis for continuous improvement, communication, and new inventions (Morgan, 2015). Furthermore, it is important for career ready students to receive the knowledge and skills through education in order to stay competitive in this economy driven by technology (Hanson, 2013). Employers look to hire people who have some skills in the areas of technical, systems, safety, leadership and teamwork, ethics and legal, and career development.

CTE's role in college and career readiness is to ensure all students obtain the 4 c's: "critical thinking, collaboration, communication and creativity" (Partnership for 21st Century Skills, 2010). However, according to the National Assessment Educational Progress (2018) report, less than 40% of students scored as college and career ready. CTE has the potential to close the skills gap within the educational system, but the challenges laid out in the next chapter sometimes outweigh the potential.

Rural CTE Challenges and Recommendations

Rural districts in Texas face many challenges when it comes to educating students in career and technical education. Many of the challenges are the same as the urban and suburban districts, but the solutions are far different. With the new graduation requirements under HB 5, students entering ninth grade must earn 22 or 26 course credits

and pass five end-of-course assessments to meet the requirements for graduation (Texas Education Act, 2018). In Table 1, a side-by-side comparison of the Foundation and Recommended Plans are shown without the endorsements. Most schools are requiring students to go the recommended route unless their parents request that they graduate early or if they failed ninth grade.

Table 1

Side by Side Comparison of Requirements

Subject Area	Foundation HSP	Recommended HSP
English Language Arts	4 Credits	4 Credits
Mathematics	3 Credits	4 Credits
Science	3 Credits	4 Credits
Social Studies	3 Credits	4 Credits
Physical Education	1 Credit	1 Credit
Languages other than English	2 Credits	2 Credits
Speech	Demonstrated Proficiency	0.5 Credits
Electives	5 Credits	5.5 Credits
Total	22 Credits	26 Credits

Note: HSP = High School Plan.

As a bonus, students may choose an endorsement in the following areas: STEM, Business and Industry, Public Services, Arts and Humanities, or Multidisciplinary Studies. The graduation requirements set forth by HB 5 and TEA require school districts to offer at least one endorsement pathway, which are outlined in Table 2.

Table 2

Curriculum Requirements for Endorsements

Endorsements	Course Selection
STEM	A coherent sequence or series of courses selected from one of the following: (a) CTE courses with a final course from the STEM career cluster, (b) Computer science, (c) Mathematics, (d) Science or (e) Any combination of two of the above
Business & Industry	A coherent sequence or series of courses selected from one of the following: (a) CTE courses with a final course from the Agriculture, Food, and Natural Resources; Architecture and Construction; Arts, Audio/Video, Technology, and Communications; Business Management and Administration; Finance; Hospitality and Tourism; Information Technology; Manufacturing; Marketing; Transportation; or Distribution and Logistics CTE career cluster, (b) the following English electives: public speaking, debate, advanced broadcast journalism including newspaper and yearbook, (c) Technology applications or (d) a combination of credits from the categories listed above
Public Services	A coherent sequence or series of courses selected from one of the following: (a) CTE courses with a final course from the Education and Training; Government and Public Administration; Health Science; Human Services; or Law, Public Safety, Corrections, and Security career cluster or (b) JROTC
Arts & Humanities	A coherent sequence or series of courses selected from one of the following: (a) Social studies, (b) the same language in languages other than English, (c) two levels in each of two languages in languages other than English, (d) American Sign Language (ASL), (e) courses from one or two categories (art, dance, music, and theater) in fine arts, or (f) English electives that are not part of Business and Industry

Multidisciplinary Studies	A coherent sequence or series of courses selected from one of the following: (a) four advanced courses that prepare a student to enter the workforce or postsecondary education without remediation from within one endorsement area or among endorsement areas that are not in a coherent sequence; (b) four credits in each of the four foundation subject areas to include English IV and chemistry and/or physics; or four credits in AP, IB, or dual credit selected from English, mathematics, science, social studies, economics, languages other than English, or fine arts

Note: Adapted from "Graduation Toolkit," by Texas Education Agency. (2018). *Graduation Toolkit*. Austin, TX.

The American Institutes for Research conducted an evaluation report of HB 5 and found that staffing concerns were the top existing barrier to offering certain endorsements (Mellor, Stoker, & Muhisani, 2017). The challenge lies in the inability of rural districts to find and hire qualified teachers who teach CTE courses (Association for Career and Technical Education, 2015). Teachers who are qualified to teach CTE courses are choosing careers outside of education because of the ability to make more money. The inability to find and hire qualified teachers forces rural districts to cut programs and/or courses, forcing students to choose an endorsement pathway of little or no interest to them. Another essential challenge faced by all districts is that CTE teachers who are employed may be required to obtain more certificates or state licenses to signify they are highly qualified (Brand, Valent, & Browning, 2013).

In 2017, the Commission of Education assembled the Texas Rural Schools Task Force (RSTF) to identify challenges faced by rural districts and offer recommendations to TEA on how to overcome these obstacles (Texas Rural Schools Task Force, 2017). The task force identified four challenges faced by rural districts: 1) teacher recruitment, 2)

teacher retention, 3) House Bill 5/CTE support, and 4) grants and contracts. Of the four challenges, two were related to the teacher shortages in Texas. The task force recommended six actions to help school districts across Texas recruit and retain teachers. According to the Texas Rural Schools Task Force (2017), rural districts could implement several strategies to recruit teachers:

> 1) Encourage and support the implementation of "Grow Your Own" programs on high school campuses through a variety of means including the public service endorsement in high school career pathways, dual credit opportunities in education coursework, exploring the possibility of an Early College High School model, and other innovative initiatives, 2) Explore the potential for a centralized, online statewide job application and vacancy matching site, 3) Promote the profession of teaching as rewarding and impactful, 4) Encourage educator preparation programs to increase awareness of rural teaching opportunities, 5) Broaden the pool of potential teachers by exploring the potential for flexibility in certification to include non-certified but qualified personnel to teach CTE courses, for certified personnel to teach outside of their field, and for retired teachers to return to full-time teaching more easily, and 6) Retain teachers who were already presently teaching within the district by encouraging career pathways for teachers including leadership opportunities, compensation and other opportunities for growth (p. 4).

The recommendations presented by RSTF are general recommendations at best and do not guarantee positions will be filled if followed. The teacher shortage in rural districts can also be contributed to the small community size (DiSchiano, 2017; Gagnon

& Mattingly, 2015). Gagnon and Mattingly (2015) stated rural districts, isolated from human capital, drive teachers away from applying and/or staying in rural districts. Teachers favor the necessities that come in urban areas. The shortage has caused many rural districts in the state of Texas to cut programs because they cannot compete with large district salaries and big-city amenities (Story Hinkley Staff, 2017). However, the teacher shortage in rural areas is not a new thing; it has been an issue documented for well over a century (Houston, 1914).

Another unique challenge faced by rural students is the decrease of CTE credits earned by students in high school between 1990 and 2009 (Institute of Education Sciences, 2009). This can be attributed to HB 5 and the endorsement pathways rural districts offer students. The additional requirements posed by HB 5, along with teacher shortages and funding, led to the sharp decline in CTE participation. The positive research on CTE courses and its ability to improve college and career readiness and help close the skills gap is causing many states to revisit their CTE policies and require students to take more CTE courses before graduating high school (Dougherty et al., 2016).

In addition to the decline in CTE participation, access to Advanced Placement (AP) courses, which offer students more intense academic training, are considerably less than in suburban and urban districts (Gagnon & Mattingly, 2015). The research by Gagnon and Mattingly (2015) found that 47.2% of rural districts have no students enrolled in AP courses, compared with 5.4% in suburban and 2.6% in urban. According to Klepfer and Hull (2012), students who are low-income and low-achieving students are 17% more likely to return for a second year of college when taking at least one AP

course. Gagnon and Mattingly (2015) listed several reasons as to why rural districts struggle to offer AP courses: 1) "rural districts may have insufficient number of capable students to take an AP course, 2) lack of certified staff, or 3) logistical concerns being small, isolated populations" (p. 3). Regardless of why there is a decline in CTE participation or a lack of AP courses, all students need the same opportunity.

Another challenge faced by rural districts is the difficulty of providing dual college credit or even work-based learning experiences due to their location. With rural districts already having limited funding, the cost to transport students to a nearby college is not feasible. According to the National Student Clearinghouse Research Center (2016), only 59% of rural students attend college while 62% of urban and 67% of suburban attend college during the first semester after high school. The low percentage of students attending college after high school demands educators and policymakers find ways to increase college attendance. Some researchers suggest providing distance learning opportunities to rural students, but many rural districts in remote areas do not have the capability or bandwidth to maximize learning in this format. In 2007, the Sloan Consortium conducted a study on the nature of online learning in K-12 schools. It found, "online learning provides cost beneficial methods of providing courses for students who would be taught by underqualified teachers or would require the hiring of a teacher" (Picciano & Seaman, 2009, p. 3). Fisher and Jenson (2016) describe, in detail, three ways to help alleviate these deficiencies: 1) develop course access programs to give schools access to highly qualified teachers across a wide array of courses, 2) remove the licensure reciprocity which creates a barrier for teachers to teach across state lines, and 3)

allow more experts into the classroom to support pathways in CTE, such as, industry, STEM, and computer science to expose students to relevant and cutting-edge insights.

Work-based learning provides another challenge to rural districts because of the lack of industries within these rural areas. Hence, rural communities miss opportunities to capitalize on building relationships with industries and struggle to grow economies to address workforce talent shortage.

Educational Gaming

Today more than ever, educational games are continuing to grow in popularity due to their ability to motivate and engage students. According to Ge and Ifenthaler (2017), "educational games are those intentionally designed for the purpose of education, or those entertainment games that have incidental or educational values" (p. 254). In a national report completed by Project Tomorrow Speak Up (2015), 68% of teachers are using educational games within their classrooms.

Teachers in the K-12 setting are using educational games because of its ability to track student performance while providing data on what the student needs to improve academically (Novotney, 2015). According to Fu, Hainey, and Baxter (2016), teachers are using games because they have a positive impact on knowledge acquisition and content understanding as well as influence on player engagement, perpetual and cognitive skills, and soft skills. Jackson, Zhao, Kolenic, Fitzgerald, Harold, and Von Eye (2008) found the usage of video games increases visual-spatial skills, which often come in handy in the fields of STEM. Robert Marzano (2010) has been involved in more than 60 studies to examine games and academic achievement. Marzano's (2010) studies showed

"academic games in the classroom is associated with a 20%-point gain in student achievement" (p. 71).

In 2012, the public learned that the Sandy Hook Elementary School gunman played violent video games. This news resulted in President Obama allocating $10 million to study the effects of violent video games. A review of research conducted by Bowen (2013) in PsychEXTRA Dataset found that playing video games, including violent games, has many positive effects and could have critical implications for education and career development. Gee and Shaffer (2010) stated, "games encourage players to think about relationships, not isolated events, facts, and skills" (p. 10). The article explained that video games strengthen cognitive skills such as spatial navigation, reasoning, memory, and perception. The study also found that video games helped children develop problem-solving skills, improved players' mood, promoted relaxation, decreased anxiety, and children learned to cope with failure. Educational games in the classroom have many positives, but it is important to discuss the conflicting views found in research.

Researchers have been investigating the negative effects of games on academic achievement for more than a decade. One concern, as mentioned by Gnambs, Stasielowicz, Wolter, and Appel (2018), is the number of hours teenagers spend playing games come at the cost of school achievement. One study found a negative correlation between the amount of time spent playing games and the students' grade point average and SAT scores (Anand, 2007). Another study found that the amount of time students spent playing video games was causing slightly lower grades in mathematics (Gnambs et.

al, 2018). In both cases the outcome was quite small, and the time dedicated to computer and video games had no effect on students' competence development over time.

The second major negative effect of games on academic achievement was in relation to student motivation and engagement. Many researchers found games to increase students' motivation and engagement, but some researchers argued that students' interest and engagement dropped after their initial excitement and introduction of the game (Fu et.al, 2016). They found that students go into educational games with certain expectations and lose the excitement when the educational games do not live up to their expectation.

Researchers provide compelling arguments both for and against gaming in the classroom. According to Halverson (2005), schools should learn to encapsulate design principles from the gaming industry in order to make the learning environment more engaging. The benefits of educational gaming on academic achievement far outweigh the negative effects gaming has on children. However, if schools could incorporate gaming principles into the learning environment, schools may see a higher level of engagement in learners while assessing skills needed for the 21st century.

Minecraft

Since Minecraft's release in 2009, it has gained attention for its simple design, allowing players to create an entire environment using blocks that look like Lego bricks (Bos, Wilder, Cook & O'Donnell, 2014; Cipollone, Schifter, & Moffat, 2014; Ellison, Evans, & Pike, 2016). Minecraft is a sandbox-type video game, meaning there is no clear objective of the game (Cipollone, Schifter, & Moffat, 2014). Minecraft allows players creative freedom to collaborate and engage in elements of survival or creativity. As a

survivalist, players must collect materials and craft tools to harvest food and build structures to survive menacing threats from mobs (Cipollone, Schifter, & Moffat, 2014; Dikkers, 2015). Surviving in this type of play requires problem solving, communication, and creativity.

In creative mode, players are allowed to build and explore. However, creative mode comes with its own set of challenges. According to Barron (2013), students were given the task to build with mud brick that was common in the Roman era. Since Minecraft does not offer mud brick, students were required to research how to make mud bricks and then them construct in Minecraft by mixing different materials.

Minecraft was not created with education in mind. The game was developed by a Swedish game developer named Markus "Notch" Persson, whose play in another independent (or indie) game, *Dwarf Fortress*, influenced the idea of Minecraft. Similar to Minecraft, *Dwarf Fortress* is an open-ended source of creativity and survival. *Dwarf Fortress* used letters, numbers, and symbols to construct a fortress in bedrock for a group of dwarves (Goldberg, Larsson, & Hawkins, 2015). Persson's passion for indie games was based on the fact that with indie games, programmers maintained control of their project and were not controlled by elaborate graphic and expensive manuscripts produced by large gaming companies (Kruger, 2016). In April 2009, Persson came across an indie game called *Infiniminer*, whose graphics are similar to Minecraft. *Infiniminer* was intended to have teams compete for minerals in the shortest time. However, shortly after the release of *Infiniminer*, the game's source code, or the game's written language on how it was developed, was leaked on the internet, and the game made it impossible for multiple players to compete against each other. The creator of *Infiniminer* believed it was

the end of the game and released the game as an open source code, which allowed fans to keep developing it as they wished.

Persson began with re-coding *Infinimer* and released the clone in May 2009. While discussing the game in TIGSource forum, Persson asked for suggestions on naming the game, and the name Minecraft was born. The word "Mine" comes from mining ore in shafts and "craft" as in building or creating something (Mojang, 2016). As Minecraft became a household name, Perrson continued to create other games and created Mojang as a development studio. In 2014, Microsoft purchased Mojang with the intellectual property of Minecraft for $2.5 billion.

Minecraft in Education

In 2016, Mojang released the educational version of Minecraft, called Minecraft Education Edition (MinecraftEdu), which is "an open-world game that promotes creativity, collaboration and problem-solving in an immersive environment" (Mojang, 2016). MinecraftEdu was created by Joel Levin and Aleksi Postari, who believed gaming could change the way students learned at school. Levin and Postari worked closely with Mojang to develop a package to make Minecraft more teacher friendly and easier to manipulate to teach their students in a virtual world.

MinecraftEdu provides teachers with creation tools, virtual assessments, and simple server management (Nebel, Schneider & Rey, 2016). Minecraft was not the first to enter the educational realm of gaming, but it was one of the first to provide learners with a blank slate to let students interpret lessons however their mind developed the content (Dikkers, 2015; Nebel et al., 2016). MinecraftEdu continues to enhance the complexity of the game by adding blocks to increase its functionality. One block that has

improved the functionality of the game is the Redstone block, which adds power to the block to create electrical circuits (Nebel et al., 2016). Brand and Kinash (2013) added, "Redstone can become a teacher's best friend by allowing models and systems to be illustrated graphically and dynamically" (p. 58). The functionality of Redstone gives students the ability to demonstrate information in different ways than previously possible (Ellison, Evans, & Pike, 2016).

MinecraftEdu is being used in some core curriculum courses such as math, science, history, and English. Decimal Island is a world in which students must move by calculating sums in order to purchase items (Zomorodi, 2017). In science, students can create models of plant or animal cells and label each part with their function (Pusey & Pusey, 2015). History students are using MinecraftEdu to place themselves in a Civil War battlefield and reflect on their adventures through journal writing or interactions with each other (Miller, 2015). Students in English courses can hide key quotations from literature that tell a story throughout the game or provide challenges for students to demonstrate processes and improve inductive and deductive reasoning skills.

Theory and Learning with Minecraft

To understand the value of Minecraft in education, there must be a connection between game design and cognitive development. Minecraft supports a constructivist learning model, where it provides a blank slate to let students interpret lessons however their mind develops the content (Dikkers, 2015; Nebel et al., 2016). The constructivist learning theory suggests that the learner is active in constructing their own understanding and knowledge through experience and reflection (Koohang, Riley, Smith, & Schreurs, 2009). Jean Piaget's (1936) work on cognitive development in children is an important

starting point in the constructivist paradigm. Piaget believed a developing child builds mental models for adjusting new experiences with prior concepts (assimilation) or adjusting concepts to fit new experiences (accommodation). Children who play Minecraft construct their own knowledge through experience. Minecraft allows students to construct their own knowledge in a way that they understand the information and allows teachers to provide feedback based on the learners' construct of information in Minecraft.

Jerome Bruner contributed to constructivism by revealing the Discovery Learning Theory, which states "practice in discovering for oneself teaches one to acquire information in a way that makes that information more readily viable in problem solving" (Bruner, 1961, p. 26). Bruner believed students were more likely to remember information if they actively sought for answers and solutions. In order for this theory to work, the lesson must encourage students in active engagement, promote motivation and develop creativity. Critics believe discovery learning can cause students to misinterpret the material if there are no guidelines, goals, or objectives. Lessons should build curiosity and lead students to explore and investigate more on the topic. MinecraftEdu is a game about creativity, problem-solving, and collaboration, which are skills young adults lack upon entering the workforce (Symonds, Schwartz, & Ferguson, 2011). According to Hanson (2013), "competitive businesses thrive on innovation, and require new skills that historically have not been a part of school curricula (e.g., critical thinking, problem solving and collaboration)" (p. 3). Success is based on how students construct knowledge by being creative and collaborative.

More recently, a prominent figure in research who has recognized the benefits and learning potential gained through video games is James Paul Gee (Cipollone, Schifter, Moffat, 2014). A Mary Lou Fulton Presidential Professor of Literacy Studies, Gee is best known for his literacy research. More recently, Gee's focus has been on learning principles in video games and how games require the type of thinking needed to be successful in the 21st century (Gee & Shaffer, 2010). Gee's goal was to understand how designers of popular games engaged their audience to learn difficult, long and complex games. Gee began his work by identifying 36 learning principles that are within the design of a good video game. However, Gee has more recently condensed these learning principles into three student centered clusters: empowered learners, problem solving, and understanding (Gee, 2005).

Gee's perspective on empowered learners is based on the idea that students who are engaged, facilitate and customize their own learning experience feel empowered when they reach goals on their own. Gaming has allowed students to experience simulations of real situations, where previously they would have to use their imagination. In order for gaming to work in education, games must challenge the player and motivate them to persevere and keep coming back (Gee, 2005). Gee (2005) explained that problem solving should be pleasantly frustrating, but doable. Students must be put into positions to be creative and make decisions that affect and change the world around them. Gee's (2005) last learning principle is understanding (Gee, 2005). This principle states that students need an overview of their learning, where the meaning of words and concepts become clear through experience of the game.

The relevant theoretical framework for this study will not only connect to Gee's learning principles, but also to skills offered by MinecraftEdu and CTE. In order to completely understand Gee's concept of how game designers engage their audience to learn difficult, long, and complex games, it is necessary to understand Albert Bandura's self-efficacy theory. Self-efficacy is defined by Bandura (1977) as "the belief in one's capabilities to organize and execute the courses of action required to manage prospective situations" (p. 193). Bandura believed that a person's belief in their ability to succeed has an impact on their psychological states, behavior, and motivation.

According to Bandura (1977), there are four main sources of influence to a person's self-efficacy: 1) mastery experience, 2) vicarious experiences, 3) social persuasion, and 4) physiological states. Mastery experience is completing a task successfully and is one of the most effective ways to increase one's self-efficacy. However, failure can undermine these feelings, especially before a sense of efficacy is firmly established (Bandura, 1994). Video games are a perfect example of mastery experience. Most video games begin with an easy task to complete so the gamer can establish self-efficacy, and as each level is successfully completed, the more complex and daunting the task becomes.

Vicarious experiences are defined by Bandura (1994) as "seeing people similar to oneself succeed by sustained effort raises observers' belief that they too possess the capabilities to master comparable activities to succeed" (p. 3). In other words, people develop confidence and persist through challenges when they see others similar to them succeed. Minecraft has the ability to create these vicarious experiences intrinsically and extrinsically (Richardson, 2018). Through intrinsic play, learners engage within the

game to accomplish the assignment. All learning takes place within the game. Through extrinsic play, learning takes place beyond the game in blogs, chats, or other video lessons. In extrinsic play, the learners are engaged in communication, sharing, and discussion to effectively change the intrinsic game experience.

Minecraft is a game in which others can work individually or together to accomplish a goal. However, whether you work individually or as a team, all characters are in the same world and working to accomplish a certain task. Being in the same world gives all gamers the opportunity to follow and watch how others create and work to accomplish their task, providing a sense of self-efficacy in gamers who may be new to the game.

Social persuasion is defined as "a way of strengthening people's beliefs that they have what it takes to succeed" (Bandura, 1994. P. 3). Social persuasion is about building up others to help them see that they have the capability to accomplish their goal. Getting encouragement from others helps overcome self-doubt and makes people want to try harder. Video games with the collaboration and communication tool were designed to help people communicate and work as a team to accomplish goals. Unfortunately, many games like Minecraft have become a bully hot spot to verbally abuse others. However, MinecraftEdu has worked on eliminating this by providing tools for teachers to monitor and set limits on how students communicate. MinecraftEdu has also given teachers the ability to provide positive feedback to students as they work throughout the game to build self-efficacy.

The last source of self-efficacy that Bandura discusses is one's physiological state and their ability to learn how to interpret their internal signs of stress. Self-efficacy

suggests that actively learning how to manage stressful situations will improve self-efficacy. Bandura (1994) noted, "it is not the sheer intensity of emotional and physical reactions that is important but rather how they are perceived and interpreted" (p. 3). People who have a high sense of self-worth or a positive view on their ability to achieve have better outcomes, whereas those who have self-doubts can lead to the inability to perform. MinecraftEdu has the ability to improve self-efficacy by creating an environment where failure is part of the learning process. Students who may not feel adequate in learning usually feel comfortable and in control while gaming (Greenidge, 2013). This potentially increases one's self-efficacy through past experiences while gaming.

The Constructionism Theory of Learning is built on Piaget's Constructivist Theory by building knowledge in real world experiences. Seymour Papert believed learning is developed by creating a personally meaningful public product (Cipollone et. al, 2014; Morgan, 2015). Minecraft is a great example of constructionism because it encourages students to create content to be shared by using collaboration, communication, and problem-solving skills to solve these real-world problems in a virtual world. If Minecraft and CTE courses can provide students with experiential, discovery, and constructionism learning, might it be useful to use as field opportunities or to build student skills in small rural districts?

Conclusion

Prior studies have failed to investigate if MinecraftEdu can improve academic achievement in students who are enrolled in CTE courses. Researchers have found MinecraftEdu and curriculum in CTE courses offer sound learning principles,

engagement for the learner, 21st century skills, personalized learning opportunities, and an environment for authentic and relevant assessment (Ellison, Evans, & Pike, 2016; Morgan, 2015; Tromba, 2013). However, few teachers incorporate MinecraftEdu into their curriculum, which provides a need to investigate the role of MinecraftEdu in CTE courses in rural school districts. The proposed study is aimed to partially fill the gap in research on MinecraftEdu's impact on student learning in career and technical education and provide detail into the perceptions of students' taking a CTE course using MinecraftEdu in a rural high school.

CHAPTER III

Methodology

This chapter provides detailed information on the methodology for this study. First, it discusses the rationale for conducting a mixed method research study and the study design, including a description of the intervention. This is followed by reviewing the theoretical framework, research questions, research setting, and participants. Lastly, the data collection procedures and the methods of analysis are discussed.

In this study, the researcher examined a digital game-based intervention used to learn the parts and functions of the human digestive system in a rural high school CTE course. The purpose of this study aims to provide information into Minecraft's ability to provide students in rural districts another flexible delivery model that supports student learning and engagement. The study determined if implementing MinecraftEdu into a rural high school CTE course would be worth the effort, time and money put forth based on student perceptions. Furthermore, this study provided additional research on the benefits of MinecraftEdu in the classroom.

Research Questions

This study examined if there was a significant difference between students who used MinecraftEdu to learn the digestive system and students who did not use MinecraftEdu and to understand student perceptions of using MinecraftEdu in CTE. The study was conducted in a career and technical education course called Principals of Health Science. The study investigated the following two questions: 1) Is there a significant difference in academic achievement between students who used MinecraftEdu

in the Principles of Health Science course and those who did not use MinecraftEdu?

2) How do rural high school students perceive using MinecraftEdu?

Research Design

This study followed a mixed method design. According to Creswell (2009), a mixed methods research is appropriate when researchers use more than one approach for collecting and analyzing data. According to Schoonenboom and Johnson (2017), "the combining of quantitative and qualitative research components, is to expand and strengthen a study's conclusions and therefore, contribute to the published literature" (p.110). The reason for using a mixed method design instead of a multiple method design is that this study combines quantitative and qualitative research to provide a fuller more in-depth account of the research problem while multiple method involves data collection using two methods from the same paradigm (Morse, 2003). Given that little research has been done on the implementation of gaming into CTE courses, it is essential to increase knowledge and validity by using multiple data collection procedures.

The mixed methods research design followed the explanatory sequential approach where the initial quantitative data collection is followed by a secondary qualitative data collection (Creswell, 2009). Phase I of this study followed a quasi-experimental design, where two groups (control and treatment) were used to determine if the intervention had a significant effect on academic achievement in a CTE course. Phase II used a focus group to understand how the participants in a rural high school setting perceived using MinecraftEdu to learn the parts and functions of the human digestive system.

Phase I.

Phase I of the study used a quantitative approach and was conducted in three parts: 1) pre-assessment, 2) lessons in the unit, and 3) post-assessment. Quantitative research data was collected from a pre- and post-assessment. The baseline assessment (see Appendix 1) was given prior to the digestive system lessons in order to gather information on what students already knew about the digestive system. The pre-assessment contained 20 questions where students must identify each part of the digestive system and the functions it serves when food enters the body.

Upon completion of the pre-assessment, students in the control group began the traditional face-to-face instruction on the digestive system. Table 3 provides an outline of the teacher's goal for the week. The classroom teacher began each day with a bell ringer that included three vocabulary words on the digestive system. Students were to take the first five minutes of class to define these terms. On days two and three, the teacher introduced the digestive system by showing diagrams, videos, and presenting a PowerPoint presentation of the foods we need for energy and nutrition, vitamins and their importance, and the four stages of digestion. On days four and five, the teacher had students partner up and create a digestion flowchart of what happens when food enters and exits the body. On day six, each student created a quiz in Kahoot over the digestive system. Once the quiz was created, the class would take each of the quizzes to prepare them for the post-assessment.

Table 3

Control Group Daily Outline

Day	Title of Lesson
Day 1	Pre-Assessment
Days 2 and 3	Introduction of the Digestion System
Days 4 and 5	Digestive Flowchart
Days 6 and 7	Kahoot Quiz creation and review
Days 8	Post-Assessment

Note: Unit outline over the digestive system.

The treatment group was given log-ins to MinecraftEdu, the server name, and the IP address to the world in which they would create their diagram of the digestive system as well as a quick tutorial of the different blocks in MinecraftEdu. The student participants were given lesson objectives to complete as partners and the day-to-day schedule, as seen in Table 4. The classroom teacher made it clear to the students that research would be done by them, and they had the freedom to use the internet, class textbooks, and any other resource materials available to them in class.

The lesson objective was for students to research the digestive system and understand what happens in the digestive system as a person ingests a cheeseburger. Students were to design the digestive system in MinecraftEdu and take the class on a journey through the digestive system explaining what happens in each part of the digestive system when a cheeseburger is consumed. Students understood they would present in either a pre-recorded video or in front of the class. The students had eight days after the pre-assessment to complete this process.

Table 4

Treatment Group Daily Outline

Day	Title of Lesson
Day 1	Pre-Assessment Introduction to MinecraftEdu
Day 2	Give directions to students and choose partners. Begin lesson on "The Cheeseburger Journey."
Days 3, 4, 5, 6, 7, 8	Design and build the digestive system in MinecraftEdu
Day 9	Post Assessment

Note: Unit outline over the digestive system.

After the lessons were complete, all students took the post-assessment which was the same as the pre-assessment.

Phase II.

The second phase investigated students' perceptions of using MinecraftEdu as a tool for learning in a CTE course. Our perceptions affect our emotions and behaviors, and our emotional and behavioral reactions also help shape our environments and skew our beliefs of those environments (Adler, Rosenfeld, & Proctor II, 2012). Qualitative data from the focus group interviews were collected in order to understand student perceptions of MinecraftEdu in CTE and gain understanding of how they perceived their learning experience. The focus group method was chosen to gain a large amount of information in a shorter amount of time. Focus groups nurture different perceptions and

points of view to evaluate information on certain programs (Villard, 2003). Villard (2003) pointed out how focus groups are wonderful at ascertaining participant perceptions, feelings, and thoughts and are not intended to help make decisions for the researcher. Greenbaum (1998) stated that focus groups are productive when used to determine the strengths and weaknesses of programs and evaluate if the program is working.

The researcher's goal was to show the participants their opinions are respected and valued. In order to obtain this goal, seating was placed in a circle to allow students to feel comfortable and secure. The focus group (n= 13) was divided into two separate groups, with six in the first focus group and seven in the second focus group. According to Onwuegbuzie, Dickinson, Leech, and Zoran (2009), "focus groups should include enough participants to yield diversity in information provided, yet they should not include too many participants because large groups can create an environment where participants do not feel comfortable in sharing their thoughts, opinions, beliefs, and experiences" (p. 3). Each focus group lasted approximately 40 to 50 minutes to provide students with enough time to share their perceptions and thoughts of learning with MinecraftEdu in a high school CTE course. Notes were recorded and gathered by the researcher to ensure fidelity and control for bias.

In the allotted 50-minute time, the researcher gathered information on the overall awareness participants had of Minecraft before its implementation and the level of knowledge each participant had of playing Minecraft. Open-ended questions were used to determine the students' perception of using MinecraftEdu as a way to learn in a high school career and technical education course.

Data Analysis

Upon completion of the two-week intervention, a post-assessment was given to the control and treatment groups. Multiple analyses were run on both the control and treatment groups. First, descriptive statistics were run to obtain the skewness and kurtosis values and the standard error. In order to determine if the data was normally distributed, the z-score was calculated and compared to a normal distribution. Due to the small sample, two statistical analyses were done to determine if the small sample increased Type II error skewing, which would decrease the power of the study. The Sharipo-Wilks test and Levene's Test of Variance were used in this analysis. Data collected from the post-assessment was compared with the pre-assessment using a paired sample t-test statistical procedure. The paired sample t-test compares two means that are from the same individual (Zimmerman, 1997). The purpose of the paired sample t-test was to determine whether there was a difference between the two means.

To determine if there is significant effect on academic achievement, a one-way analysis of variance (ANOVA) was used to determine if the difference between the two means exists. For this analysis, a one-way analysis of variance was calculated on the academic achievement after the intervention between the control group and treatment group.

To understand students' perceptions of using MinecraftEdu as a learning tool, qualitative data was collected and analyzed from the focus group discussion. As the moderator, the researcher used recording software to record the focus group discussion in order to go back and adequately transcribe the conversation during the focus group. The researcher also used an assistant moderator to take notes during the focus group

discussion. The assistant moderator was to listen for notable quotes, key points, big ideas, or even follow up questions for the moderator to ask at a later time.

In analyzing the results of the discussion, the work of Strauss and Corbin (1998) was followed. Strauss and Corbin (1998) believed coding was a process of labeling and categorizing data in the analytical process. Strauss and Corbin (1998) explained there are three basic types of coding: open, axial, and selective. Open coding is where the discovery of categories and properties are made. Axial coding provides links between the data, and the development of subcategories are related to the categories. Selective coding is selecting one or more core categories to generate the story in order to answer the research question. With themes coded using Strauss and Corbin's (1998) systematic steps, the researcher interpreted the meaning of themes. The researcher also debriefed with the assistant moderator to validate the accuracy of the notes and perceptions. Finally, final reports were shared with the assistant moderator and the focus group to help verify the truthfulness of the transcribed information.

Ethical Consideration

An application for permission to conduct this study was sent to Sam Houston State University Institutional Review Board (IRB) for approval. Additionally, approval from the school superintendent and high school principal to conduct the study was obtained. A parent consent form (see Appendix 3) was sent home for the students' guardian to sign in order to conduct this research. The parent consent form explained the rights of the students and the responsibility of the principal investigator as well as gave parents the option to withdraw their child from the study. Additionally, students were given the child assent form (see Appendix 4) to sign before the study began. Participants

were informed that they could withdrawal from the study at any time. Names will be kept confidential, and the participant's name, ID number, or any other identifying information was not required for this study and was not collected during any of the above studies. If identifying information was collected, it will be stripped of any data before being saved in a password protected filing folder.

Participants

The high school where the study was conducted is a small rural school district located in East Texas. This school district serves 1,526 students in pre-k through 12th grades, 452 of which are in grades 9-12. According to the Texas Academic Performance Report (2017), the district's economically disadvantaged population is 56.8% (n= 864), and 41.8% (n= 638) are labeled as at risk (Texas Education Agency, 2017). The participants of this study consisted of 26 students in 9th, 10th, or 11th grade with ages ranging from 14-17 years of age.

The control group had a total of 11 students in the Principles of Health Science course. Of the 11 students in the class, eight students completed the requirements necessary to participate in this study. This included returning consent forms and taking the pre-and post-assessments. The age of the participants in the control group was 38% at 14 years old, 50% at 15 years old, and 12% at 17 years old. The ethnicity makeup of the students in the control group was 76% Caucasian, 12% Hispanic, and 12% African American. The student participants' gender ratio was 87% female and 13% male.

The treatment group had 15 students in the Principles of Health Science course. Of the 15 students in the class, 13 of the students completed the requirements necessary to participate in this study. The age of the participants in the treatment group was 31% at

14 years old, 38% at 15 years old, 23% at 16 years old, and 8% at 17 years old. The ethnicity makeup of the students in the control group was 54% Caucasian, 38% Hispanic, and 8% African American. The student participants' gender ratio was 92% female and 8% male.

The data collected for the quantitative phase of the study was derived from two Principle of Health Science courses in the Spring Session of 2019. Sampling of participants for this study was a non-random convenience sampling due to the samples being already scheduled in the Principles of Health Science class. Additionally, the number of classrooms (2) in this study allowed for a control group and a treatment group without inconveniencing schedules and the structure of the school day.

In Phase II, the qualitative research phase, the unit of analysis was two subsamples of the treatment group. According to Onwuegbuzie and Collins (2007), sampling of participants for a focus group should be between eight to 12 participants. The two subsamples of the treatment group were separated into two focus groups, where the first focus group contained six students and the second focus group had seven students. The researcher randomly assigned individuals from the treatment group to participate in one of the two focus groups, with all 13 students participating in the interview.

Conclusion

This mixed-methods study examined rural students' academic achievement using MinecraftEdu to learn the digestive system and gathered students' perceptions of the use of MinecraftEdu in a CTE course.

CHAPTER IV

Results

The mixed methods study followed the explanatory sequential approach where the initial quantitative data collection is followed by a secondary qualitative data collection (Creswell, 2009). Phase I of this study used a quasi-experimental design, where two groups (control and treatment) were used to determine if the intervention had a significant effect on academic achievement in a CTE course. Phase II used focus groups to understand how participants in a rural high school setting perceived using MinecraftEdu to learn the parts and functions of the human digestive system.

Quantitative Phase

Phase I of the study used a quantitative approach. An assessment (see Appendix 1) was given to the control group and the treatment group prior to the digestive system lessons. Upon completion of the pre-assessment, the treatment group used MinecraftEdu to create a model of the digestive system to explain the journey of a cheeseburger as it enters and exits the digestive system. The control group received traditional face-to-face instruction from their Principles of Health Science teacher. On the ninth day of instruction, student participants in both the control and treatment groups were given a post-assessment.

The purpose of the quantitative phase was to answer the following research question: Is there a significant difference in academic achievement between students who used MinecraftEdu in the Principles of Health Science course and those who did not use MinecraftEdu? To determine if a difference of two related variables was present, several analyses were run in SPSS.

Participants.

The participants in Phase I of this study included all students currently enrolled in a career and technical education course called Principles of Health Science, returned a consent form, and completed the pre- and post-assessments. A total of 26 students were enrolled in these two Principle of Health Science classes, according to the teacher. Of the 26 students enrolled, 21 students met the criteria to participate in this study. The control group had eight students, and the treatment group had 13 students. Onwuegbuzie and Collins (2007) provided sample sizes for detecting moderate effect sizes with .80 statistical power at 5% level of significance. Their recommendations for a quasi-experimental mixed method research design study would be a minimum of 21 participants per group. Studies that have a sample size too small will find it difficult to find significant relationships from the data (Onwuegbuzie & Collins, 2007; Creswell, 2009).

Results.

Multiple analyses were run in this study. First, descriptive statistics were run to obtain the skewness and kurtosis values and the standard error on the dependent variable for each group of the independent variable. Calculating the z-score from this data determined how the data differed compared to a normal distribution and whether the data was normally distributed.

Due to the small sample, two statistical analyses were done to determine if the small sample increased Type II error skewing, which would decrease the power of the study. The Sharipo-Wilks test and Levene's Test of Variance were used in this analysis. Lastly, paired t-tests were run for analysis.

After examining the descriptive statistics, the Shapiro-Wilks test was run to gather the significance value for each group of the independent variable. If the assumption of normality has been violated, the significance value will be less than .05 ($p < .05$). If the assumption of normality has not been violated, then the significant value will be greater than .05 ($p > .05$). The Shapiro-Wilks test is testing the null hypothesis that the data's distribution is equal to normal distribution.

Lastly, Levene's Test of Variance was used to check the variance was equal across all samples (Urdan, 2016). The Levene's test of variance provides an F-statistic and a significance value (p-value). If the significance value is greater than .05 ($p > .05$,) the group variance can be treated as equal. However, if $p < .05$, there are unequal variances, meaning there is a violation of the assumption of homogeneity of variances.

Control Group. Analysis of the pre-assessment and post-assessment results were conducted to determine if there was a significant change in data based on the traditional face-to-face style of teaching. For the control group, descriptive analysis was run to calculate the z-score for skewness and kurtosis. To get the z-score, the skewness and kurtosis values were divided by their respective standard error.

Table 5

Descriptive with Skewness, Kurtosis and Z Value for the Control Group

		Statistic	Standard Error	Z Value
Pre-Assessment	Skewness	.878	.752	1.17
	Kurtosis	.276	1.481	.19
Post-Assessment	Skewness	-.686	.752	-.91
	Kurtosis	-.038	1.481	-.03

Difference	Skewness	-.149	.752	-.20
	Kurtosis	-2.075	1.481	-1.40

Note. Z-value of skewness and kurtosis are normally distributed if the z-value is within +/-2 standard deviations.

Table 5 shows the skewness, kurtosis, and z-value for the pre-assessment, post-assessment, and difference for the control group. The pre-assessment scores were normally distributed for the control group with a skewness of .878 (SE=.752) and a kurtosis of .276 (SE=1.481), a skewness of -.686 (SE=.752) and a kurtosis of -.038 (SE=1.481) for the post-assessment, and skewness of -.149 (SE=.752) and a kurtosis of -2.074 (SE=1.481) for the differences between the paired values of pre-assessment and post-assessment. Based on the z-score for the control group, the scores for the pre-assessment, post-assessment, and difference all showed to be normally distributed within the +/-2 standard deviations.

Following the descriptive analysis, the Shapiro-Wilk was checked to determine if the control group met the assumption of normality. According to Table 6, the Shapiro-Wilk test shows the assumption of normality for pre-assessment, post-assessment and difference scores was satisfied for all group combinations. The pre-assessment for the control group revealed a significance value of (p = .261), a post-assessment value of (p = .660), and difference of the two assessments of (p = .062), which were greater than (p = .05).

Table 6

Tests of Normality for Pre-Assessment, Post-Assessment and Difference for Control Group

	Shapiro-Wilk		
	Statistic	*df*	Sig.
Pre-Assessment	.895	8	.261
Post-Assessment	.945	8	.660
Difference	.832	8	.062

Note. Shapiro-Wilk p > .05 = normally distributed.

A paired samples t-test was conducted in the control group to compare the academic growth by students before (pre-assessment) and after (post-assessment) MinecraftEdu was implemented in the Principle of Health Science class (Table 7).

Table 7

Paired Sample Statistics for Control Group

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Post-assessment	73.13	8	16.24	5.73
	Pre-assessment	38.13	8	11.63	4.11

Note. N and Std. represent sample size and standard, respectively.

The paired samples t-test was conducted to compare the pre-assessment in the control groups with the post-assessment. The results from the paired samples t-test are found in Tables 7 and 8. There was a significant difference in the pre-assessment (M= 38.13, SD= 11.63) and the post-assessment (M=78.13, SD=16.24) on the digestive system assessment; t(7)=5.5, p=.001). Table 8 indicates that on average, post-assessment scores were 35 points higher than pre-assessment scores (95% [20.01, 49.99]). An r of .90 (r^2 = 81%) was calculated as the effect size, indicating a large effect size. This

suggests that 81% of the variance of academic achievement can be determined by the amount of learning students received from the traditional face-to-face intervention. Post-assessment and pre-assessment were positively correlated (r = .206, p<.000). Overall, students in the control group made statistically significant gains.

Table 8

Paired Samples T-Test for Control Group

		Paired Differences					t	*df*	Sig.
		Mean	Std. Dev.	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Post-Assessment & Pre-Assessment	35	17.93	6.34	20.01	49.99	5.5	7	.001

Note. $p < .05$

Treatment Group. Analysis of the treatment group was conducted to see if there was a significant change in data caused by the intervention MinecraftEdu. Table 9 shows the descriptive analysis with the z-value computed for skewness and kurtosis. The pre-assessment shows a skewness of .049 (SE=.616) and a kurtosis of -.803 (SE=1.191), a skewness of .599 (SE=.616) and a kurtosis of .103 (SE=1.191) for the post-assessment, and skewness of .475 (SE=.616) and a kurtosis of -.174 (SE=1.191) for the differences between the paired values of pre-assessment and post-assessment.

All three z-values of skewness and kurtosis for the pre-assessment, post-assessment and the differences between the paired values are within the +/-1.96 for the treatment group. Therefore, we can assume that the data are approximately normally distributed in terms of skewness and kurtosis.

Table 9

Descriptive with Skewness, Kurtosis and Z Value for the Treatment Group

		Statistic	Standard Error	Z Value
Pre-Assessment	Skewness	.049	.616	.08
	Kurtosis	-.803	1.191	-.67
Post-Assessment	Skewness	.599	.616	.97
	Kurtosis	.103	1.191	.09
Difference	Skewness	.475	.616	.77
	Kurtosis	-.174	1.191	-.15

Note. Z-value of skewness and kurtosis are normally distributed if the z-value is within +/-2 standard deviations.

The Shapiro-Wilk test followed the descriptive analysis to see if the random sample came from a normal distribution. Table 10 shows $p > .05$ in the pre-assessment, post-assessment, and difference scores, confirming the data is normally distributed.

Table 10

Tests of Normality for Pre-Assessment, Post-Assessment, and Difference for Treatment Group

	Shapiro-Wilk		
	Statistic	*df*	Sig.
Pre-Assessment	.929	13	.333
Post-Assessment	.955	13	.669
Difference	.935	13	.400

Note. Shapiro-Wilk coefficients >.05, confirming equal normally distributed data.

The test results for the treatment group showed improvements for the post-assessment. The mean post-assessment scores indicated that after MinecraftEdu implementation, students increased their test scores from pre-assessment to post-

assessment. Table 11 shows descriptive data analysis regarding students' academic achievement on the pre-assessment demonstrated a mean of 24.62%, a minimum number of 10, a maximum number of 40, and a standard deviation of 9.89. Descriptive data analysis regarding students' academic achievement on the post-assessment demonstrated a mean of 51.2%, a minimum number of 25, a maximum number of 85, and a standard deviation of 16.7.

Table 11

Descriptive Statistics for Academic Achievement in Treatment Group

	N	Minimum	Maximum	Mean	Std. Deviation
Pre-assessment	13	10	40	24.62	9.89
Post-assessment	13	25	85	51.15	16.73
Difference	13	5	55	26.54	15.19
Valid N (listwise)	13				

Note. Examination of the mean scores.

A paired samples t-test was conducted in the treatment group to compare the academic growth by students before (pre-assessment) and after (post-assessment) MinecraftEdu was implemented in the Principle of Health Science class (Table 12).

Table 12

Paired Sample Statistics for Treatment Group

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Post-assessment	51.15	13	16.73	4.64
	Pre-assessment	24.62	13	9.89	2.74

Note. N and Std. represent sample size and standard, respectively.

The results from the paired samples t-test found there was a significant difference in the pre-assessment (M= 24.62, SD= 9.89) and the post-assessment (M=51.15, SD=16.73) on the digestive system assessment; t(12)=6.3, p=.000). Table 13 indicates that on average, post-assessment scores were 26.5 points higher (95% CI [17.4, 35.7]). An *r* of .88 (r^2 = 77%) was calculated as the effect size, indicating a large effect size. This suggests that 77% of the variance of academic achievement can be determined by the amount of learning students received from the MinecraftEdu intervention. Post-assessment and pre-assessment were positively correlated (r = .206, p<.000). Overall, students in the treatment group made statistically significant gains.

Table 13

Paired Samples T-Test for Treatment Group

		Paired Differences							
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		T	*df*	Sig.
					Lower	Upper			
Pair 1	Post-Assessment & Pre-Assessment	26.5	15.2	4.2	17.4	35.7	6.3	12	.000

Note. $p < .05$

Due to the small sample size, the researcher was unable to run analyses comparing the control group to the treatment group. Each group made statistically significant gains between pre- and post-assessments. However, there was not a large enough sample size to determine if the null hypothesis can be accepted or rejected.

Qualitative Phase

The qualitative phase of this study provided an account of students' perceptions of using MinecraftEdu from focus group interviews. Data provided from the focus group interviews will help to answer the second research question of this study: How do rural high school students perceive using MinecraftEdu as a learning tool in a career and technical education course?

According to The National Research Center on the Gifted and Talented (2015), "the influence of schools on students' academic performance is derived from a student's individual perception rather than the activities and interpersonal relations in the educational environment." Increased student achievement should be an important measuring factor for any district. However, it is also important to understand the students' perception of using certain tools and resources for learning. In this section, the study's purpose was to determine if implementing MinecraftEdu was worth the effort, time and money based on high school students' perceptions and self-efficacy.

Qualitative data was collected through two focus group interviews. The interviews were transcribed and provided the researcher with a descriptive account of students' perceptions on using MinecraftEdu as a learning tool. The focus group interview questions were designed by the researcher to gather students' perceptions regarding their experience in the Principle of Health Science class in which MinecraftEdu was used to facilitate the learning of the digestive system.

Participants.

For Phase II of the study, focus group interviews were conducted with participants from the treatment group. There were two focus group interviews due to

scheduling. The researcher was the primary moderator for both focus group interviews. The researcher followed the practical guide for conducting a focus group interview (Krueger, 1994). The moderator took responsibility for organizing the interview, preparing the equipment to record, creating a warm and friendly environment, asking the interview questions, and taking notes. There was an assistant moderator, a fellow teacher in the career and technical education department, who helped the moderator by taking notes throughout the interview, operating recording equipment, summarizing student responses, and debriefing with the moderator.

The first focus group consisted of six students and the second focus group consisted of seven students. Students were chosen randomly by the researcher for each focus group. The focus group interviews lasted approximately 40 to 50 minutes and provided students with enough time to share their perceptions and thoughts about learning with MinecraftEdu. The focus group interviews took place during the Principles of Health Science period agreed upon by the teacher, principal, and students.

Results.

Audio recordings made during each of the focus group interviews were recorded using the researcher's iPhone as well as the researcher's MacBook using the application QuickTime. The recording on two devices provided the researcher with back up data in case one device failed in mid-record. The researcher listened to the audio recordings multiple times and transcribed the dialogue while trying to maintain the character of the comments provided by the students. Students were given fictitious names to protect their privacy. The transcription of the focus group was transcribed in Microsoft Excel so the researcher could easily begin the coding process.

Following the works of Strauss and Corbin (1998), the researcher began with open coding the data line by line and developing "first impression" phrases derived from the transcribed focus group data. Once the "first impression" codes were developed, the researcher used tabs in Excel to create axial codes. The researcher then moved all related open codes within the axial tabs created at the bottom of the Excel spreadsheet.

After coding the data in the axial tabs, the researcher created an extensive list of indicators collected from the focus group interviews as shown in Appendix F. Three themes emerged from the research data to answer research question two: "How do rural high school students perceive using MinecraftEdu as a learning tool in a career and technical education course?" The three themes are:

1. Self-Efficacy based on students' interests and experience.
2. Students' perceptions of using MinecraftEdu as a learning tool.
3. Students' perceptions on implementing MinecraftEdu in future courses.

Many of the student participants gave detailed answers during the focus group interviews, which will be explained in the following paragraphs.

Self-efficacy based on students' interests and experiences.

In order to better understand students' perception on using MinecraftEdu as a learning tool, the researcher began the focus group by asking if students were interested in using technology in class. According to Harackiewicz, Smith, and Priniski (2016), "Interest is a powerful motivational process that energizes learning, guides career trajectories, and is essential to academic success." According to data from the focus group interviews, the students' interest in using technology in the classroom showed that 69% (9) of the students liked using technology. Karl explained, "I like using technology

because it provides a better source of education and students are more engaged in the lesson." Another student, Jayla remarked, "I like using technology because you can use it for many things and find a better understanding of some things that you may not know. It provides unlimited possibilities in learning." These students understand the importance of accumulating information and how using multiple resources can increase the accuracy of information being investigated. Research by Wardlow (2016) stated that technology helps teachers create and present content and instruction that is interesting and relevant to students. Additionally, Gee (2005) stated, "to be an active learner, one must experience the world in new ways, create affinity groups with like-mined people, and use these elements to prepare for future learning."

Although a high percentage of students like using technology in the classroom, 23% (3) of the students explained it was not the only way they like to learn. Katelyn explained, "I like using technology, but not all the time. I like to be taught in a number of different ways, especially hands-on activities." Tammy expanded upon Katelyn's ideas:

> I like using technology but there are times I would prefer not to use it. But many people learn differently. Using technology is a good way to learn because there are so many ways to gather information. You can use your phone to watch videos. Good to have so many ways to learn.

Statements like Katelyn and Tammy are backed by theories such as Howard Gardner's theory of multiple intelligences. Gardner (2011) added, "no two people have exactly the same intelligences in the same combination." In order to reach all students, teachers must differentiate to meet the varying levels of knowledge processed by students. In the book by Bruetsch and Dunn (1998), *Multiple Intelligences Lesson Plan*

Book, Dunn stated, "if a child is not learning the way you are teaching, then you must teach in the way the child learns."

Research has shown significant growth of technology use in the classroom; however, there are many students who do learn better in other formats. Kenzie stated, "I do not like using technology because I like to have my hands on doing projects that involves writing or drawing." In a 2015 national report conducted by Pearson, a survey was sent to 1,007 high school students, and 4% of those students mentioned not learning well with technology. These results suggest a need for teachers to differentiate lessons so all students have their individual needs met in the classroom.

After discussing students' interests in the use of technology in the classroom, the researcher asked students about their experience with playing MinecraftEdu prior to the class. Of the 13 students, 46% (6) had prior experience playing Minecraft or MinecraftEdu. Donna described that her experience was not with Minecraft in general but with a knock-off game similar to MinecraftEdu. Only two of the six students currently play, while the remaining four students said they stopped playing Minecraft while in junior high. Understanding a student's prior knowledge with a given technology allows instructors to design instructions to the current cognitive level of the student. Students connect what they learn to what they already know, interpreting incoming information and even sensory perception through the lens of their existing knowledge, beliefs, and assumptions (Vygotsky, 1978; National Research Council, 2000).

Given that six students had prior experience playing MinecraftEdu, 54% (7) had no prior experience in playing MinecraftEdu. Katelyn explained, "I only heard my brothers discuss Minecraft, but I have never played until this lesson." Students with prior

knowledge or experience in playing MinecraftEdu were more into providing the researcher with answers than students who did not have experience playing.

Student self-efficacy is influenced by student experience and interest level. Students with prior experience had a higher level of self-efficacy because of their comfort level playing Minecraft. As evidence of this, Steven said, "it was fun and interactive. Easier and quicker way to learn the digestive system." However, the students with low self-efficacy were students with no prior experience with Minecraft. Hidi and Harackiewiez (2000) found that students who are interested in an academic topic are more likely to become engaged and process information effectively and ultimately perform better. This study confirmed those findings.

Students' perceptions of using MinecraftEdu as a learning tool.

Students are an important source of information on the quality of material presented in individual classrooms (Measures of Effective Teaching Project, 2012). Since students are an important source of information, it was important for the researcher to ask students about their use of MinecraftEdu as a learning tool in order to understand if this was something that needed to be implemented in the future. The perception of students was divided into two categories: 1) overall impression of using MinecraftEdu to learn about the digestive system and 2) providing feedback into the value of learning via MinecraftEdu.

Overall, 85% (11) of students enjoyed or liked using MinecraftEdu as a learning tool. Students emphasized their satisfaction with using MinecraftEdu because it was a fun, easy, quick way to learn, visually appealing, and helped them remember parts of the digestive system. Madison explained, "it was a fun way to learn and helped me visually

understand the digestive system." Brittany mentioned, "I liked using Minecraft because it was helpful since I am a visual learner." Students mentioned how fun it was to play MinecraftEdu to learn the digestive system. Brooke stated, "I get bored just sitting and listening to the teacher." MinecraftEdu made learning more enjoyable than reading from a textbook or listening to the teacher the whole time. Furthermore, Tammy said:

> I think Minecraft is relatable to students because a lot of students play video games. When they are having fun, the information being learned will stick more. More than just sitting and listening to a teacher or doing a worksheet.

Being able to build the digestive system using MinecraftEdu allowed students to learn and not even realize they were learning because it was all in a game, as Tammy and Madison explained. Pusey and Pusey (2015) provided similar findings on students' responses with the use of MinecraftEdu in a classroom setting. In their article, students mentioned how the activities using MinecraftEdu were fun and provided a good mixture of fun and learning. In order for students to learn, lessons should be relevant and relatable to the student.

Students also mentioned MinecraftEdu being easy in regards to building and/or designing the digestive system. Tammy explained, "building was easy because of my creative outlook." Students were given the creative freedom to build the digestive system as they understood it from their research. This allowed each digestive system to look different but be expressed in a way that students could understand. Interestingly, students who thought the building process was easy had prior experience in Minecraft. For example, Karl stated, "using MinecraftEdu was an easier and quicker way to learn the

digestive system." Karl had extensive experience playing Minecraft and currently plays today.

However, not all students liked using MinecraftEdu to learn the digestive system. Katelyn mentioned, "building was the hardest part, I didn't think the blocks were equipped with what I needed." She had no previous experience using MinecraftEdu, thus, to understand the blocks and their power within the time allotted for lessons was not attainable. Donna reiterated, "the building part was difficult because I had never played MinecraftEdu before." Donna and Katelyn were not the only students having trouble building. Jayla stated, "the building part of the lesson was difficult and also understanding the objective of the lesson was confusing." Lack of experience had an impact on the students' learning experience.

There are many different types of learners—visual, kinesthetic, and tactile to name a few. Karl claimed that video games in the classroom are not for everybody. He stated, "If you didn't know anything about MinecraftEdu, it would be confusing and difficult." Furthermore, Kenzie said, "some students like to have hands-on lessons where they can draw and build with their hands. I am a tactile learner, and I like to be taught the information by a teacher so I know the information being consumed is correct." Overall, the level of experience students possessed influenced not only their level of self-efficacy but was a larger predictor in their perception of using MinecraftEdu as a learning tool.

Value of MinecraftEdu.

Students were then asked if they saw any value in learning with MinecraftEdu. Five students mentioned the visual benefits of designing and building the digestive system using MinecraftEdu. Being able to create the digestive system from scratch and

consistently looking at the design would help students remember where parts of the digestive system are located. Katelyn said, "I also learned that color coding helped me learn the digestive system and visually learn parts." Tammy also mentioned how she remembered the order of the organs as she built the digestive system so labeling was easy on the post-assessment. In an article by Lorence (2015), a teacher uses Minecraft to "help students visualize concepts, work on communication and collaboration skills, foster positive online behavior, [and] differentiate for students who need more than just words in a textbook" (para. 17).

Several students also enjoyed that the lesson was self-paced. This way they could work on as little or as much as they wanted. Natalie stated, "it was a quicker way to learn the digestive system. Usually, it takes two to three weeks to learn the digestive system and we were able to learn it in a week." Brooke said, "having the ability to go at my own pace allowed me to learn faster and better." A word count for self-pace and quicker in the focus group transcriptions yielded a total of five hits: self-pace with two and quicker with three.

The students enjoyed using MinecraftEdu as a learning tool and mentioned the value of using MinecraftEdu in a classroom setting. Students enjoyed using MinecraftEdu because of their high self-efficacy in using the game to learn about the digestive system. Additionally, using MinecraftEdu was fun and interesting. The game allowed students to get a better sense of what the digestive system looked like in the body. In conclusion, students' perception of learning the digestive system with MinecraftEdu was favored by most students. However, students still want lessons to be differentiated and do not want every lesson to incorporate one teaching technique.

Student perception on implementing MinecraftEdu in future courses.

There are many research articles on interest and its ability to motivate, engage, and stimulate students intellectually (Harackiewicz, Smith & Priniski, 2016; Van der Hoeven Kraft, 2017). However, little research has looked at the students' perceptions of wanting MinecraftEdu in classrooms. In order to give students' the opportunity to share their perception of future implementation, the researcher asked students if they would take another course designed like this lesson. Of 13 students, 77% (10) would take a course designed like this lesson. Five of the 10 students would take a course like this lesson and not change anything about the way it was set up and delivered. Steven said, "I learned the digestive system while building and much quicker too, like a week or so." Brooke stated, "I feel like it would help us learn better and faster." Lastly, Caroline commented, "it was a quicker way for me to learn the digestive system because I knew the end date and could self-pace and learn at my own speed." One student mentioned how she would much rather take a course with MinecraftEdu than sit and listen to the teacher all day. Madison stated, "I get bored just sitting and listening to the teacher." Clearly, some of the students felt MinecraftEdu was a good way to learn for various reasons.

Two of the 10 students would like to see it implemented but with some changes to its implementation. For example, Karl said, "I personally would like to see this in more classes if some things were to change a little. For instance, give a little more information into what and how we are to accomplish the lesson." The need for more instruction was supported by Tammy when she stated:

> I feel like it should be added but with some changes. I think it would be good to have a teacher explaining it to you. Some students may do good but others may

not. This way all students completely understand the directions and objectives to be accomplished and not relying on student interpretation.

While only two of the students felt this way, it is important for educators to consider.

Three of the 10 students agreed that it should be added as a supplement to the lesson. Kenzie stated, “I think it should be added but also being able to learn from the teacher because balance is good. More than one way of learning is more enjoyable.” Brittany mentioned, “I feel that there should be a balance. If incorporated, I think having a teacher would be beneficial because I did not learn that much from it.” Katelyn agreed by stating, “I think it would benefit some and not others. Students who are into this type of learning, it would benefit. But not the students who do not like to game. I see both sides.” These perceptions are important to understand.

It was also mentioned by two students that younger students would benefit more from this type of instruction. Younger students are the ones who are playing games and would probably enjoy coming to school to play games. Katelyn said, “I think younger students would benefit more from this type of instruction because they play games.” Karl stated, “I also think younger students would take school more seriously because they would look forward to going to school to play video games. They probably would not realize they are learning.” These ideas are something for educators to consider.

Three students said they would not take another course that implemented MinecraftEdu. As stated by Katelyn, “I would rather learn from someone. I like to communicate with others when I’m learning. I like other people’s opinions.” Jayla said, “I just don’t think I would learn as much as being taught by someone.” Kenzie

mentioned, I would not take that course. I just don't think I would learn as much as being taught by someone." Clearly, the use of MinecraftEdu is not for all students.

Overall, 77% of students would like to see MinecraftEdu implemented into future curriculum. Even though a majority of students thought MinecraftEdu should be implemented, students' opinions varied on what the implementation should look like. Some students believed it should be implemented but with some changes, such as the teacher explaining in further detail and creating a good balance between other teaching strategies. Other students thought it may be better implemented in younger grade levels because they are already into playing games. Lastly, 23% thought it should not be implemented because they like to learn from others.

Conclusion

This chapter contained the results of the quantitative and qualitative analyses. Due to a small sample size in Phase I, the data did not represent a true sample size for a normally distributed population. Hence, the first research question could not be answered. In Phase II, three themes emerged from the focus group data: (a) self-efficacy based on students interests and experiences, (b) students' perceptions of using MinecraftEdu as a learning tool, and (c) students' perceptions on implementing MinecraftEdu in future courses.

CHAPTER V

Discussion

The purpose of this mixed methods study was to determine if the use of MinecraftEdu in a career and technical education course increased student achievement and examined student perceptions of MinecraftEdu being used as an educational tool in a rural high school. This chapter includes a discussion of the major findings as related to the literature on gaming in CTE courses, implications for practice, and recommendations for future research. The chapter concludes with a discussion of the limitations of the study and a brief summary.

Phase I

The quantitative analysis of the study used non-random convenience sampling due to the limited number of available participants. The Shapiro-Wilk test demonstrated normal distribution of the difference between pre- and post-assessment scores. The Shapiro-Wilk test is important because normal distribution tells shows that if this study was repeated several times on a large scale, then the sum of their distribution would be close to normality. This allows the researcher to easily estimate the confidence level in making future decisions with the information given. The Levene's test demonstrated the need to run a paired samples t-test because of the unequal variances. The paired samples t-test determined the difference between the pre-assessment and post-assessment scores using a 95% confidence interval for an assumed normal population distribution. The use of the paired samples t-test for the control and treatment indicated the post-assessment scores increased as a result of face to face and MinecraftEdu interventions. Comparison

of the control and treatment group means found both the control and treatment group to be outside of the 95% confidence interval for a true mean.

Due to the limited number of participants, the sample did not represent a true sampling of a normally distributed population. However, for this particular study, the control group and treatment group had significant increases in post-assessment scores compared to their pre-assessment. The control group had slightly better scores on the post-assessment than the treatment group. The results indicated that MinecraftEdu can be a factor for improving academic achievement. For this study, it was found that traditional face-to-face teaching strategies were more effective.

Phase II

The qualitative data was collected from two separate focus groups interviews within the treatment group. The results of focus group interviews comprised three themes based on rural student perceptions of using MinecraftEdu as a learning tool in a career and technical education course: (a) self-efficacy based on students' interests and experience, (b) students' perceptions of using MinecraftEdu as a learning tool, and (c) student perception on implementing MinecraftEdu in future courses. Students were overwhelmingly interested in implementing MinecraftEdu into future courses. However, students' lack of experience using MinecraftEdu played a vital role on student response and self-efficacy. These three themes set the stage for the following implications section.

Implications

Career and technical education has been constantly evaluating its curriculum to prepare students for success after high school. Although research shows MinecraftEdu to promote collaborative learning, critical thinking, and problem solving, research had

neglected to investigate MinecraftEdu in a CTE course (Ellison, Evans & Pike, 2016). In this section, we will discuss the implications found while using MinecraftEdu in a CTE course.

This study was conducted in a rural setting, which resulted in a small sample size thus limiting the findings of the quantitative phase of this study. Coladarci (2007) suggested, "rural education researchers must offer vivid contrasts between rural and non-rural contexts in order to establish the rurality of the phenomena they putatively uncover" (p. 3). This comparison between the two contexts allows a corresponding figure to be reported in hopes of understanding if this phenomenon is a rural problem or a high school student problem in whole. While the findings may not have been statistically significant due to sample size, every student in the treatment group had an increase in scores between the pre- and post-assessment, which would represent academic growth.

Another important implication of this study was the gender imbalance within the sample. Of the 13 students who were in the treatment group, only two were males. In a study by Mavoa, Carter and Gibbs (2017), they found boys (54%) aged 3 to 12 are much more likely to play Minecraft than girls (32%). Most research agrees that males play more video games than females (Shaw, 2012; Entertainment Software Association, 2018; & Mavoa, Carter & Gibbs, 2017). The gender imbalance from this study is likely due to the course in which MinecraftEdu was implemented due to a heavily weighted female class. In order to have better representative sample of males and females in data, researchers would need to look at other courses to complete this study.

Due to the limitations in the quantitative phase of this study, the majority of the analysis came from the focus group data, which evaluated students' perception of using

MinecraftEdu as a learning tool in a career and technical education course. Little research had been done on MinecraftEdu in a high school classroom and understanding high school student perceptions of this topic is non-existent. This study found 85% of rural high school students liked using MinecraftEdu as a learning tool and 77% of them believed it should be implemented into future courses.

While students favored MinecraftEdu, the level of experience a student had with Minecraft directly affected their perceptions of using MincraftEdu in the classroom. Students with prior experience were more likely to answer questions during the focus group and showed an increase of confidence during gameplay. Self-efficacy has strong ties to the interest level students express from the focus group interviews. Students with previous experience playing Minecraft had higher levels of self-efficacy and were more intrinsically motivated to try this activity. Research makes it clear that students flourish when they have choice and control over their education (Evans & Boucher, 2015). Students with lower self-efficacy because of the lack of experience playing Minecraft reported how hard and difficult building was within MinecraftEdu. This may have been due to the students not only learning the functions of the digestive system but also learning how to play the game at the same time.

Students need a voice when it comes to curriculum decisions. There is a lot of research on the benefits of student choice. Parker, Novak, and Bartell (2017) said:

> It's important to give students influence over how and what they learn in the classroom. But not all choices are equal. Teachers should structure learning scenarios that equip students with opportunities to strengthen their autonomy, competence, and relatedness (p. 37).

Students having a voice will give them more ownership, which will increase engagement in the learning process.

Regardless of gender, economic status, or experience, high school students liked using MinecraftEdu as a learning tool. Gaming in high school classrooms has been overlooked by the research community because gaming is often thought of for younger students. Glenwood High School is challenging that philosophy by embracing game-based learning to build skills like collaboration, communication, and critical thinking. While this implementation is still in its infancy, the student excitement level to learn is off the charts (Microsoft, 2018). The implication is to make sure educators provide quality, engaging, and intellectually stimulating lessons for all age students.

Recommendations for Future Research

The courses offered within CTE are diverse, and research has only just begun with investigating the possibilities of using gaming in CTE courses. Researchers should consider replicating this study on a large scale in similar CTE courses at multiple rural high schools. The quantitative phase of this study was insignificant due to the small sample. The need for a larger sample size would give the study a true evaluation of the population in regards to their academic achievement using MinecraftEdu in a CTE course. Future researchers should attempt to have more gender balance in the sample population of the study. This study was heavily weighted with female perspectives due to the enrollment of females within the Principles of Health Science course. A study with gender balance would allow researchers to have a better overall understanding of high school students.

Another area of exploration for future researchers would be to examine the use of MinecraftEdu in other CTE courses, such as business or vocational, to evaluate the potential effects on academic achievement. For example, researchers could investigate students playing in survival mode to grow food, build communities, and collect resources in order to thrive and survive. This would allow students to understand and prepare for what life is like after school.

In the current study, several students could justify implementing MinecraftEdu in future courses if changes were made in the lessons. Future researchers could provide students with training, tutorials, and detailed instructions of how to play MinecraftEdu. This may increase game knowledge and students' level of confidence and self-efficacy. Overall, there are several aspects to consider when conducting research on the use of MinecraftEdu in CTE courses in rural settings.

Conclusion

The results of this mixed methods study of 21 students in a career and technical education course is two-fold. First, this study cannot determine that using MinecraftEdu in a career and technical education course had any impact on academic achievement. Due to the small sample size, there was not statistically significant data. However, the results of the qualitative phase of this study suggested three themes related to students' perception of using MinecraftEdu as a learning tool: (a) self-efficacy based on student experience and interest, (b) student perception of using MinecraftEdu as a learning tool, and (c) student perceptions on implementing MinecraftEdu in future courses.

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APPENDIX A

Digestive System Test

DIRECTIONS: Answer the following questions in the space provided.

___ 1. **The gastrointestinal tract includes the mouth, _____, esophagus, stomach, small intestine, and large intestine.**

A. liver
B. larynx
C. pancreas
D. trachea
E. pharynx

___ 2. **The accessory organs of digestion are _____**

A. pancreas and liver
B. stomach and duodenum
C. pancreas, liver, ileum
D. esophagus and duodenum
E. duodenum, ileum, and jejunum

___ 3. **Amino acids are the result of digesting _____**

A. carbohydrates
B. proteins
C. fats
D. bananas
E. none of these

___ 4. **The function(s) of the digestive system is (are) _____**

A. to ingest food
B. to digest food to small molecules
C. to absorb nutrient molecules
D. all of the above
E. none of the above

___ 5. **The enzyme amylase in saliva acts on _____**

A. starch
B. proteins
C. fats
D. nucleic acids
E. glucose

___ 6. **The wall of the small intestine contains fingerlike projections called**

A. rugae
B. flagella
C. villi
D. reticula
E. extensions

___ 7. **The large intestine consists of the _____ .**

A. colon
B. cecum
C. rectum
D. A and B
E. A, B, and C

___ 8. **The _____ conducts the bolus from the pharynx to the stomach.**

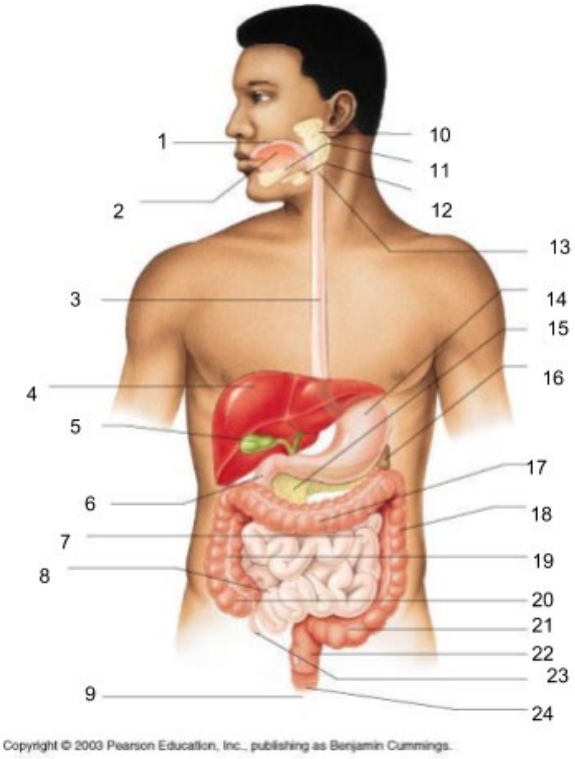
A. trachea
B. pharynx
C. uvula
D. glottis
E. esophagus

___ 9. **The appendix is a projection extending from the _____**

A. small intestine
B. stomach
C. colon
D. cecum
E. rectum

___ 10. **Food leaving the stomach is called _____.**

A. bolus
B. feces
C. chyme
D. rhyme
E. cholestyme



Matching: Match the number with its name. Questions 11 - 20 refer to the diagram above

___ 11. transverse colon

___ 12. appendix

___ 13. duodenum

___ 14. ileum

___ 15. stomach

___ 16. rectum

___ 17. esophagus

___ 18. descending colon

___ 19. ascending colon

___ 20. liver

APPENDIX B

Focus Group Questions

Introduction (5 minutes)

Welcome! This focus group discussion is to learn how you think and feel about MinecraftEdu being used in the class Principles of Health Science to learn about the digestive system. I really appreciate your willingness to participate!

- Remember, there are no right or wrong answers; we want to hear your unbiased opinions!
- The moderator is independent of the discussion.
- Everyone should participate; no one should dominate the conversation.
- Recording is taking place and notes are being taken so we don't miss anything you say.
- Let us know if you need to excuse yourself by leaving the focus group early.

Questions

Awareness

- Determine students' awareness of Minecraft before its implementation into the classroom
    - Have any of you played with Minecraft or MinecraftEdu prior to the class?
        - Please give details on your extent of experience?
    - How aware do you think the class as a whole was of Minecraft prior to its implementation?
        - Answer Percentage...Does this surprise you?

Perception

- Looking back at the MinecraftEdu lesson, can you give me your overall impression of using MinecraftEdu to learn about the digestive system?
- Do you like learning about the digestive system? Why or why not?
- Do you like to use technology in your day to day learning?
- Do you see value in taking a complete course using MinecraftEdu? Why or why not?
- Do you feel that you learned more about the digestive system via creating MinecraftEdu?
- What is your overall perception of MinecraftEdu as a learning tool? Explain
- Would you rather learn using MinecraftEdu or through the traditional face-to-face? Explain
- What were the benefits to learning this way? Negatives?
- Would you like to see MinecraftEdu implemented in more classes?
- Was there any pare of the lesson that had no impact on you or your learning?

APPENDIX C

Sam Houston State University, Huntsville, TX

PARENT PERMISSION FOR MINOR TO PARTICIPATE IN RESEARCH

Gaming in the Classroom: A Mixed-Methods Investigation of Minecraft in a Rural Career and Technical Education Courses

Your child is invited to participate in a research study conducted by Kyle Ivey, a doctoral student at Sam Houston State University. I am conducting the study as part of my course work under the supervision of Dr. Julie Herron and Dr. Karla Eidson, Department of Curriculum and Instructional.

The focus of this research is to study the use of MinecraftEdu in career and technical education course, Principles of Health Science by answering the following research question: Does MinecraftEdu impact student learning in career and technical education classes and what are the perceptions of students taking this course in a rural high school? As the Principal Investigator, my goal is to determine if MinecraftEdu integrated into a career and technical education course will increase student grades compared to a class who will not use MinecraftEdu.

What will happen if my child takes part in this research study?

- Your child would complete a pre-assessment prior to using MinecraftEdu and a post-assessment after using MinecraftEdu in the fall of 2018. Each assessment will be completed in their Principle of Health Science class. Students will create a digestive system using MinecraftEdu using terms associated to the digestive system.
- Your child would possibly attend a focus group in the fall of 2018 lead by Kyle Ivey, the Principal Investigator. The focus group is employed to gather the perception of students who used MinecraftEdu to learn about the digestive system. Group discussion will be documented by the principal investigator and saved in a password protected file and external hard drive. However, no identifying information will be used in the report.

How long will my child be in the research study?

Participation will take a total of about one hour depending on if your child participants in the focus group or not.

Are there any potential risks or discomforts that my child can expect from this study?

I do not anticipate any risks for your child participating in this study other than those encountered in day-to-day life.

Are there any potential benefits to my child if he or she participates?

Your child will not directly benefit from his/her participation in this research. However, the results of the research may benefit your child in the future by providing researchers with the knowledge in how successful students learn using MinecraftEdu in a career and technical education course.

Will information about my child's participation be kept confidential?

Any information that is obtained in connection with this study and that can identify your child will remain confidential. It will be disclosed only with your permission or as required by law. Confidentiality will be maintained by means of a password protected filing system and external hard-drive that will be kept in the Principal Investigators lock and key filing cabinet.

The survey's will ask students to create a study ID in order for the Principal Investigator to link the responses together. The study ID will be created as follows:

A. What is the first two initials of your high school's name? _____
B. What day of the month were you born? _____
C. What is the last letter of your first name? _____
D. Combine your responses from A-C in order here (e.g., CE07E) _____ (this is your study ID)
E. Insert your study ID into question #1 of the attached survey

What are my and my child's rights if he or she takes part in this study?

- You can choose whether or not you want your child to be in this study, and you may withdraw your permission and discontinue your child's participation at any time.
- Whatever decision you make, there will be no penalty to you or your child, and no loss of benefits to which you or your child were otherwise entitled.
- Your child may refuse to answer any questions that he/she does not want to answer and still remain in the study.
- Your decision whether or not to permit your child to participate will not affect your current or future relations with Sam Houston State University or Central Independent School District. If you decide to participate, you are free to withdraw at any time without affecting those relationships.

Who can I contact if I have questions about this study?

If you have any questions, comments or concerns about the research, you can talk to the one of the researchers. Please contact:

Kyle Ivey – Principal Investigator
ksi005@shsu.edu

Dr. Julie Herron– Faculty Supervisor
jkhl037@shsu.edu

SHSU Office of the Protection of Human Subjects (OPHS)-Institutional Review Board (IRB):

If you have questions about your child's rights while taking part in this study, or you have concerns or suggestions and you want to talk to someone other than the researchers about the study, please call the OPHS at (936) 294-4875 or write to:

Office of Research and Sponsored Programs
Institutional Review Board
ATTN: Sharla Miles
ORSP-SHSU Box 2448
Huntsville, TX 77341-2448

You will be given a copy of this information to keep for your records.

SIGNATURE OF PARENT OR LEGAL GUARDIAN

Name of Child

Name of Parent or Legal Guardian

Signature of Parent or Legal Guardian | Date

SIGNATURE OF PERSON OBTAINING CONSENT

Name of Person Obtaining Consent | Contact Number

Signature of Person Obtaining Consent | Date

APPENDIX D

ASSENT TO PARTICIPATE IN RESEARCH

A Mixed-Methods Investigation of Minecraft in a Rural Career and Technical Education Courses

1. My name is Kyle Ivey and I am a doctoral student at Sam Houston State University.

2. We are asking you to take part in a research study, because we are trying to examine if MinecraftEdu can increase student academic achievement in a rural high school.

3. If you agree to participate in this study, you will complete one pre-assessment and one post-assessment in the Fall of 2018. The pre-assessment will be used to gather what knowledge you have previous to the implementation of MinecraftEdu. The post assessment will be used to see what you learned after the implementation of MinecraftEdu. Both assessments will be completed in your Principle of Health Science class and will contain 20 questions. You would also attend a focus group in the Fall of 2018 lead by Kyle Ivey the Principal Investigator. The focus group is employed to gather more detailed information on student's interest and why or why not MinecraftEdu would be valuable to career and technical education courses. Group discussion will be documented by the principal investigator and saved in a password protected file and external hard drive. However, no identifying information will be used in the report.

4. I do not anticipate any risks for you while participating in this study other than those encountered in day-to-day life.

5. You will not directly benefit from participation in this research. However, the results of the research may benefit you in the future by providing valid information to improve career and technical education course offerings and engage learners in the process.

6. Any information that is obtained in connection with this study and that can identify you will remain confidential. It will be disclosed only with your permission or as required by law. Confidentiality will be maintained by means of a password protected filing system and external hard-drive that will be kept in the Principal Investigators lock and key filing cabinet.

7. Please talk this over with your parents before you decide whether or not to participate. We will also ask your parents to give their permission for you to take part in this study.

8. If you do not want to be in this study, you do not have to participate. Remember, being in this study is up to you, and no one will be upset if you do not want to participate or if you change your mind later and want to stop.

9. If you or your parents have questions about your rights as a research participant, you may call the Office of Research and Sponsored Programs—Sharla Miles at 936-294-4875 or email her at sharla_miles@shsu.edu.

10. If you have questions about the research, you may contact me at ksi005@shsu.edu or my faculty sponsor, Dr. Julie Herron at jkh037@shsu.edu

11. Signing your name below means that you agree to be in this study. You and your parents will be given a copy of this form after you have signed it.

_____ _____

Name of Subject Date

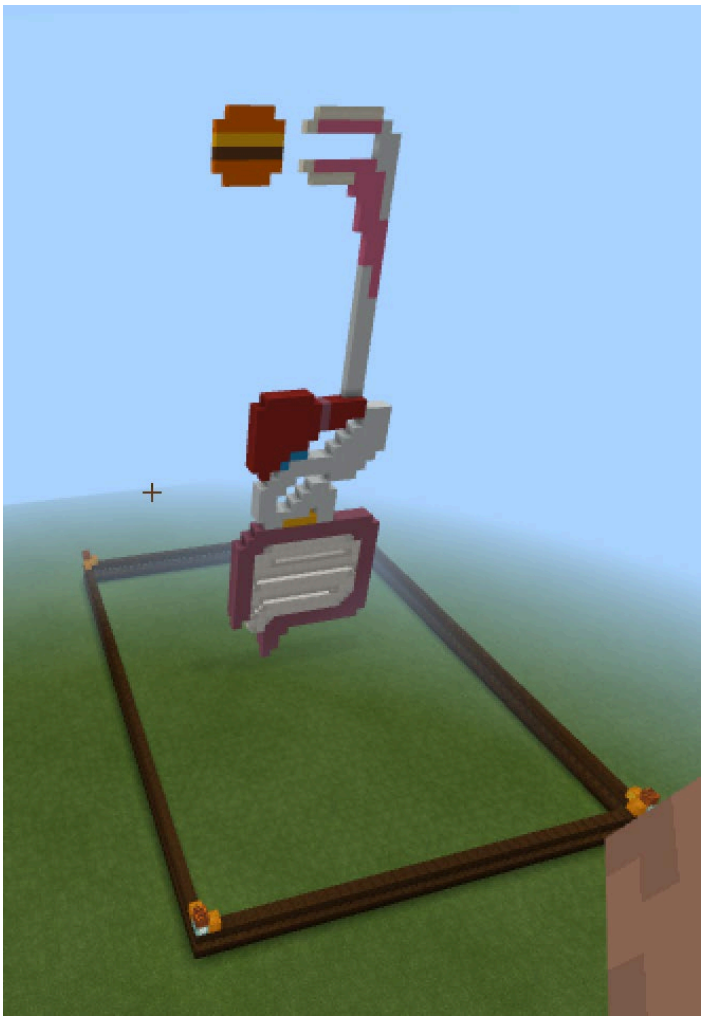
_____ _____ _____

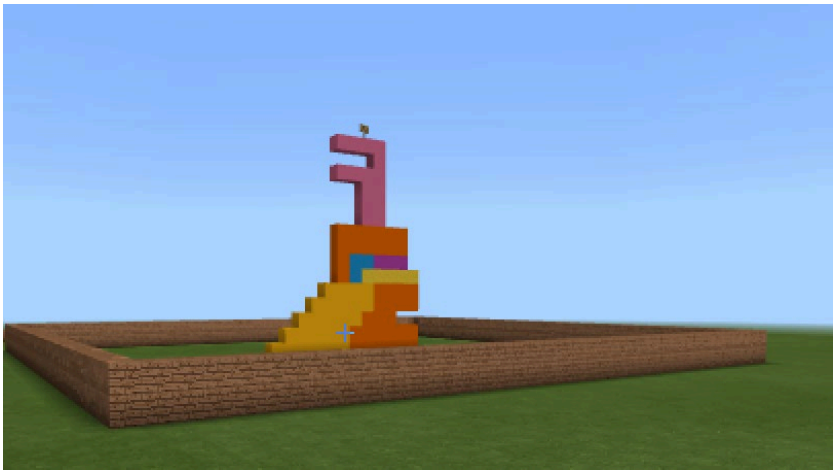
Signature Age Grade in School

Assent obtained by Kyle Ivey

APPENDIX E

Student Created Examples





APPENDIX F

Coding Results for Treatment Group

Table 14

Coding Results from Focus Group Interviews

Words or Phrases Repetitively Used	
Visual	Difficult/Hard
Fun	Confusing
Easy/Easier	Teacher taught
Helped	Hands-on
Quick/Quicker	Did not like
Relatable	Would not take another course/lesson using MinecraftEdu
I liked it	Not all the time
Interesting	Depends on course or lesson taught
Would take another course like it	Not for everybody
Self-Pace	Balance
Remember	

Note. Interview Participants in Treatment Group

VITA

Kyle Ivey

Education

Doctorate in Instructional Systems Design & Technology · Projected Completion (2019)
Sam Houston State University · Huntsville, TX

Master in Educational Leadership, Principal Certificate (2009), Superintendent (2010)
Stephen F. Austin State University, Nacogdoches, TX

Bachelor of Science in Exercise and Sports Science, (2004)
Texas State University-San Marcos, San Marcos, TX

Career Related Experiences

Director of Instructional Technology
Central Independent School District
2012 – Present

- Implement professional development for district staff, direct instruction, one-on-one coaching, implement training for student Chromebook rollout, pedagogical changes incorporating technology, 21st century skills, and integration of technology into classroom curriculum.
- Worked closely with Director of Curriculum & instruction and campus principals to infuse technology tools into grade level curriculum.
- Establish regular communication with staff, principals, district administrators, and local committees to disseminate information and gain feedback on technology integration and needs of staff development.
- Develop integrated projects with classroom teachers that support district initiatives: 1:1 learning, iPads, blended learning, etc.
- District Webmaster
- Prepared and received $100,000 Grant to purchase 118 new Macbooks for Central ISD Staff
- Prepared and received $145,000 Grant to purchase 515 new Chromebooks for Central High School Students
- Other responsibilities include: supporting teachers in use of Skyward, DMAC, Google Apps, website development, and other district initiatives
- Created Doggovation Day where innovative teachers display best instructional practices.

Associate Principal
Central Elementary School

2007 - 2012

- Campus Exemplary Rating for four consecutive years. 2009, 2010, 2011, 2012
- Technology liaison for elementary campus
- Title 1 Distinguished School- 4 Consecutive Years
- Implemented staff development on MAC computers during OFYP in-service days.
- Successfully implemented benchmarking and instructional accountability measures.
- Assisted with implementation of GCS and Read 180 at elementary campus.
- Implemented mentoring program using high school students.
- Provided instructional support and leadership to seventy-one teachers and support staff.
- Supervised and administered student discipline for seven hundred and thirty students.
- Chaired several campus committees.
- Coordinated ARDs for student special education population.
- Provided guidance to campus team leaders.
- Assigned duty assignments and provided accountability for attendance.
- Served as campus representative at truancy hearings.
- Assisted principal in financial planning and budgeting.
- Aided curriculum director with planning of summer staff development.
- Facilitated and coordinated Student Code of Conduct.
- Assisted Superintendent/Principal in the implementation of routines and procedures for entering a new school.
- Elementary District Coordinator and Site Administrator for AVID

Other Experiences

- District Administrator's Leadership Committee · 2007-Present
- District Technology Committee Director · 2012-Present
- Placement Coordinator for Student Teachers from SFASU · 2007-Present
- AVID District Coordinator Training in San Diego, CA · 2012
- Director for "Central After School Care Program." · 2008-2013
- Co-Director of Academic UIL · 2008-2012
- Lightspeed Web Filter Training · 2012-Present
- Member, Texas Computer Education Association (TCEA) · 2013-Present
- Member, International Society for Technology in Education (ISTE) · 2014-Present
- Creator, www.1techydude.com - Web resource databank
- Techy Tuesday Web Training - YouTube Channel "1techydude"
- District Instructional Best Practices – Doggovation

- Deacon - Holly Springs Baptist Church

Certifications and Awards

- Teacher Who Made a Difference · 2007
- Capturing Kids' Hearts · 21 Hour Training · Flippen Group 2007
- Professional Development and Appraisal System (PDAS) · 2008
- Mentoring Minds RtI Institute · 2009
- Grand Central Station Implementation · 2009
- Google Professional, Google Web Academy · 2013-Present
- Google Certified Trainer · 2014-Present
- Capturing Kids' Hearts Leadership Blueprint · Flippen Group 2016
- Technology Administrator of the Year · TCEA 2017-18
- Blue Ribbon Educator - Tynker 2018-19

Presentations

- **Ivey, K**. (2010, April). *The perfect interview*. Stephen F. Austin State University KDP Teacher Sorority, Nacogdoches, TX.
- **Ivey, K.** Allen, D. & Nash, R. (2010, June). *Motivation through mentoring*. National Gear-Up Conference, San Francisco, CA.
- **Ivey, K**. (2011, April). *The perfect interview*. Stephen F. Austin State University KDP Teacher Sorority, Nacogdoches, TX.
- **Ivey, K**. (2012, April). *The perfect interview*. Stephen F. Austin State University KDP Teacher Sorority, Nacogdoches, TX.
- **Ivey, K**. (2012, September). *Closing the achievement gap*. Stephen F. Austin State University, Nacogdoches, TX.
- **Ivey, K.** (2017, February). *To Cast or Not to Cast...I'll Google Cast.* TCEA Conference, Austin, TX.
- **Ivey, K.** (2019, February). *Choosing and Promoting a Digital Reading Service*. TCEA Conference, San Antonio, TX.

Publications

- **Ivey, K.** (2018, August 7). Central ISD Prepares Students with Computer Literacy Skills | Tynker Blog [Web log post]. Retrieved from https://www.tynker.com/blog/articles/ideas-and-tips/central-isd-prepares-students-with-computer-literacy-skills/

Workshops

What	Where	Evidence
Getting Googly with Google	Annex Training Room - Central ISD	Presentation

Apps		
Chromebook Staff Development	HS Library - Central ISD	http://bit.ly/ChromebookStaff
What can Google Classroom Do for You?	Annex Training Room - Central ISD	http://bit.ly/Classroomandyou
High School Staff Development	HS Classrooms - Central ISD	http://bit.ly/2dShuuB
Presenting using ELMO	Central ISD	http://bit.ly/2dShWcD
Record your Teaching	Central ISD	http://bit.ly/2dSiMG2
Elem. Staff Development	Central Elementary	bit.ly/elemtrain
What is Digital Citizenship	HS Library - Central ISD	http://bit.ly/DigCite
High School Staff Development	HS Classrooms - Central ISD	http://bit.ly/2dSiQWf
Google This	Central ISD	https://goo.gl/JD8BVy
Elem. Staff Development	Elementary Classroom - Central ISD	http://bit.ly/2dSjMKs
New Teacher Technology Training	Annex Training Rm - Central ISD	goo.gl/lIkqpG
Jr. High Tech Agena	Junior High Library - Central ISD	http://bit.ly/2dSlUld
Google Staff Development District	Central ISD	http://bit.ly/2dSkN5l
New Teacher Orientation Agenda	Central ISD	http://bit.ly/2dSmI9R
Google Training Day 1	Central ISD	http://bit.ly/2dSv6Gx
Let's Get the Party Started	Douglass ISD	http://bit.ly/2dSv01u
Chromebook 101	Junior High - Central ISD	Chromebook 101
Plickers	Central Elementary	
Elem. Staff Development	Central Elementary	Central Elementary PD
It's More than a Cube..It's Rubrics	Central ISD	More than a Cube

Let's Get the Party Started	Central Heights ISD	goo.gl/eHrR14