Supporting the Literacy Skills Necessary to Master Technical Vocabulary

by

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Dedication

I am dedicating this dissertation to my late mother, Sharon. One of the milestones she most wanted to see was my completion of this degree program. She was always my biggest cheerleader. No matter what I did, or how far she had to go to see me do it, she was always there. From my very first day of kindergarten to earning my last degree, she never missed a defining educational moment in my life. My heart is heavy that she will not be with me as I complete this program, but I do believe she is watching from above.

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Abstract

Background: CTE programs integrate authentic experiences that incorporate work-related skills into curricula, which provide students instruction related to a wide variety of careers and occupational fields. Pretest, intervention assessments, and posttest curricular initiatives are common strategies that ensure student success. These strategies often include interventions for Microsoft Excel, which students have difficulty understanding due to the sophisticated level of the technical vocabulary required to comprehend discipline-specific verbiage. Having a clear understanding of technical vocabulary will enable them to obtain an industry-based certification. **Purpose:** The purpose of this mixed-methods study was to determine how implementing an intervention for technical vocabulary in a dual credit CTE business course might affect students' ability to pass posttest exams. This study evaluated the implementation of the pretest, intervention assessment, and posttest model in a dual credit Business Computer Applications class that taught Microsoft Office applications to students. The intervention was introduced based on student needs and addressed misconceptions about the meaning of the technical vocabulary in the form of verbal discussion, and a daily digital word wall. The study addressed the following question: In order to ensure success for students who have participated in CTE industry-based training, how will we support the literacy skills necessary to master technical vocabulary to the extent that students are successful in passing their posttest assessments? **Methods:** A mixed-method design to collect data and to explain the appropriateness of the methodology was used to interpret answers to the research question. This methodology combined both qualitative and quantitative research, which assisted in neutralizing the weaknesses associated with a singular approach to the

study. Additionally, a convergent parallel mixed-method research design was most beneficial, as it merged the qualitative and quantitative data in a triangulation design to ensure the research question was addressed thoroughly. The archival data sets were compared in a paired sample t-test for pretest (M=19.08, SD=14.093) and posttest (M=87.13, SD=8.42). The control group scores from the paired sample t-test were (M=21.08, SD=12.301) and posttest (M=74.64, SD=14.985) and were received from a high school dual credit course in which the intervention was applied. The quantitative data sets evaluated by the researcher, included Excel pretests, vocabulary intervention assessments, and end of the unit posttest. A control group was established by retrieving data from a previous semester course in which the students did not receive the intervention. The data from the control group and the experimental group were evaluated via a t-test between groups on pretest and posttest scores to determine the effectiveness of the intervention. Students in the intervention group were provided with an anonymous end of course survey, which was completed as a part of their regular end of semester activities. This survey asked open-ended questions about the effectiveness of the intervention and the method of instruction. Additionally, it was utilized as the qualitative data set and a portion of the quantitative data set for the study. Qualitative content analysis was used to evaluate the students' written answers, which were grouped into themes based on the comments made. Coded themes were the perception of the method of instruction, and their views of the relevancy of the content. The prewritten questions were evaluated in percentages based on student responses. The researcher utilized a second reviewer to reduce the likelihood of biases and blind spots by reading the answers independently, developed themes, and compared ideas. **Results:** A paired-samples t-test

was conducted to compare the students' pretest Excel scores to their posttest Excel scores. There was a strongly significant difference (p= .001) in the scores for pretest (M=19.08, SD=14.093) and posttest (M=87.13, SD=8.42). versus scores in the control group scores (pretest, M=21.08, SD=12.301; posttest, M=74.64, SD=14.985). Results of the end-of-course survey indicated that student perceptions of the intervention were positive. The reporting method was a score of 1 to 5, and the result was (M=4.57, SD=0.60). Additionally, the students believed that the course developed their ability to think critically about their subject resulting in (M=4.52, SD=0.81). The survey also indicated that students perceived the learning was relevant to their field of study, career, or degree at (M=4.90, SD=0.30) while providing meaningful feedback at (M=4.81, SD=0.51). **Conclusion:** These results suggest that relevant technical vocabulary intervention can influence student success.

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Chapter I

Introduction

Imagine a classroom with students and a teacher, having a discussion on their first day of instruction in a new concept, while the teacher uses academic vocabulary to explain a process. The students are confused and ask why the teacher is using the word in that context. The teacher stops and thinks about the terminology, and begins to explain a different way.

That was the researcher's classroom in the Spring 2018 semester of their dual credit Business Computer Applications (BCIS) class. The researcher was introducing Microsoft Excel and had referred to the toolbar as a ribbon. One of the first concepts the students learned was to change a feature in a cell, which is a box used to enter information in the program, and one of the researcher's students stopped them and asked what ribbons have to do with a computer. The student went on to say that a ribbon is for tying a bow or to wrap a present with. The researcher realized at that moment that there were many confusing words in Microsoft Excel and that they needed to introduce technical vocabulary to their students in a manner that would allow them to comprehend the curriculum and successfully navigate their way through the dual credit class. It was through this interaction that the researcher began the study in their classroom.

Introduction

Dual Credit CTE (CTE) programs are continuously evolving to meet our nation's need for skilled workers. These programs combine real-world applications with skills learned in the core academic classroom. The main goal of CTE is to properly educate students and prepare them to enter post-secondary education or the workforce by

assisting in the development of skills, technical knowledge and vocabulary, rigorous academics, and real-world experience for skilled, in-demand, successful careers.

Nationally, there has been a movement to restructure high schools and affiliate with universities and technical schools that offer the ability to provide students with hands-on training and real-world education that may lead to better positions and opportunities to advance the students' careers. The Texas Education Agency in 2019 adopted new certifications and altered the requirements necessary for a student to graduate with a CTE endorsement. These new certifications will allow the student to graduate with the college and career-ready skills necessary to compete in a global economy (Texas CTE Fact Sheet).

The transition from an economy based on industry and manufacturing to one that is knowledge-based has caused significant concerns for students choosing to undertake an education that includes workforce training. However, it is essential to maintain competitiveness in a global economy, and to do so, it is imperative to sustain comprehension of the complexities of the workplace. Technology has altered employment, changing from positions entrenched in production to professions related to information and data (Grubb & Lazerson, 2005).

The role CTE plays in assimilating students to post-secondary or workforce applications has also changed. It requires higher-order thinking, the ability to communicate, and special skills unique to the industry beyond the role of the core classroom. The level of technical vocabulary in the workplace, utilizing critical thinking, and STEM (science, technology, engineering, and math) in fundamental problem-solving skills is the measure that decides whether to outsource jobs to other countries or keep

them within our borders (National Governor's Association, 2008). Today's graduate finds that he or she is not only competing locally with other candidates for a position within a company; they are also in competition globally as well.

In the 19th century, public schools in the United States integrated vocational education to train students for future employment (Castellano, Stringfield, & Stone, 2009). When manufacturing positions declined, enrollment in these courses did as well (U.S. Dept, of Education, 2007). Due to this occurrence, researchers conducted studies that suggested these courses should become more productive and change to a twenty-first-century model. Legislators updated the Carl D. Perkins Act (U.S. Department of Education, 2006), and vocational education changed to the term Career and Technical Education (CTE) in hopes that it would reflect the adoption of more rigorous technical courses. In 2010, CTE courses across Texas were realigned to support college, career, and military (CCMR) readiness and shifted from more traditional vocational classrooms. Today, students in Texas enroll in one Career and Technical Education courses at the rate of seventy-seven percent. Students participating in a Career and Technical Education course will enroll in more than one at a rate of one to four, and many will enroll in three or higher. In 2010, one million twenty-seven thousand four hundred thirty-five students enrolled in a Career and Technical Education course. Economically disadvantaged students make up thirty-eight percent of the participants. Of that thirty-eight percent, at-risk students make up forty-nine percent (2018-2019 Economically Disadvantaged Students, 2020). Even with a high number enrolled in these classes, only twenty-five thousand certificates were earned by these students in the 2007-2008 school year (Texas CTE Fact Sheet). Connections between Career and Technical Education and student

success exist, as CTE students are significantly more likely to indicate they have developed problem-solving, research, organizational, and critical thinking skills while enrolled (Career, National Research Center for CTE, 2015).

Career, National Research Center for CTE (2015) determined that rigorous CTE courses would subject students to more stringent content, including technical vocabulary, and provide the relevant material that would motivate enrollees to develop literacy skills because they were interested in learning a skill. To assist students' understanding of a rigorous curriculum, we can look to the work of Vygotsky (1978), who suggested a zone of "proximal development" or, the place that the most valuable instruction initiates, so that the student may develop a higher skill set. Doing so could help to develop higher levels of thinking and functionality.

The zone of proximal development is described "as the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem-solving under adult guidance, or through relationships with more capable peers" (Vygotsky 1978). Comparing a journeyman to an apprentice in this instance is the same as comparing the teacher to the student. The student would imitate the teacher's skills while the teacher would mentor and coach them through observation. Coaching would provide feedback at the most critical level or just at a higher level than the student could perform alone (Vygotsky, 1978). This scenario could be just one demonstration of Vygotsky's term.

Career and Technical Education programs show that not all students will require a four-year degree to become functioning members of society that can sustain a household and a family, and in fact, could gain this status through industry certifications that would

show them as experts in their fields. These industry certifications contain technical vocabulary, indicating that adding more technical vocabulary to the Career and Technical Education curriculum is necessary (Reese, 2012).

Vocational education had somewhat of a controversial appearance when reformers recommended dividing public education into two different categories: college preparatory courses for some, and technical courses for others. Some opponents thought that doing so would push immigrant, poverty-stricken, or minority children to seek industry positions, thus not receiving higher education and prohibiting social mobility (Quinton, 2013). The economy of the 21st century needs a different way to train for careers and one that will assist students in preparing for their educational futures and emphasizes problem-solving and creative thinking. Dewey (1902) believed that coursework should be relevant to the student. He determined that participatory learning and developing soft skills, such as those needed to be successful in a Career and Technical Education course, were imperative to a student's education. Dewey believed that students should actively participate and participate in the content of the curriculum. To this measure, CTE has become not only coursework vital to a future career, but also a way to challenge students to think at a higher level, and because of that acquire the technical vocabulary necessary for success. CTE courses mimic the traits that Dewey indicated could result in enhanced learning.

Chappell (2006) indicates that the costs of academic underachievement are continuing to grow. Because Career and Technical Education programs are continually evolving in response to the needs of society, it is a part of a solution to curb high school dropouts, layoffs, and a weak economy. Career and Technical Education students actively

participate in a curriculum that leads to occupations that are in high demand. Those that have participated in Career and Technical Education courses after high school, even without garnering industry certifications, still earn a higher salary than graduates who did not take these classes (Silverberg, 2004).

Previous research indicates that Career and Technical Education courses give students the necessary skills and academic rigor that prepares them for higher-level thinking, college, and industry (Kristen, 2002). When taking Career and Technical Education courses, male students' literacy rates increased by 23%, and females literacy rates increased by 19%. Low-income students gained 25% compared to those who had no Career and Technical Education courses in school (Gerwertz, 2016). In addition, "eighty percent of students taking a college preparatory academic course with rigorous Career and Technical Education curriculum met college and career readiness goals, compared to only sixty-three percent of students taking the same academic core who did not experience rigorous CTE" (Southern Regional Education Board, High Schools That Work, 2012). Some view Career and Technical Education as less rigorous than core classes; however, they are now trending in a different direction. Harris and Wakelyn (2007) discussed that students who took these courses were more apt to stay driven because they believed that what they were learning was relevant and useful to them in the future (Harris and Wakelyn, 2007).

Statement of the Problem

Technical vocabulary proficiency is essential for student success in a Career and Technical Education course. For success, students need to grow strategies to develop the literacy skills needed to be proficient in their fields. This is a problem because most

students prefer tactile learning, and many teachers who come from successful careers in an industry do not have the teaching background to properly promote literacy in their classrooms (Park, 2012). Student resistance decreases when they understand there is a purpose to learning technical vocabulary, as this is a vital component of the Career and Technical Education classroom, bringing knowledge of how to perform a task, and there is a chance for them to become more engaged in the assignment (Senegupta, 2002). Students who do not have a complete understanding of the technical terms associated with Career and Technical Education courses will struggle to acquire industry certifications.

Students may gain a higher level of understanding by combining their activity with a new understanding of technical vocabulary, which will allow them to become more interactive, helping them to understand the technical vocabulary they need for their industry-specific curriculum (Harris & Wakelyn, 2007). The researcher hoped to determine that increasing the technical vocabulary comprehension for Career and Technical Education courses may also improve the passing rate on the comprehensive exams needed to become industry certified for these students.

Purpose of the Study

The purpose of the study is to understand how implementing a pretest, technical vocabulary intervention, and posttest design will increase the passing rate on industry certifications of Career and Technical Education students. As a teacher solely in a Career and Technical Education environment, I have recognized student struggles with technical vocabulary comprehension, even in a dual credit classroom. For a student to become competent in a future career, technical vocabulary comprehension skills are necessary

(Tews, 2011). With that in mind, I am seeking to determine what the most effective approaches are to promote technical vocabulary acquisition in Career and Technical Education classrooms

Research Questions

The researcher developed the following research question to provide answers to the predicament posed in the statement of the problem. In order to ensure success for students who have participated in CTE industry-based training, how might teachers support the literacy skills necessary to master technical vocabulary to the extent that students are successfully passing their posttest exams?

Context for the Study

The study occurred in a dual-credit CTE classroom on a high school campus. The enrollees were in a dual credit Business Computer Applications class taught by the researcher. The class took place in the fall 2019 semester, where students took a pretest and posttest assessment that measured their success in Microsoft Excel.

Significance of the Problem

Students who take CTE courses are engaged in comprehending technical language. Teaching a Career and Technical Education student how to utilize strategies for reading correctly may help to foster disciplinary literacy skills they will need to understand the technical vocabulary associated with their field of study. CTE students often favor hands-on learning and show opposition to reading, while many CTE teachers lack the tools to implement literacy successfully (Park, 2012). Studies found that students are more likely to read when they comprehend the reasoning behind the purpose for it, or when they were more enthusiastically involved with the text (Senegupta, 2002). When

teachers share technical vocabulary with action, such as a task within a program, or a physical activity, more interaction will ensue. Because of this, students can understand more rigorous technical vocabulary, which is associated mainly with Career and Technical Education coursework (Harris, 2007).

Educational Value of the Study

The study holds educational value as it explored if technical vocabulary intervention in a pretest, technical vocabulary intervention, posttest model will significantly increase the passing rate of Career and Technical Education students taking posttest assessments. Comprehension of technical vocabulary could increase student knowledge of terminology utilized in testing material, thereby giving them an additional advantage when taking the tests necessary to measure student success.

Definitions

While there are many definitions of literacy, and career and technical education, the present research defines them as follows:

- Literacy is the capacity to apply the knowledge and skills learned in a subject, as well as the aptitude to relate that information in fundamental topics. They would also be able to examine, inquire, and converse effectually as they actively resolve problems and develop resolutions. (Hyslop, 2010).
- Career and Technical Education (CTE) is defined as courses developed towards preparing a student for post-secondary or career-ready positions within a variety of fields such as business, technology, construction, or other skilled trades. (Dewitt 2016).

Limitations

This study was limited in scope. There were twenty-four participants in the experimental group, and while that in itself was not a limitation, there may be future concerns about the implementation of the intervention district-wide. This limitation was due to generalizability issues because the sample size is small compared to the traditional high-school level Business Information Management (BIM) courses on the campus. Transferability issues could become visible upon implementation.

Summary

Dual Credit CTE programs provide students with a means to gain not only experience in the field of their choice but the ability to earn industry-based certifications to supplement their experience. Technical vocabulary is a barrier to success in these programs, and thus, an initiative to better teach technical vocabulary at the rigor necessary for success is imperative.

Chapter II

Literature Review

Introduction

Dual credit Career and Technical classrooms prepare students for higher-level thinking, either at the college or secondary level. Many students who enroll in these courses do so to better themselves, and to provide themselves and their families with a brighter future. Many of these students are first-generation college students, and many are also first-generation Americans. Providing these students with a gateway to a successful future is vital to them, and a review of the literature will provide insight into the problems and the solutions found. There have been questions Literacy instruction for students in Career and Technical Education classrooms, and implementing curriculum to alleviate that limitation should be at the forefront of educators' plans. Preparing youth to be successful and competitive on a global level means that we will need a reliable, sound education system (Rojewski & Hill, 2014). Before attempting to initiate change, we must first review the literature that addresses concerns regarding literacy and technical vocabulary in a dual credit Career and Technical Education classroom. A review of relevant literature will show a historical evaluation of past successful techniques.

Dual Credit

Dual credit courses are university-level courses taken by secondary students primarily in high-school classrooms, where the students gain credit at both the college level and the high-school level simultaneously (Texas Education Agency, 2019; Troutman, Hendrix-Soto, Creusere, & Mayer, 2018; Cowan & Goldhaber, 2015). Those who take dual credit courses gain experience in the college classroom earlier than those

who choose to wait to enroll in college courses upon graduation. They are more prone to be college-ready when graduating (Troutman, Hendrix-Soto, Creusere, & Mayer, 2018). Students may complete their undergraduate degree at a younger age, to either go on to an advanced degree or enter the workplace. Additionally, they may save money on college tuition (Texas Education Agency, 2019; Troutman, Hendrix-Soto, Creusere, & Mayer, 2018). Those who are economically disadvantaged may receive college classes at a reduced cost, helping to reduce the overall price of a degree (Troutman, Hendrix-Soto, Creusere, & Mayer, 2018). There are also other advantages, one being a better knowledge of how to be successful in college.

Students who enroll in dual credit courses frequently report they have better time-management skills and are more likely to understand what to expect of them for success (Texas Education Agency, 2019; Texas Higher Education Coordinating Board, 2016; Troutman, Hendrix-Soto, Creusere, & Mayer, 2018). The Texas Higher Education Coordinating Board reports a six-hundred-fifty percent rise in students enrolled in dual credit in Texas from fall 2000 to fall 2015 (Texas Higher Education Coordinating Board, 2016), indicating that students are aware of how these courses may assist them in achieving their goals. Schools and colleges were legislated in 2006 to assist students in earning twelve hours of college credit before graduating from high school (Texas Higher Education Coordinating Board, 2016; Troutman, Hendrix-Soto, Creusere, & Mayer, 2018). This legislation allowed students who may not have had access to college due to their socioeconomic status to either gain access to these courses free of charge or at a reduced rate.

The Texas Education Agency governs student eligibility to enroll in dual credit

courses (Texas Education Agency, 2019). The students must successfully pass the Texas Success Initiative (TSI) exams that are pertinent to the course, such as the reading TSI for English, History, Science, and Business Computer Applications, and the math TSI for math-related courses. Also, the student may score above a 4000 on the English II STAAR end of course, or a score of 4000 when taking the Algebra I STAAR. (Texas Higher Education Coordinating Board, 2016; Troutman, Hendrix-Soto, Creusere, & Mayer, 2018). Researchers estimate that more than two million students enrolled in dual credit courses in 2015 (Cowan & Goldhaber, 2015). In Texas, total student participation is one-hundred-thirty-three-thousand students (Miller, et al., 2017) (Texas Higher Education Coordinating Board, 2016). Students may be able to earn a college degree when they graduate high school (Troutman, Hendrix-Soto, Creusere, & Mayer, 2018; Miller, et al., 2017).

Both the THECB (2018) and RAND (2018) researched the likelihood of student success in college after taking college credit courses in secondary settings. They both determined students who took dual credit classes, perform better in college courses upon high school graduation. They also indicated these students were more likely to finish their bachelor's degrees, and spend less time in college, reducing their overall tuition cost, as well as have a higher first-year average, and stay beyond their first year (Miller, et al., 2017; Cowan & Goldhaber, 2015). More Hispanic students take dual credit courses than caucasian students (Troutman, Hendrix-Soto, Creusere, & Mayer, 2018). With the many dual credit courses offered, it is no surprise that some of them are Career and Technical education classes.

Career and Technical Education in the United States

Career and Technical Education (CTE) became prevalent after World War II because there was a significant need for educating individuals to reenter the workforce after returning from the military. The war had increased a need for skilled workers for manufacturing military resources for defense and needed schools to introduce vocational education in classrooms to provide a ready workforce when they graduated (Castellano, et al., 2007). After many increases in programs related to Career and Technical Education, a diminishing need for manufacturing occurred, and there was less need for vocational programs in schools (U.S. Dept. of Education, 2000). Because of the lesser need, federal legislators decided to overhaul the vocational programs and make them more relevant to the changing society and their needs. When doing so, legislators changed the terminology, and Career and Technical Education or CTE replaced vocational education. (Lynch, 2000).

There was no longer a need for previous versions of vocational programs offered courses in our society. Construction and auto repair was still valid and could lead to immediate employment after graduating from high school (Weingarten, 2015). However, these courses have changed, generating different outcomes, such as earned certificates that lead to higher-paying positions or entry into trade schools or other avenues of post-secondary education (Career National Research Center for CTE , 2015; Weingarten, 2015). They lead to careers in technology, business, cosmetology, welding, and even aerospace positions upon graduation. Students who enroll in these courses today gain needed assistance and knowledge in preparation for a chosen career, and designing CTE courses to assist them with their careers and post-secondary goals is essential (Grubb &

Lazerson, 2005; Weingarten, 2015). The vocational courses that were still in schools also were revamped, teaching students not only carpentry but also the ability to read blueprints, the ability to utilize computer-aided-drafting, and many programs related to business, for example. Typing has given way to proper computer usage, where students now learn to utilize programs such as Microsoft Office to complete letters, business correspondence, store data, and manipulate spreadsheets. Even the automotive courses have adapted and changed to become technologically advanced, using computers for diagnostics, and electronic devices to help to diagnose problems with today's computerized vehicle systems (Texas CTE Fact Sheet; Career National Research Center for CTE, 2015).

The Carl D. Perkins Vocational and Technical Education Act became law in 1984 because increases in rigor were needed to keep up with the changing technologies in the industry. The Perkins Act was again updated in 2006 to keep up with the ever-changing requirements to be workplace ready. It was also updated to separate career and technical education funding from regular funding, and also to keep administrative costs to five percent (Weingarten, 2015; U.S. Department of Education, 2006). This newest version of the Perkins Act grants over a billion dollars to career and technical education each year to improve courses and to advance technical programs with federal funding. The states also allocate Perkins dollars to fund teachers and help pay for the cost of equipment and training needed for the programs to be successful (Career National Research Center for CTE, 2015; Castellano, et al., 2007; Harris & Wakelyn, 2007).

The Perkins Act incorporated ways of helping students to develop the skills needed to succeed in their post-high school pursuits They are: "(a.) academic attainment

in challenging reading/language arts and mathematics; (b.) technical skill attainment aligned with industry standards; a secondary school completion as evidenced by a secondary school diploma, a General Education Development certificate, or other state-recognized equivalents; (c.) student graduation rates; (d.) placement in post-secondary education or advanced training, military service, or employment; (e.) non-traditional participation in or non-traditional completion of CTE programs that lead to non-traditional fields" (Perkins, 2006).

CTE has a unique place in school districts all over the country. CTE is needed to assist students in reaching their goals upon leaving high school for their post-secondary trade schools or universities. Without Career and Technical Education, the industries of our country would decline, a recession could occur, or worse, a shortage of needed goods and services would lead to unemployment, underskilled workers, and fewer consumer goods and services consumers need to survive (Career National Research Center for CTE, 2015; Castellano, et al., 2007; Harris & Wakelyn, 2007; Weingarten, 2015)

Literacy in the United States

There is vast research concerning the literacy skills of students in our country, and improving literacy has become very important for schools. Students who are in fourth grade keep up with other countries around the globe, but by high school, the United States trails globally. (Carnegie Council, 2010). The declination of adolescent reading performance leads to a reduction in secondary student performance by seven percent, and with the ever-widening gaps in minority students, we must do something to stop the decline. The reading levels are falling for adolescents, high school student performance

diminished seven percent, and gaps for minorities grew as well (U.S. Department of Education, 2005).

Learning technical vocabulary is challenging in the classroom. However, learning technical vocabulary is necessary for success for these students, and it is vital for their post-secondary success. Employers want highly skilled workers who can read data related to their position and can practice twenty-first-century skills at a high level. Many CTE classrooms fail to focus on learning technical vocabulary, and instead of reading, teach students processes that are hands-on instead. In one assessment, the *High Schools That Work (HSTW) Assessment* (Rice, 2010), students stated that they were not required to do any in-depth reading or writing when completing their assignments, with the assignment only requesting task-based assignments related to the skills they had learned. Teachers asked less than a third of students to do any written work or to write up data findings in a formal report. Fewer than half of the students were assigned any career-related reading that was relevant to their field. Researchers found that teachers who engaged their students in reading and writing in their subject scored higher on exams than teachers who did not (Career National Research Center for CTE, 2015; Chauvin & Theodore, 2010; Gewertz, 2016).

Career and Technical Education Classroom Literacy Practices

Students who skim texts are not engaging in higher-order thinking, and are in fact, just learning the basics of the assigned topics. There is no rigor involved in this act. Often, students who practice skimming have mediocre scores on their exams, and no comprehension of technical vocabulary, even though they may be able to perform the tasks required in the classroom (O'Connor, 2010). These students are not in reality

learning at a high level and are therefore not fully prepared to successfully navigate a posttest exam over what they learned.

When students do not stop to reflect on what they have read and done so mindlessly, they are practicing mindless reading. They will not comprehend what the text is trying to instill upon them. There is no point-of-confusion because they have not thought through their reading and have nothing of substance to discuss in class (O'Connor, 2010; Rice, 2010). Many times the student could indicate that they do not understand the reading because they have only skimmed the pages (O'Connor, 2010; Rice, 2010). In order to stop this mindless reading, teachers may substitute this type of assignment with a lecture, or a hands-on activity, lessening the student's comprehension of the written word, thus reducing exposure to technical vocabulary, allowing the student to harbor the idea they do not need to read to be successful (Asunda, Finnell, & Berry, 2015; Career National Research Center for CTE, 2015; Chauvin & Theodore, 2010; Rice, 2010).

When students do not question themselves about what they have read, they will likely forget what they have read, leading to forgetful reading (Chauvin & Theodore, 2010; Gulla, 2012; Jolly, Campbell, & Perlman, 2004). The student who is engaged in forgetful reading will not successfully recall technical terms required to comprehend their subject matter. Without practicing activities that require higher-order-thinking, students will not retain information longer than in their short-term memory. Indeed, this is not the teacher's intention when assigning reading related to their subject, as they are trying to instill long-term retention of the content. When students do not use strategies that involve higher-order thinking, they do not remember the content beyond their short-term

memory (Gulikers, Bastiaens, Kirschner, & Kester, 2006; Lynch R., 2000; Senegupta, 2002). This is not the intent of the teacher, who is trying to impart permanent knowledge and is an issue.

Students enrolled in these courses often want to experience performing the tasks they are trying to become proficient at. Without promoting literacy and developing different techniques for students to learn from reading and writing about the subject they are learning, technical vocabulary and step-by-step processes may prohibit them from fully comprehending their skill. CTE courses are known for their hands-on, project-based alternative to a core classroom. However, literacy must be a part of the curriculum. While students would like to experience learning and practicing the skills necessary to be proficient in their future field of work, teachers must be cognizant of the students' need to retain information in different ways (Park, Pearson, & Sawyer, 2011; Ridge, 2014). Assigning many hands-on activities may be the reason why researchers perceive CTE courses as ones that lack higher-order-thinking and rigorous course work (Gulla, 2012)—in actuality, designing CTE courses. Hence, they include comprehension of skillsets that are associated with learning occupational skills that may offer a student instructional experience that assimilates them into their career of choice (Asunda, Finnell, & Berry, 2015).

Polkinghorne, Hagler, and Anderson (2010) have deemed that business instructors do not believe that they are, responsible for the development of student literacy, and do not think their focus should be on reading for comprehension. If these instructors focused on increasing emphasis on the written word, they would gain more student comprehension of their subject. Because many students are not proficient in skills related

to reading and literacy, and for their future in post-secondary coursework or the workplace, Career and Technical Education teachers must determine how to focus on literacy as well (Polkinghorne, Hagler, & Anderson, 2010; Rice, 2010; Weingarten, 2015).

In addressing the uniqueness of the different classrooms associated with the realm of CTE, teachers usually focus on a particular mindset. Students are indeed enrolled in these courses to learn a trade or to prepare themselves for the workplace. Neither the student nor teacher truly focuses on literacy in their daily interactions, and it is essential that the educator be mindful of the students' literacy levels, as well as technical vocabulary acquisition, and make a genuine effort to promote the understanding of the materials being presented to them daily. These are the foundations of their careers, and how the students will become future productive employees (Carnegie Council on Advancing Adolescent Literacy, 2010; Chauvin & Theodore, 2010; Harris & Wakelyn, 2007; Ridge, 2014).

Effective Literacy Programs and Career and Technical Education

Career and Technical Education programs succeed in preparing and grooming students for their futures. Those that are most effective promote and incorporate literacy in their curriculum and model their lessons after situations and careers that students will someday enter upon graduation from high school, trade school, or college (Asunda, Finnell, & Berry, 2015; Jolly, Campbell, & Perlman, 2004). Many Career and Technical Education instructors have become quite adept at literacy instruction and present students with examples of work-related documents they will encounter in the workplace. You can find these in careers such as architecture, construction, business, process technology,

technology, pipefitting, or welding, as examples (Hilliard, 2016; Meeder & Suddreth, 2012). It is of the utmost importance that students have opportunities to grow their soft-skills, as well as their industry-specific skills, and opportunities to read, write, define, and purposefully use terminology. Career and Technical Education teachers may be able to utilize common literacy standards to implement curriculum and task-oriented lessons that apply concepts of literacy into the career and technical subject areas (Meeder & Suddreth, 2012 (McKenna & Dougherty Stahl, 2015). Teachers of career and technical courses must be taught through professional development how to instruct students to deepen their levels of reading comprehension, as well as technical vocabulary that will be significant within their chosen careers (Meeder & Suddreth, 2012; O'Connor, 2010; Rainey, 2016).

There are a variety of ways to include technical vocabulary in a Career and Technical Education classroom, including presenting students the opportunity to summarize articles after reading them in class, practicing inquiry skills with the articles, or discussion that provides higher-order-thinking about a subject or term within the field of study. Reflecting on the reading and responding to reflection is also vital to long-term recollection. Reflecting on challenging reading or curriculum will provide students with deep thinking and, ultimately, enough knowledge to evaluate data or problems that may arise, gaining the ability to present and provide supporting evidence. An example of this could be a presentation regarding personal protective equipment, safety in the workplace, or a marketing strategy in a business course. Effectively doing so could mean that the student would have an understanding of articulating their answer both clearly and in a logical manner (Carnegie Council on Advancing Adolescent Literacy, 2010; Gulikers, Bastiaens, Kirschner, & Kester, 2006; Hilliard, 2016; Jolly, Campbell, & Perlman, 2004).

Making real-world connections to reading and technical vocabulary in CTE courses promises to put together an extraordinary influence on student literacy as it may allow the opportunity to recognize industry-specific links to their interpretation of technical vocabulary. Doing so could assist even the most resistant students and help in building a working knowledge of the aspects of their course. It is unfortunate, though, that most students are unable to read at the level of their current grade, and certainly not at a technical level suitable for their coursework (Career National Research Center for CTE, 2015; Graham & Hebert, 2010). The National Reading Panel, in the year 2000, presented elements they felt were vital to reading effectively and instructing students to engage in active reading strategies. They were phonics, phonemic awareness, fluency, comprehension, and vocabulary (Chauvin & Theodore, 2010; McKenna & Dougherty Stahl, 2015). Understanding what they read is essential for the CTE student (Gulla, 2012).

Motivating Career and Technical Education Students

Learning technical vocabulary is a task that CTE teachers should place great emphasis on, as their students are interested in the course they are enrolled in and are therefore more likely to read and comprehend the material. Because Career and Technical Education courses are contextual, teachers may assist students in comprehending technical vocabulary by embedding it in the course, through class assignments, the opportunity to utilize the technical vocabulary through a laboratory experiment, or through collaboration (Career National Research Center for CTE, 2015; Jolly, Campbell, & Perlman, 2004; Meeder & Suddreth, 2012). Career and Technical Education classrooms demonstrate examples of future workplaces. They teach students how they

will need to speak, dress, present, and write in a career-specific way, which is strengthened by their desire to learn how to act in their future workplace. Teachers are then able to connect the technical vocabulary in different perspectives of instruction (Carnegie Council on Advancing Adolescent Literacy, 2010; O'Connor, 2010; Park, 2012).

After realizing their success in the CTE classroom, students may find that they are also successful in their core classes when reading discipline-specific materials. They experience growth in subjects they previously struggled in, because students have begun to learn items that interest them, and have gained skills that will assist them in being successful in other classes, such as science because they now understand how to report lab results correctly (Asunda, Finnell, & Berry, 2015; Harris & Wakelyn, 2007; Tews, 2011). Discussing reading views with teachers, regarding connecting technical vocabulary and industry-specific terminology in their classroom, may provide new insights on ways to incorporate literacy (Rice, 2010; Ridge, 2014; Shanahan & Shanahan, 2012).

Testing Career and Technical Education Students

Testing in the CTE fields takes many forms. Some of these include a hands-on demonstration of the skills necessary to perform the job, such as testing a student's knowledge of Microsoft Office products. These exams are tactile and showcase the students' current skill level meeting the minimum necessary to become skilled professionals. Passing a written examination means that the student must know the technical vocabulary, and in some cases, must understand how to compose an essay in order to be successful. In order for this to be a fruitful undertaking, the student must

possess the needed decoding skills to comprehend what the question is asking, and the literacy skills to determine the vocabulary that details the requirements of the testing. This is made possible by rigorous technical vocabulary instruction by the teacher that is retained in the long term memory of the student to ensure success.

CTE courses are gateways to post-secondary education and student careers. Because these courses encompass many fields of study, seeing the courses as a cornerstone of career preparation is necessary (U.S. Department of Education, 2000; Weingarten, 2015). These students will need disciplinary literacy skills to compete in their future workplace.

Disciplinary Literacy

Disciplinary literacy is discipline-specific literacy, immersing the student in the language of the subject, emphasizing the differences in each (Hynd-Shanahan, 2013; Lent, 2016; Lent & Voight, 2019). For instance, a mathematician may read to look for clues to solving problems, while a historian may read to compare or contrast historical events. A scientist might read content to search for conclusions or alternatives to a hypothesis. In a dual credit Career and Technical Education classroom, the student may read to comprehend how to perform a technical task.

Rainey (2016) addresses disciplinary literacy and the methods of teaching it. She discussed that although disciplinarians work with texts to accomplish goals in teaching their subject, the nature of such varies from discipline to discipline. Mainly this is because there are significant differences in the topics due to the variety of subjects. She said all the subjects had to have a basic understanding of literate practice and that these teachings should involve engaging students in disciplinary inquiry. Uniqueness in the

technical texts from one subject to the next shows us that we must educate teachers so that they will understand the importance of literacy education in their CTE classrooms. She also discussed gaps in the literature regarding this subject, specific to the English and language arts aspect (Rainey, 2016). Rainey is not the only researcher to write about this exact topic. It is also written about by Timothy Shanahan (2012), Cynthia Hynd-Shanahan (2012, 2013), and Releah Lent (2016).

Additionally, heightening inquiry can be done within the disciplines. Using inquiry in the classroom promotes learning within the discipline when students can solve intricate problems related to science, math, or in a Career and Technical Education classroom, they are doing so by practicing disciplinary literacy (Lent, 2016; Lent & Voight, 2019). Moving instruction to an inquiry-based format may have challenges for teachers, due to the additional responsibilities regarding organization and classroom management. Exposing students to inquiry-based learning and immersing them in the content areas helps them view their text practicing inquiry, and utilize disciplinary literacy through the inquiries they are making in the classroom (Hynd-Shanahan, 2013; Shanahan & Shanahan, 2012).

Many secondary schools do not have specific reading classes for students, relegating the responsibility to content teachers. When these teachers assign reading in their content, they should require them to think like a professional in that discipline, thus practicing disciplinary literacy in the classroom. Instead of focusing on teaching students to read for content comprehension, they should be teaching students to think like a professional in the field they are studying (Shanahan & Shanahan, 2012; Hynd-Shanahan, 2013). The teachers in each discipline bear the responsibility of teaching students how to

think within their discipline, and read disciplinary texts as a professional in that subject would (Hynd-Shanahan, 2013; Lent, 2016; Lent & Voight, 2019; Shanahan & Shanahan, 2012).

Digital Literacy

Classrooms have begun to teach literacy in different ways. An observer in a classroom may find a teacher asking students to blog instead of writing in a journal or request that they watch a podcast that is relevant to their learning. Engaging in these activities will require the student to utilize a device and the internet. Students can participate in learning commons with students from around the world using digital sources, promoting digital literacy (Beach, 2012; Greene, Seung, & Copeland, 2014). Students are immersed in digital literacy when using an e-reader, or a handheld computerized version of a book, to highlight text relevant to their classwork. E-readers are quickly taking the place of actual books, and while many would much rather hold a book than a device such as an e-reader, the technology continues to grow in the classroom and for leisure reading purposes.

Using computers also requires digital literacy to be successful. All plethora of sources are available via computer and can help students to learn and grow their literacy knowledge in a variety of ways. These resources will assist students in gaining twenty-first-century skills, such as collaboration, problem-solving, critical thinking, and digital skills that are essential aspects of the workplace (Rich, 2010; Stauffer, 2020). These skills help students to be marketable as employees upon completion of their post-secondary education. The ability to interact with others is vital to the workplace, and digital literacy is a twenty-first-century skill (Beach, 2012; Stauffer, 2020). It is unfortunate that outside

the classroom, not all students have access to resources that promote digital literacy, which creates inequality in technology.

Inequities in Technology

There should be an opportunity for all students to have access to technology outside the classroom, and researchers state that nine out of ten families in the United States have some form of access to technology (Rideout & Katz, 2016; Pew Research, 2019). There are questions as to how reliable that source of technology is, however. Many students and parents in low-income homes only have access to a cellular phone, and are under-connected, meaning that their source of technology is unreliable at best (Lynch M., 2017; Rideout & Katz, 2016; Pew Research, 2019). The digital divide, or the gap between those who have access to technology, and those who do not are real, and students who suffer

from a lack of technology are the ones who are most affected (Pew Research, 2019; West, 2011).

Many low-income families are not able to afford the internet or computers in their homes, leaving students with no way to complete assignments once they leave school. Demographically, these students are children of parents that are racial minorities and likely with lower education levels than middle-class students (Pew Research, 2019; Lynch M., 2017; West, 2011). Many of these families use their smartphones as a means of overcoming their lack of access to traditional internet, utilizing hotspots to connect any devices they may have to the internet to complete assignments at home. Not having access to traditional internet is more common in non-whites, young adults, and low-income families, who do not have the means to afford a reliable connection (2018-2019

Economically Disadvantaged Students, 2020; Lynch M., 2017; Pew Research, 2019; Rideout & Katz, 2016; West, 2011).

When students without access to reliable technology must complete homework after school, many times, they are unable to do so due to a lack of resources. Student engagement is in jeopardy, as it is next to impossible for these students to complete their work unless there is access to technology near their homes, such as a library, school parking lot, or restaurant they are welcome to be in without ordering food (Rideout & Katz, 2016; West, 2011). Not having technology at home could harm students that are participating in dual credit courses because they would not have any ability to work on tasks outside the classroom or laboratory. In addition to the problems of inequality in technology, these students do not have an opportunity to become skilled in programs necessary to become successful in school and post-secondary ventures, such as Microsoft Office Products.

Conclusion

Since World War II and the inception of the Carl D. Perkins Act, schools across the nation have included CTE courses in their set of courses (U.S. Department of Education, 2006). Not only have these courses become popular, but many today are dual credit courses. Students taking these classes are preparing themselves for their futures, and by doing so, they are learning valuable skills that will enable them to become experts in their field.

Introducing literacy in CTE classrooms has not been a priority for many instructors; however, doing so could enhance the reading, writing, and inquiry skills of enrolled students (Harris & Wakelyn, 2007). By including literacy concepts, the teachers are allowing students to become more fluent readers, which could trickle into their other courses (Asunda, Finnell, & Berry, 2015). The students may then become more focused on their reading and writing, all the while becoming better and better each day.

Through the use of technology, these students have become more adept at digital literacy, successfully navigating different types of digital instruction, including research, utilizing online resources for class, and becoming more technologically savvy than their ancestors (Greene, Seung, & Copeland, 2014). They have instructors who are assisting them to become comfortable acting as professionals in their field while learning their trade, providing them with an opportunity to become comfortable with disciplinary literacy and the skills necessary to do so (Shanahan & Shanahan, 2012; Hynd-Shanahan, 2013). The downfall to using technology, though, is that due to the socioeconomic status of many students, they do not have reliable technology outside of school, meaning that they must utilize their time in class wisely, or find other means of accessing instructional materials when not at school (Castellano, et al., 2007; Lynch M., 2017).

Chapter III

Methodology

Mixed Methods Research Methodology

The researcher used mixed methods to collect data and explain the appropriateness of the methods to interpret answers to the research question: in order to ensure success for students who have participated in CTE industry-based training, how will we support the literacy skills necessary to master technical vocabulary to the extent that students are successfully passing their posttest exams? The reasoning for the mixed-methods approach was discussed, as well as why it was relevant to this research.

Through extensive research on methodology concerning the research question, a mixed-method was determined to be essential to determine the outcome of the study. Creswell (2014) discussed this methodology as combining both qualitative and quantitative research, which assisted in neutralizing the weaknesses associated with a singular approach to the study (p. 15). Additionally, a convergent parallel mixed method was the most beneficial to this study, as it combined quantitative and qualitative data together and provided a complete view of the research question (Creswell, 2014). I was doing this to assist in triangulating the data collected for complete reporting (Teddlie & Tashakkori, 2009).

Research has proven that utilizing a mixed-methods approach would allow for triangulation, which allowed the researcher to incorporate many approaches and viewpoints when evaluating the data collected. Mixed-methods also enabled the researcher to validate the findings by providing a complete picture of the research.

(Creswell, 2014; Teddlie & Tashakkori, 2008).

The Rationale to Use Mixed Methods Research

The researcher chose to conduct a mixed-methods study in order to report their findings most accurately. Furthermore, mixed methods research corresponded with their purpose for this study, which was to determine how technical vocabulary retention could be supported in the CTE classroom. Mixed-methods research helped the researcher to determine how students retained technical vocabulary, and if it would provide them with the ability to navigate posttest exams successfully. For these reasons, the researcher felt that using mixed-methods to evaluate the data would provide them with significant and trustworthy results that could be important for future students' ability to pass their posttest exams. Additionally, the researcher was able to correlate their intervention by customizing it to the student after interviewing the student and reviewing the data from the pretest.

By combining quantitative and qualitative data and then triangulating it to examine it through a different view was helpful upon the analysis of the data. With the complementary aspect, the researcher was able to use the results from the quantitative data to illuminate the findings from the qualitative survey and researcher journal. Results from the mixed-method research helped to demonstrate how comprehension of technical vocabulary affected students and assisted them in enhancing their retention of the technical terminology, helping them to pass their posttest exams. By utilizing triangulation, the researcher believed they would have more complete and accurate results for my study.

Research Design

It was of the utmost importance to choose an appropriate research design when performing mixed-methods research. This research employed the convergent-parallel design, evaluating the data simultaneously, and weighed it equally after analyzing it independently (Creswell J. W., 2012; Creswell J. W., 2014). The researcher utilized archival data and qualitative data to find answers to the research conducted. The convergent-parallel design allowed the researcher to nest the data within my ethnography (Creswell & Clark, 2018).

Methodological Framework

The researcher adopted a convergent-parallel approach utilizing triangulation while using mixed methods for the collection of data. A definition of a convergent-parallel design is "to simultaneously collect both quantitative and qualitative data, merge the data, and use the results to understand a research problem" (Creswell J. W., 2012, p. 542). The researcher's rationale for doing so was that the quantitative data from the pretest was designed to supply numeric data to support the researcher's qualitative anonymous end-of-course survey process. The survey process was intended to determine how to apply an intervention to assist the student in becoming successful when being administered a posttest exam.

The researcher gave equal opportunity to their quantitative and qualitative data, as they believed they would be equally important in the study. The researcher believed the interview data was just as important as the scores the students received on the pretest and the posttest. The researcher compared the results of both data sets to determine if they yielded results that were similar or dissimilar. The results were described simultaneously.

The design strength allowed the researcher to combine the benefits of the mixed data sets and assisted in comparing the findings of the study. The design gave the researcher the ability to utilize the results from two different methods of research (Creswell, 2012). There could have been difficulties in determining how to merge the data. However, the researcher felt that the patterns would become apparent upon review.

Participants

The population of the study was a convenience sample of dual credit students enrolled in BCIS (Business Computer Applications) courses taught in the fall 2019 semester through a local community college by the researcher. This equated to the twenty-four students who initially enrolled and began class on August 26, 2019. No other participants were included in the study, and any student who chose to drop the course during the enrolled semester was disqualified as a candidate for research. The students selected were high school students who had successfully completed the Texas Success Initiative (TSI) testing in reading with a minimum score of 349, as this was the minimum requirement to register for the course (Texas Higher Education Coordinating Board, 2016). The control group used was from the spring 2019 semester, which did not receive the same level of focused technical vocabulary intervention.

Sampling Design

The sample was drawn from a convenience, single-stage sampling procedure (Creswell J. W., 2014), as the researcher had access to twenty-four students enrolled in a dual credit Business Computer Applications (BCIS) course the researcher taught. The researcher had the availability to these students through their affiliation as an adjunct professor with the local community college. Due to the uniqueness of the dual credit

course, the researcher conducted all research. The only other similar courses on campus were secondary Business Information Management (BIM) classes taught by high-school teachers. This qualified as convenience sampling due to the participants' proximity to the researcher, as enrollees in the researcher's fall 2019 dual credit course.

Methods of Data Collection

The researcher collected the data sets, both qualitative and quantitative, concurrently, with the researcher journal component of the qualitative and quantitative assessment data collected. The concept of achievement was measured in both qualitative and quantitative forms, as described below. The researcher reviewed archival data collected from August 26, 2019, through December 8, 2019, through pretest, technical vocabulary intervention, and posttest assignments given in the Business Computer Applications (BCIS) dual credit courses facilitated by the researcher. In addition, a voluntary, anonymous survey was given to the students as an end of course survey through the community college, where twenty-one of the twenty-four students participated and returned the anonymous survey. The survey sought to identify student opinions of the interventions the researcher put in place to facilitate comprehension of technical vocabulary to the extent that students were able to navigate the posttests successfully. To assist with data collection, the researcher kept a journal throughout the semester to record daily assignments, observations regarding the implementation of interventions, and subsequent posttests, as well as possible questions for further research.

Instruments

The instrument used as a barometer to begin the pretest of student achievement in the dual credit classroom was the GMetrix Excel Practice Test One. GMetrix itself is a

program designed to familiarize the students with the skills and academic vocabulary needed to pass and acquire Microsoft Office Excel skills (GMetrix, n.d.). In GMetrix, there are training and testing modes for the Core Skills Review, as well as the Practice Exams (GMetrix, n.d.).

The students were required to take and pass these exams in testing mode for Practice Exam One, with a score of 700 or higher (scores range from 0 to 1000 with a score of 700 required to pass) (GMetrix, n.d.) in order be considered competent in Microsoft Excel. The GMetrix exams were administered on the campus of the high school the students were enrolled in through the dual credit Business Computer Applications (BCIS) course offered through the community college. The licensing for the product was through the local high school and was used as part of the curriculum for the dual credit course.

The GMetrix Practice Test One in testing mode was the first instrument that was measured. It was given first as a pretest to gauge the student's prior knowledge of Microsoft Excel. The test consisted of seven projects with five tasks per project (GMetrix, n.d.), where the student needed to utilize digital literacy, as well as academic vocabulary, in order to be successful and understand the procedures needed to complete complex tasks in Microsoft Excel. The students were given access to the test at the beginning of the Microsoft Excel unit, where they were administered the exam without any knowledge of the program. After evaluating the test, the researcher created an intervention to assist the students with the terms necessary to be successful if it was is not passed with a score of 700 or higher.

The second instrument was a voluntary, anonymous survey. The survey was

given to the student as a part of the voluntary, anonymous post-course survey through the community college. There were three questions asked of the students in the post-course survey. They were:

1. What level of knowledge of Microsoft Excel did you have prior to the Excel pretest?
2. In what ways do you believe the content presented after your pretest prepared you for the Excel posttest?
3. What do you believe your knowledge of Microsoft Excel to be after taking the Microsoft Excel posttest?

Once the students completed the survey, it was evaluated and then used to gain insight regarding students' perceptions of the effectiveness of the intervention.

The third instrument was the researcher's journal. The researcher used the journal to discuss observations in the classroom, student attitudes, and any questions that arose during the intervention. The journal included logging student comments, and any subsequent actions created or taken to modify the intervention. The researcher wrote in the journal upon the introduction of a new term or when there was a conversation focused on vocabulary and the utilization of the terminology in the lesson.

Each of these instruments was chosen for its ability to measure student success. The GMetrix exams measured performance, and the interviews measured students' perceptions of their success or failure regarding their skill levels in Microsoft Excel.

Data Screening and Analysis Procedures

To examine the comprehension of digital literacy and academic vocabulary retention, the researcher engaged in a pretest, technical vocabulary intervention, posttest

strategy. The intervention consisted of a visual representation of the technical vocabulary word to be discussed that day on a digital whiteboard at the front of the class. After the tardy bell rang, the technical vocabulary term was then discussed with the students for comprehension, and then applied to a task in Microsoft Excel by the researcher. The students then had an opportunity to ask questions for clarification before attempting to utilize the terminology on their own. The researcher then analyzed the results of each of these methods. In order to do so, the researcher needed to confirm a method of data screening and analysis procedures.

For data screening, the researcher first reviewed the qualitative and quantitative results separately, and independently, then converged them together in a convergent parallel mixed-methods design (Creswell J. W., 2014). By comparing these data sets, the researcher could determine if the findings confirmed or did not confirm the data. The key reason for screening these separately was that both methods provide different information, as the pretest, intervention, and posttest provided numeric data, and the voluntary, anonymous survey provided qualitative data in the form of a digital document taken by the student. I was able to compare the test scores on both the pretest and posttest for the control group and the experimental group. When I looked at the data, I was able to see the differences in the mean, as well as the differences in the standard deviation of the two groups. By comparing the quantitative data to the anonymous student survey and their comments that I wrote in the journal I kept, I was able to triangulate the data to form a conclusion.

In analyzing the data, the researcher examined each quantitative instrument and measured it by its own set of codes based on the scores, and then further narrowed the

examination to analyze the exact questions missed on each instrument and then coded them by each particular question until the researcher could confirm a pattern in the data. Once the researcher identified the patterns, they placed similar data in buckets to analyze for my results. The researcher then processed the qualitative data.

In processing the qualitative data, the researcher first broke down the survey into the three specific questions on the end of course survey the students received from the community college. Once the researcher did so, they further broke down the data into types of answers and coded them into separate categories. Once the researcher had the categories, they grouped those that were alike into groups based on their importance to the research. After that, the researcher converged the data for further examination. (Creswell J. W., 2014). First, the researcher reported the quantitative data; then, they discussed the qualitative findings and journal entries that either confirmed or disproved the quantitative data, then used the data to form results and to inform findings (Creswell J. W., 2014). I reported the results from both my quantitative and qualitative databases and then followed up with an analysis of the results in order to get a clear picture of the outcome of the study. I then compared the quantitative data with that of a control group that did not receive the technical vocabulary intervention between the pretest and posttest to validate the results as being significant.

Practical Limitations

The practical limitations of this study began with its size. Because there were only twenty-four enrollees who completed the Business Computer Applications (BCIS) dual credit course of the researcher, the results available to be interpreted were smaller than the researcher had hoped. Therefore the researcher felt that the results might not be

generalizable. The size of the study limited the number of results in confidence intervals and could cause the reader to have doubts regarding their validity. However, the sample size was the actual size of the enrollment of the course, so the size of the research was appropriate in context to the researcher for this particular study. This limitation has not been taken lightly and will be considered by the researcher for further investigation in other Business Computer Applications (BCIS) classes on the community college campus. Doing so will help to determine if the methods used in this research will translate to another group of students.

There was also a limited amount of research in this particular area. Research into digital literacy and academic vocabulary in the Business Computer Applications (BCIS) classroom was almost non-existent, so the researcher had to determine the validity of the research and any advantage and recommendations it may have for future research. The researcher determined that the study held value and was necessary to determine how to ensure success for future students enrolled in dual credit Business Computer Applications (BCIS).

These limitations may also be recommendations for future research because the researcher had no control over the size of the study, as there were only twenty-four students who enrolled in the class. Replication of this study is possible in a single class, as well as district-wide.

Ethical Considerations

The first ethical consideration was to minimize the risk of harm. The researcher addressed this concern by using archival data as a way of protecting the participants, as well as deleting any identifying data, such as student names, student identification

numbers, or notes with student names from the study (Creswell J. W., 2014). Upholding individuals' rights to confidentiality and privacy was of great importance, and as such, was protected during the research process by deleting any individual identifiers, and redacting any names of the institutions that the research took place at. Also, the researcher avoided relationships with the participants during the research process, as the data was archival, and the participants were no longer enrolled in the course when the study commenced.

Additionally, Creswell (2014) discussed avoiding "going native" (p. 99) meaning, espousing the views of the study participants. The researcher reviewed an anonymous end-of-course survey through the community college portal that reported student views of the course and the teaching methods, and in doing so, took care not to disregard data that proves or disproves any views or ideas of the researcher. The researcher also disclosed all results, both positive and negative (Creswell J. W., 2014).

The researcher had the responsibility to ethically report, share, and store data findings and conclusions accurately. This included not intentionally suppressing, falsifying, or intentionally deleting evidence or findings that did not support the views or intent of the researcher.

The researcher always communicated in straightforward and appropriate language with the students (Creswell J. W., 2014). No bias regarding gender, sexual orientation, racial or ethnic group, disability, or age was communicated in the research, and indicators of any specific group were only used to report outcomes as done by the Texas Education Agency (Texas Education Agency, 2019). The data was also to be shared with others through the review of the dissertation committee, as well as through the review of the

school district the research was conducted at and the community college by providing copies of the research and all reports about the study.

Summary

This chapter's goal was to outline the methods of research utilized to determine how to answer the effect of the technical vocabulary intervention effectively. The theoretical perspective, type of study, participants, sampling design, methods of data collection, instruments, data screening and analysis procedures, practical limitations, and ethical considerations were all explicitly discussed concerning the study. This mixed-method study may be considered as a basis for future research.

Chapter IV

Data Analysis

Introduction

The rationale of this mixed methods research study was to determine if a technical vocabulary intervention for students attempting to master Microsoft Excel was useful. The study focused on the theory that a vocabulary intervention would assist in student learning and retention of the skills necessary to master the posttest and ultimately gain an industry-based certification in Microsoft Excel. The question that guided this research was: to ensure success for students who have participated in CTE industry-based training, how will we support the literacy skills necessary to master technical vocabulary so that students are successfully passing their posttest exams?

Harris (2007) indicates that by combining technical vocabulary with activity, students can be more interactive. In doing so, they can gain a deeper understanding of the highly technical terminology, which is prevalent within CTE coursework. The researcher determined that it was beneficial to use this guidance in designing technical vocabulary intervention. By discussing a term a day that was related to learning the concepts as students moved through the phases of mastering skills associated with Microsoft Excel, students were exposed to the technical vocabulary differently than only seeing it in the program, thus highlighting what the terminology meant in connection to the lesson.

Study Sample and Instrumentation

The study sample consisted of an experimental group of dual credit CTE students taking a Business Computer Applications (BCIS) course taught by the researcher in the Fall 2019 semester. The requirement to be included in the study was the students'

enrollment in the dual credit class taught by the researcher and completing both the pretest and the posttest assessment. Thus, the sample consisted of 24 students who completed both phases of the research. The control sample was taken from a BCIS course taught by the researcher in the Spring 2019 semester and consisted of a group of fourteen students. The control group did not receive the technical vocabulary intervention and did not achieve the test results that the experimental group did. The two groups were given a pretest and a posttest, and the results were compared.

The quantitative data that was analyzed was from an archival data set. Also, the researcher gave a voluntary end of course survey to the experimental group that contained quantitative data, as well as qualitative data in the form of student comments regarding the intervention itself. The students in the sample were enrolled in a dual credit BCIS (Business Computer Applications) course through a local community college, which was taught by the researcher. The students were given a pretest for Microsoft Excel to determine their beginning knowledge of the program. After the pretest, the data was reviewed to determine areas of the researcher's focus for the unit. The researcher determined that a technical vocabulary intervention would be useful in assisting the students' comprehension of terminology that was confusing to them. At the end of the Microsoft Excel unit, the students took a posttest exam, which was then compared through a two-tailed t-test to determine the outcome of the intervention. The control group data was from the pretest and the posttest, with no technical vocabulary intervention. The qualitative data consisted of an evaluation of student comments from an end-of-course survey administered anonymously by the community college. The survey

asked for student perceptions of the teaching method, their thoughts on the usefulness of the lessons, and there was space given for unique student comments.

Quantitative Data Findings

The researcher decided to compare the archival pretest and posttest means of the Microsoft Excel assessments from the fall 2019 semester in GMetrix by running a paired sample two-tailed t-test using the SPSS program. They used the two-tailed test because it would not indicate the direction of the relationship. The experimental group was given a pretest for Microsoft Excel at the beginning of the unit. After the pretest, each time they encountered a new technical vocabulary term, the students were exposed to it before the unit in Excel, so that they would be familiar with the term and what it meant before they applied it in a task. The intervention was given through exposure to the term in two ways. They were first shown the term via a digital word wall on a smartboard upon entering the classroom. After the tardy bell rang, the researcher discussed using the term in context to Microsoft Excel, then gave the students a chance to discuss the word with the teacher and ask questions about its application in the program. After the discussion, the curriculum for the day commenced, which included applying the term in the Excel program. The control group did not benefit from the technical vocabulary intervention at all, and upon taking the posttest, the control group students achieved the scores in figure 1. The pretest results (blue bars) are given along with the posttest results (orange bars), to

show the improvement made. The experimental group took the same pretest and posttest, and their results are indicated in figure 2.

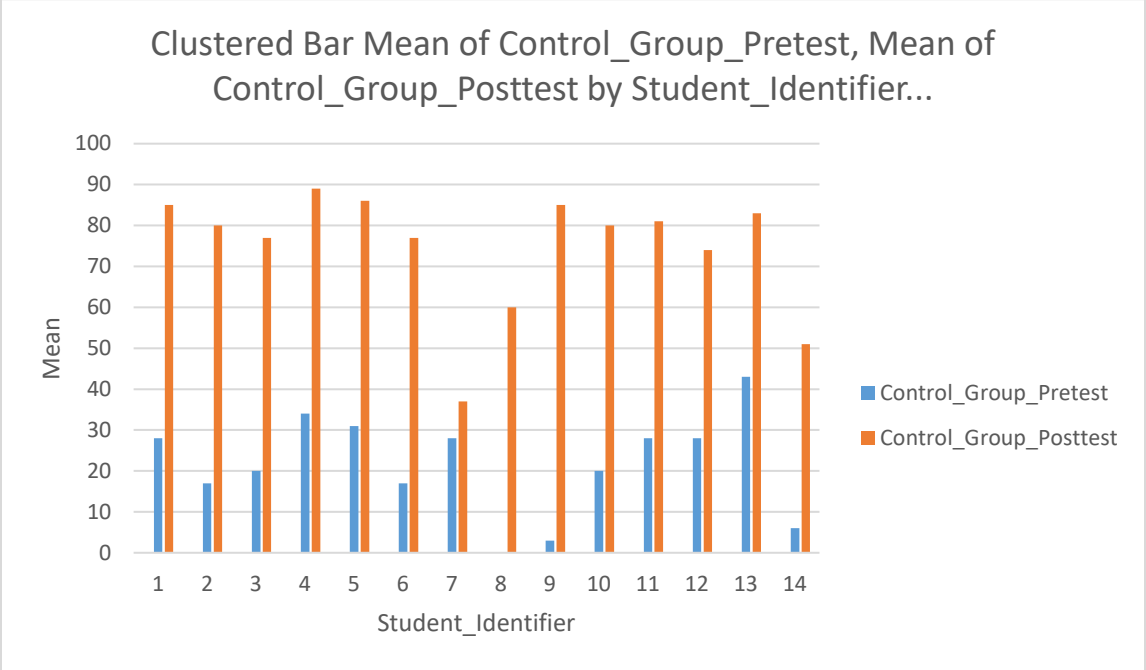

Figure 1 *Control Group Pretest vs. Posttest Score Chart*

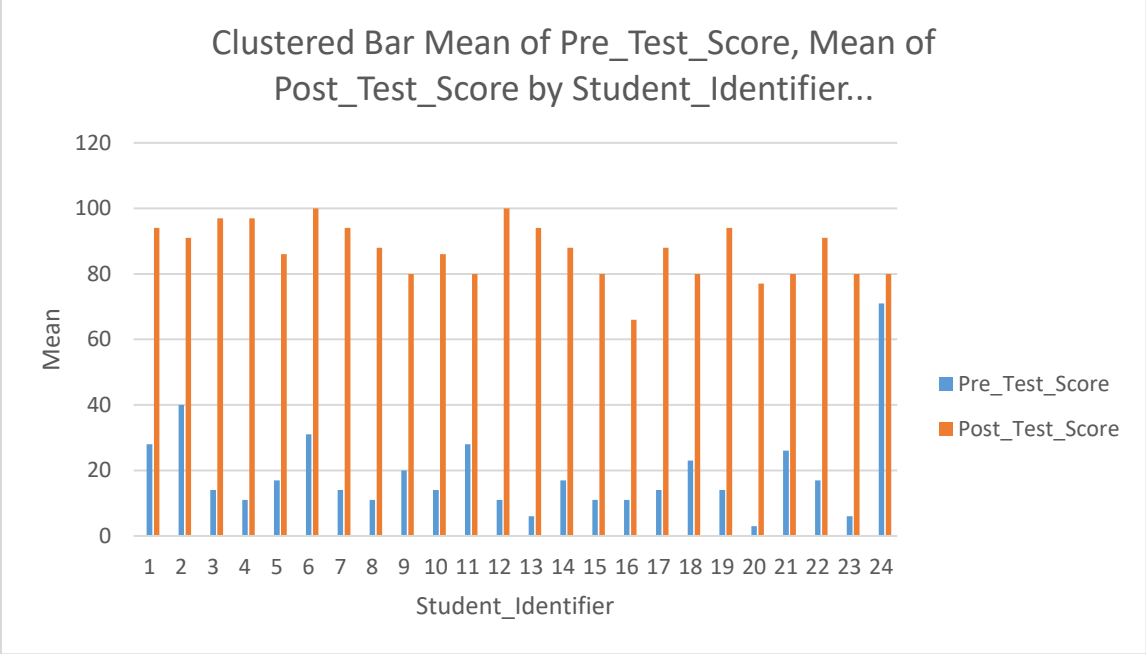

Figure 2 *Experimental Group Pretest vs. Posttest Score Chart*

In reviewing the experimental group data in the bar chart, student twelve is of interest. The earned score in the pretest for this student was eleven, and the posttest score was one hundred, resulting in an eighty-nine-point improvement in knowledge of Microsoft Excel. While this student had the most significant gain in the score, all students gained at least nine points on the posttest, and while the student who gained nine points had previous knowledge of the curriculum, and scored a 70 on the pretest, the second least improved score was fifty-two points for student eleven. The scores for the experimental group had a *p*-value (p = .0001), indicating that it is unlikely the null hypothesis is correct. See Figure 3 below.

Bootstrap for Paired Samples Test

			Bootstrap[a]				
						95% Confidence Interval	
		Mean	Bias	Std. Error	Sig. (2-tailed)	Lower	Upper
Pair 1	ExperimentalGroupExcelPosttestScores - ExperimentalGroupExcel1PretestScores	65.04545	.15827	3.89046	.001	57.22843	72.18066

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

Figure 3 *Experimental Bootstrap chart with the p-value*

The top score for the control group was eighty-nine, and the lowest score earned was a zero. Figure 4 displays descriptive statistics for the control group. The control group's (N = 14) pretest scores (M = 21.64, SD = 12.301) were higher than the experimental group's (Figure 4) (*N* = 24) pretest scores (*M* = 19.08, *SD* = 14.093). At the end of the semester, the control group's scores for the posttest were (*M* = 74.64, *SD* = 14.985). When reviewing the experimental group's posttest scores (*M* = 87.13, *SD* = 8.482), they showed greater improvement than the control group (see figure 5).

A standard deviation is an estimate of the spread of scores around the mean (Field, 2018). The control group had a standard deviation of (*SD* = 14.985) on the posttest, meaning that the scores deviated by 14.985 points from the mean. The high number indicates that there is a significant deviation from the average test score. The standard deviation shows that there was no consistency in the students' comprehension. However, the standard deviation for the experimental group on their posttest was (*SD* = 8.482), indicating that the scores deviated less from the mean, reducing the standard deviation from the control group to the experimental group by 6.503 points. The minimalization of the standard deviation from the control group to the experimental group also shows that the experimental group as a whole had a better understanding of the curriculum than the control group.

Paired Samples Statistics

				Bootstrap[a]			
						95% Confidence Interval	
			Statistic	Bias	Std. Error	Lower	Upper
Pair 1	Control_Group_Pretest	Mean	21.64	-.01	3.15	15.29	27.43
		N	14				
		Std. Deviation	12.301	-.617	1.980	7.407	15.260
		Std. Error Mean	3.288				
	Control_Group_Posttest	Mean	74.64	-.27	4.07	65.65	81.21
		N	14				
		Std. Deviation	14.985	-.818	3.798	5.469	20.453
		Std. Error Mean	4.005				

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

Figure 4 *Control Group Mean and Standard Deviation*

Paired Samples Statistics

				Bootstrap[a]			
						95% Confidence Interval	
			Statistic	Bias	Std. Error	Lower	Upper
Pair 1	Pre_Test_Score	Mean	19.08	-.14	2.71	14.38	25.00
		N	24				
		Std. Deviation	14.093	-1.036	3.950	6.440	20.192
		Std. Error Mean	2.877				
	Post_Test_Score	Mean	87.13	.10	1.70	83.79	90.46
		N	24				
		Std. Deviation	8.482	-.338	1.153	6.083	10.650
		Std. Error Mean	1.731				

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

Figure 5 *Experimental Group Mean and Standard Deviation*

The control group pretest mean (red) is highlighted with the posttest mean (blue) in the chart below (figure 6). Additionally, the experimental group pretest mean (red) is highlighted with the posttest mean (blue) to assist in the visualization of the difference between the pretest and posttest means (figure 7).

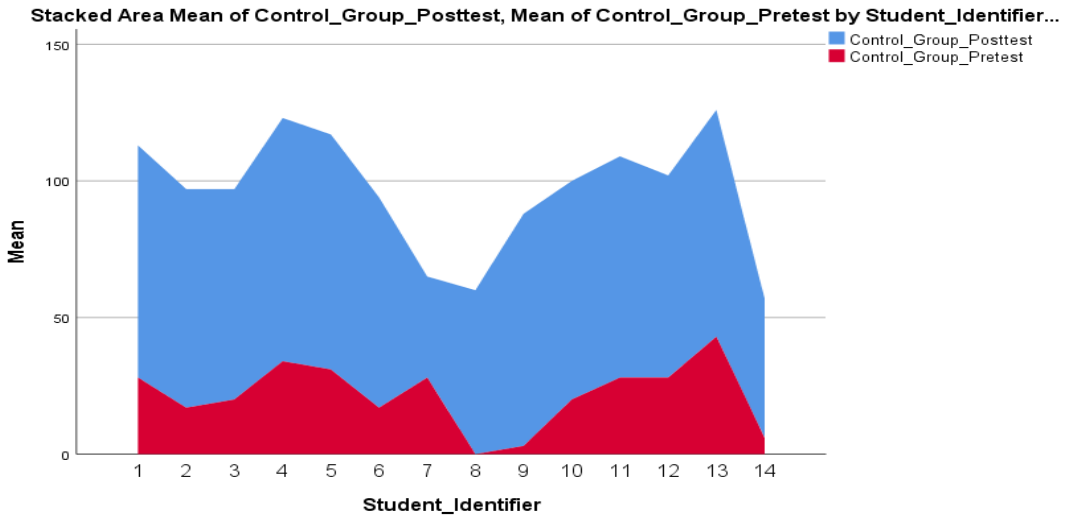

Figure 6 *Control Group Stack Chart of Pretest and Posttest Mean*

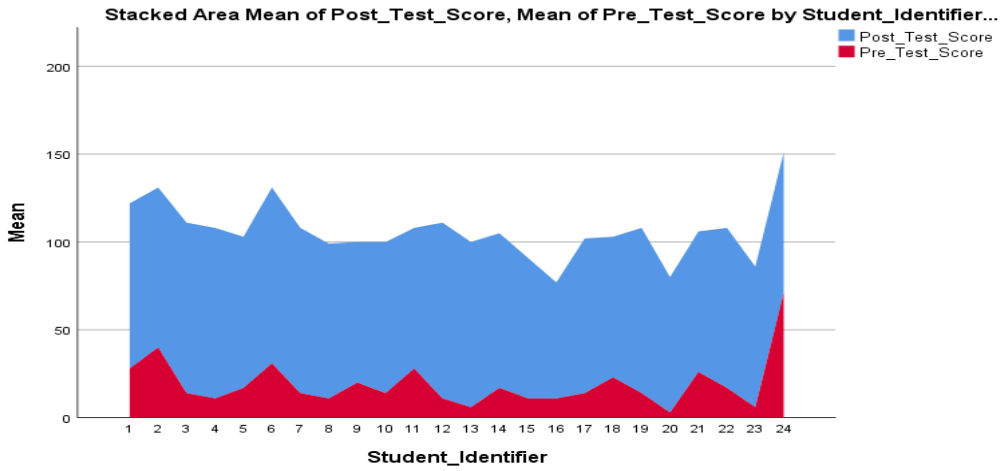

Figure 7 *Experimental Group Stack Chart of Pretest and Posttest Mean*

The scores of the posttest exams in the control group versus the experimental group, with the experimental group garnering a higher mean and lesser standard deviation, prove the hypothesis that a vocabulary intervention would increase posttest scores.

Student Survey Results

All students in the experimental group were allowed to participate in an anonymous end-of-course survey regarding their perceptions of the course and researcher. Students who took the end-of-course survey indicated that they believed that the learning outcomes were clearly stated throughout the course, and of those, 66.67% strongly agreed, and 28.57% agreed. 4.76% were neutral. These results revealed to the researcher that communication was useful for the students. Additionally, the 21 students who participated stated that the instructions for activities and assignments were clear. 71.43% of them strongly agreed, 14.29% agreed, and 14.29% were neutral. No student disagreed with this indicator. The researcher provided a syllabus to the students to indicate learning outcomes and instructions regarding assignments. In addition to the syllabus, the researcher initiated communication with the students daily, both verbally and in writing, regarding their expectations for the assignments. The activities of the

researcher proved beyond a reasonable doubt that the students were aware of researcher communication regarding the assignments, as the survey results given above show.

These same students indicated that the course activities assisted them in meeting the course learning outcomes at a rate of 61.9% strongly agreed, 33.33% agreed, and 4.76% neutral. Again, no student disagreed with that statement. These scores lead the researcher to believe that the students felt that the vocabulary intervention was beneficial to them. The students also felt that the course developed their ability to think critically about the subject. 61.9% strongly agreed, 23.81% agreed, and 14.29% were neutral. For the students to understand that they were thinking critically of the content shows higher-order thinking as well as growth in their understanding of their learning. Their overall impression of the mode of delivery for the course, which was face-to-face was also positive at a rate of 66.67% strongly agreed, 23.81% agreed, 4.76% neutral, and 4.76% disagreeing with this indicator. The dissenting student did not leave a comment as to what piece of the delivery of the course was not useful for them. The face-to-face delivery method was beneficial in this study, as the students were immersed in the subject in the classroom, and therefore had access to the teacher leading the researcher to believe that if this class is to be taught online in the future, that care will need to be taken to ensure that the students get the opportunity to discuss the technical vocabulary terms with the researcher and among themselves.

Regarding the distribution of the assignments for the course, students indicated that they strongly agreed at a rate of 42.86%, agreed at 38.1%, and 19.05% were neutral. In revisiting the distribution of the assignments, the researcher determined that the class spent six weeks on Microsoft Word curriculum, three weeks on Microsoft Excel, three

weeks on Microsoft Access, and three weeks in Microsoft PowerPoint. In light of this knowledge, the researcher will determine if there is a more efficient manner to distribute the different applications so that there may be more time spent in all of them for future courses.

71.43% of students strongly agreed that the researcher provided meaningful feedback on their assignments and progress, and the remaining 28.57% answered that they agreed. No student was neutral or disagreed with this statement. 85.71% strongly agreed 9.52% agreed, and 4.76% were neutral that the researcher provided timely feedback on their assignments and progress, and 80.95% strongly agreed, 9.52% agreed, and 9.52% were neutral that the researcher evaluated their work fairly. In assessing this data, the researcher determined that the intervention and corresponding curriculum was received positively from the majority of the students.

Qualitative Data

When the researcher began investigating how technical vocabulary intervention would affect posttest scores, the researcher chose to use coding to link the data gathered into themes that were of impact on the effectiveness of the intervention. The researcher did this to gain main ideas that could be coded further in a second-round to develop sets or themes appropriate to the research. The coding was first initiated on the student end-of-course survey the experimental group completed. There was a section of the survey where the students had the chance to give their answers to three questions posed by the researcher. Those questions were:

1. What level of knowledge of Microsoft Excel did you have prior to the Excel pretest?

2. What do you believe your level of knowledge to be after the Microsoft Excel pretest?
3. Do you feel the content presented after the Excel pretest prepared you for the Excel posttest?

The first theme that emerged was student perceptions of the method of instruction. This theme was of particular interest to the researcher, as it indicated how the students perceived the information from the researcher regarding the teaching method Microsoft Excel. The second theme was student perception of their level of knowledge post-intervention. The third theme that emerged was from the researcher journal, and it was the researcher's direct interaction with the students. The fourth theme was the student perception of the relevance of the content. Table 1 will give further information regarding the themes.

Student perception of the teaching method	Methods of teaching and instruction
Student perception of their level of knowledge	The level of knowledge is the student comprehension of the learning that occurred during the intervention.
Direct interaction by the researcher	The level of interaction the researcher had with the students directly during instruction.
The students' perception of the relevance of the content	The level of relevancy the students believed Microsoft Excel would have in real-world applications.

Table 1 *Emerging Themes*

Theme 1: Student Perceptions of the Teaching Method

An end-of-course survey was used to measure the students' perceptions of teaching methods used in the dual credit BCIS classroom. Students were given the opportunity through the survey to express their views regarding the effectiveness of the teacher and the methods used in the course. One of the questions asked in the survey was, did the researcher effectively use online learning systems to promote learning? When coding the written answers to this question, it became apparent that students believed that the researcher did use the online learning systems successfully. It was apparent through the answers the students gave, and the quantitative data set from the question. The quantitative data was (*m = 4.67, SD = .58).* This question was vital to the study because the curriculum used for the course was on a classroom desktop computer through an application called GMetrix. GMetrix is an online training application that prepares students to become proficient in the operation of Microsoft Office products (GMetrix, n.d.). This program was used district-wide to create uniformity for their secondary courses, and it was adopted by the researcher for the dual credit course as well. The difference in the secondary course and the dual credit course was the secondary course is two semesters, and the dual credit course is completed in sixteen weeks, thus making the content more rigorous as it may be completed in half the time.

The comments of the students were triangulated with the quantitative data question in the survey and the teacher journal. The data for the questions are indicated in Figure 8 and indicate a positive experience with the course curriculum and teaching methods employed.

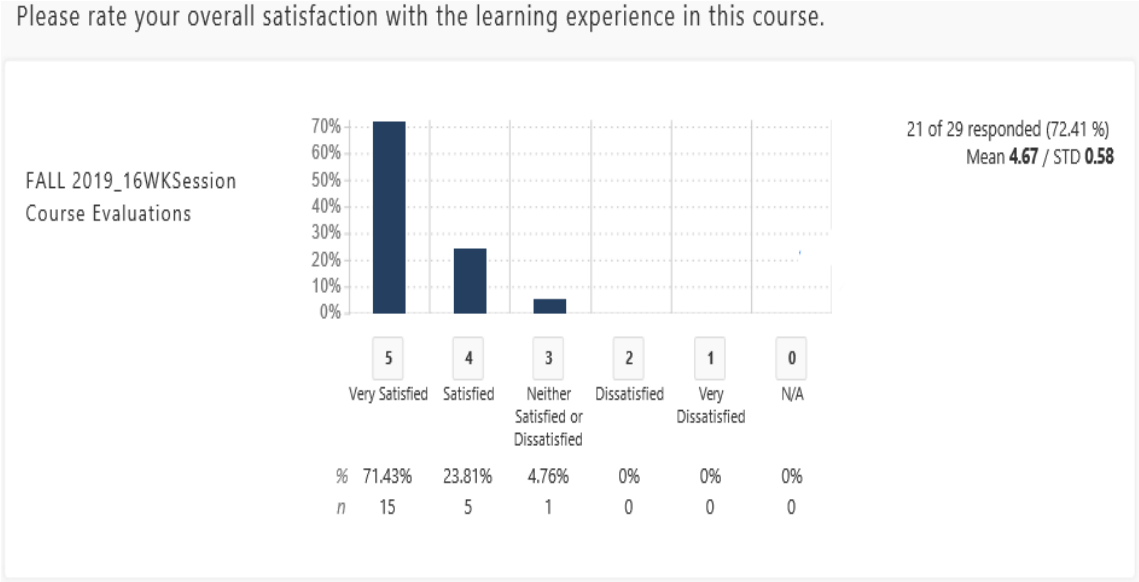

Figure 8 *Overall Course Satisfaction*

Some quotes from students were:

> *giving you valuable and useful content.*
>
> *I believe I have a good understanding of excel, and I believe I can apply what I learned in my future career.*
>
> *Improved vastly due to great teaching*
>
> *It made me understand the concept better, and it made things much more simple* (end of course survey, 2019).

A quote from the researcher journal stated on *Day three: I asked for student feedback regarding the method of instruction I was using. I asked them to tell me if it was helpful or if they would understand better by employing a different method. Student input was, "I thought that the way you taught it helped me to understand the term drop-down much better. I did not even know what that was or how to use it until you showed me." A second student said, "I cannot believe you made that so I could understand it. I have always had trouble learning different ways to do something, and the word that you talked to us about tells you how to do that* (journal, fall 2019).

The student perception of the teaching method showed the belief that they felt the

teaching method was positive. The method the researcher used was one of not only introducing the curriculum to the students but also one where they immersed the students in the work as though they were experts in their field—practicing this method utilized disciplinary literacy in the classroom (Hynd-Shanahan, 2013; Lent & Voight, 2019; Shanahan & Shanahan, 2012). On day one of instruction in Microsoft Excel, the researcher discussed different careers at length, showing the students how relevant Microsoft Excel would be in the future. The example that the students wanted to discuss the most was the executive chef. The researcher showed the students a picture of a tour that they took to a company that employed an executive chef using Microsoft Excel to track how much food they needed for the week, and how many employees they would need by night. The students were amazed that a person used Microsoft Excel whom they felt only cooked or direct employees in the kitchen. The researcher had this discussion with the students in hopes they would see that this program would be valuable to them, and from the student comments, it was apparent they understood.

When the researcher reviewed the data from this theme, they realized through triangulating the quantitative and qualitative data, that student perceptions of the method of instruction were positive, and in the context of the research, were successful.

An excerpt from the teaching method is listed below:

Monday: Introduction of Microsoft Excel to the class. Explain what it is and go over key terms to get started—cell, worksheet, formula, drop-down box.

Tuesday: Demonstrate to students how to use the terms introduced on Monday in the Excel worksheet. Have a whole-class discussion regarding how employers use Excel and how they may apply it in a real-world scenario. (Introduce it to include careers they do not think Excel applies to, such as a chef, or other occupation that is hands-on). Ask students to research what the usage of Excel would be in their future careers.

Wednesday: Discuss in class several student's findings on the use of Excel in the career they chose. Continue by introducing more terminology that applies to the week one

curriculum used by the school, and discussing it with the students.

Thursday: Individual student work in Excel. The teacher should move throughout the classroom and interact with each student individually to determine their level of understanding and assist the student with any issues or concerns they have.

Friday: Assign the unit one Gmetrix exam to assess student comprehension.

For weeks two and three, follow the same guidelines as week one and differentiate as needed based on the content for the week. Note the importance of the teacher interacting with the class and providing examples of context. Enhance student comprehension by having a daily discussion of a different career that uses Microsoft Excel in the workplace to provide context.

Theme Two: Student Perception of their Level of Knowledge

One of the questions asked on the end-of-course survey was: what do you believe is your level of knowledge after the Microsoft Excel pretest? The question was designed by the researcher to determine the students' perception of their level of knowledge. Overwhelmingly, the students' perception regarding their level of knowledge was positive, with the majority stating that they felt their understanding increased.

"I am able to do mostly everything in Microsoft Excel now."

"I feel accomplished and tech-savvy."

"It improved vastly due to great teaching."

"It increased beyond my expectations."

"It made me understand the concept better, and it made things much more simple."

"Pretty high standards."

"It strongly increased."

"To grow extremely (end of course survey, 2019)*."*

The researcher found that student perception of knowledge is essential to the researcher and that building further instruction around the students' positive perceptions of their knowledge was beneficial. Upon reviewing the student responses, the researcher felt that it was essential to understand why the student perception of knowledge was vital. In reviewing previous research, the researcher determined that exploring student perceptions of their learning may help the researcher to understand how the students generate knowledge (DeMarie, 2010). This exploration may assist in determining what aspects are present in the curriculum that students feel help them learn best.

An excerpt from my teacher journal on day six indicates that students' perception of their level of knowledge increased as well. "*Today, I talked to the class about what they thought about their knowledge level, to determine what their perception of it was. One student started to discuss how they felt their knowledge had grown because they understood what Microsoft Excel was asking them to do. I asked the student why they felt that was, and the student responded by indicating that the knowledge of the vocabulary made utilizing the application much easier. A second student entered the discussion and said that it was not until they began to understand what the words meant that they were able to manipulate Microsoft Excel* (journal, 2019)*."* Upon review of both the teacher journal and the student responses, the researcher determined that the students' perception of knowledge of the technical vocabulary enabled them to truly understand what steps they needed to take to perform a task in the program.

Theme Three: Direct Interaction by the Teacher-Researcher

Directly interacting with the students helps to build a positive learning environment. Teacher-researchers who regularly do so can help not only with behavior management, productivity, and participation but also build a relationship with the students that motivates them to succeed (Muntner, 2008; Pianta, 2010). The developed curriculum could be excellent, but without teacher-researcher interaction, it may not result in the level of student achievement necessary for comprehension. Consistently, evidence indicates that focusing on teacher-student interactions will improve academic achievement (Muntner, 2008; Pianta, 2010).

The end-of-course survey utilized by the teacher-researcher asked the students to indicate the performance of the researcher and their interactions with the students. Three statements, in particular, pertained to teacher-student interactions. They are:

1. The teacher provided opportunities for students to speak, ask questions, and be involved in the class.
2. The teacher was readily available for questions outside the classroom.
3. The teacher utilized a variety of instructional methods to reach the learning outcomes.

When looking further at these questions, the researcher triangulated the results from the statistical portion of the survey, as well as the free responses of the students.

The direct interaction questions listed above asked of the students inquired if the teacher provided opportunities for students to speak, ask questions, and be involved. Overwhelmingly, students strongly agreed with this at a rate of 90.48% or 19 of the 21 students who participated in the anonymous survey. Only two students or 9.52% agreed

instead of strongly agreed to indicate to the teacher that the students felt heavily involved in their own learning experience. Part of the reason for this may be related to the fact that students felt that the teacher was readily available outside the classroom at a rate of 80.95% strongly agreed, 14.29% agreed, and 4.76 remained neutral on the question.

The teacher journal on day ten explained how they remediated student discouragement. *"The students are getting discouraged with the vast amount of formulas and terms they do not understand in Excel. I tried to encourage them not to give up and to remain focused! They were just not happy, one student more so than others. I asked what I could do to help, and the student said they did not know where to begin. I asked the class where they were stuck and determined that they were all having trouble with the same concept, applying sparklines. I initiated a brain break, where the students stood up, stretched, and interacted with each other on a personal level, to give them time to refocus. I then discussed the technical vocabulary term sparkline with the class, indicating that it was just a little chart that is inside a cell that represents data* (Microsoft, n.d.). *I talked to them about how they could use them in a real-world context, such as increases or decreases in productivity. Once they understood what they were, we then applied the process of adding sparklines in the cells in a way that assisted the students with an understanding of how to perform the task"* (journal, fall 2019).

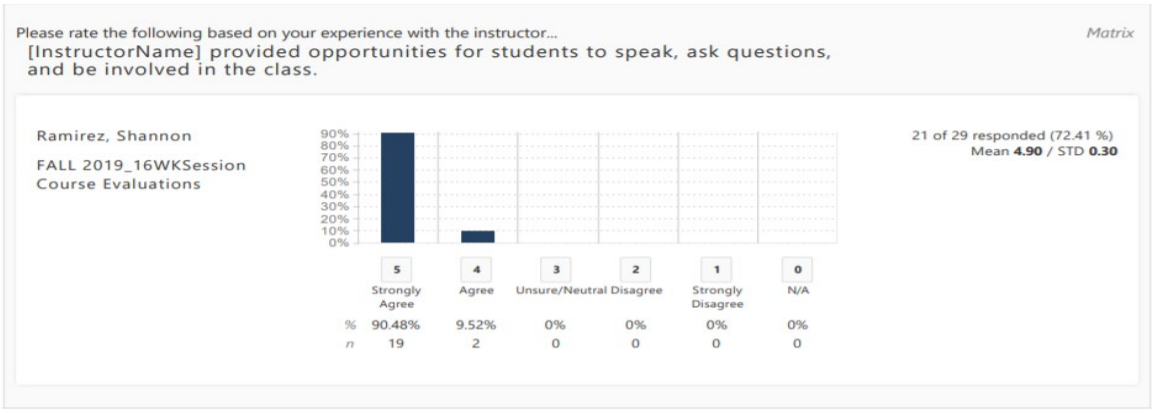

Figure 8 *Student Opportunity to Speak, Ask Questions, and be Involved in Class*

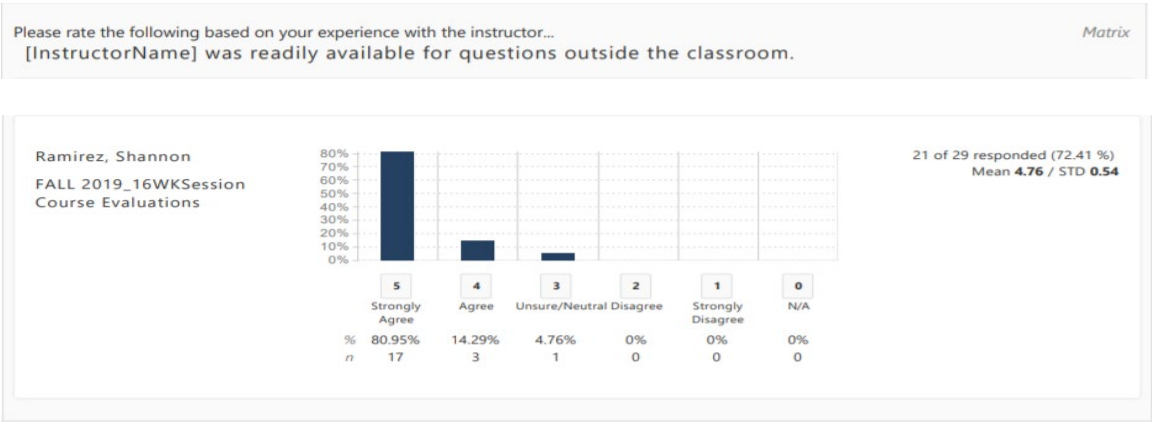

Figure 9 *Researcher was Readily Available for Questions Outside the Classroom*

Upon querying the students regarding the variety of instructional methods, they revealed that the majority strongly agreed with the statement. The statistical calculations (*M = 4.38, SD = .86)* show this beyond a reasonable doubt. The intervention method of visibly displaying technical vocabulary on a digital word wall, the class discussion of the technical vocabulary, and the demonstration of how to use the vocabulary within the Microsoft Excel spreadsheet were beneficial to them.

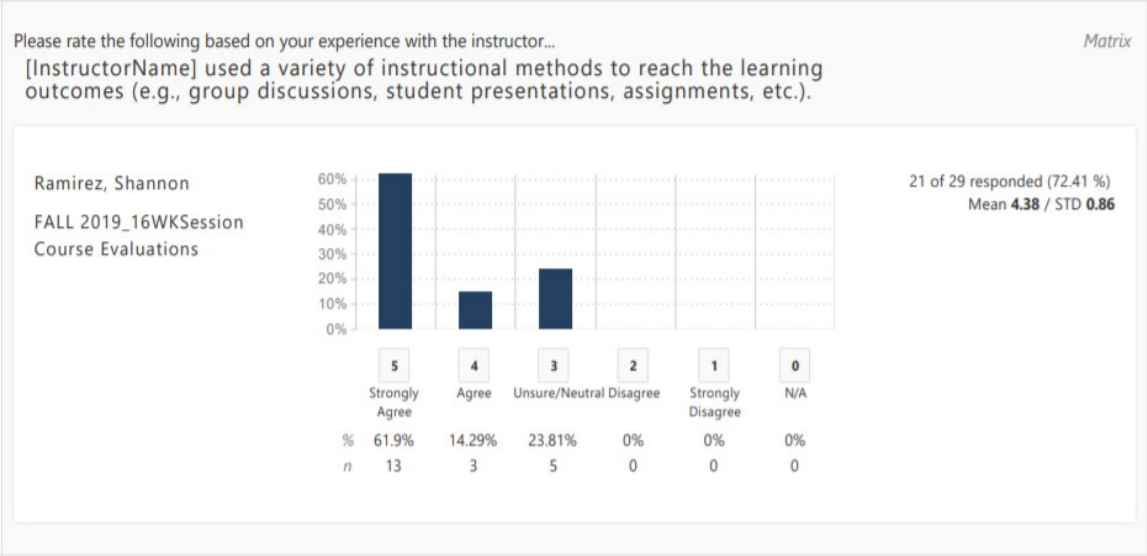

Figure 10*Variety of Instructional Methods*

Student comments about the three statements above include:

"Great professor, I can't say enough good things about Mrs. Ramirez."

"Giving you valuable and useful content(end of course survey, 2019)*."*

The researcher journal also indicated a variety of instructional methods on day two:

"*I introduced a class discussion today about the toolbar, but I called it a 'ribbon.' None of the students comprehended that a ribbon and a toolbar defined the same term. We had a class discussion regarding the terminology, and held a question and answer conversation. We discussed that a toolbar was like a toolbox for Microsoft Excel and that the ribbon held the tools just like the toolbox. When discussing these words in a new way, I could see by the students' expressions that they understood what the technical vocabulary meant and how it was applied* (journal, 2019)*."*

After examining all of the evidence regarding teacher interaction with the experimental group students, the researcher feels that there was sufficient evidence to prove that researcher interaction with the students resulted in a positive outcome. The

technical vocabulary intervention helped the students earn a higher score on the Microsoft Excel posttest.

Theme Four: The Students' Perception of the Relevance of the Content

How students perceive what they learn is essential, as it genuinely influences their academic behaviors and motivation to learn a new concept (Nauert, 2018). The consequential validity of the form of assessment is also a contributing factor. In the end-of-course survey, students were asked if the researcher made the learning in the course relevant to their future careers, degree, or field of study. When triangulating this data, the researcher first looked at the quantitative data from the survey. The mean (*M = 4.81)* indicated that students felt that the course content was relevant to their futures, and with the low standard deviation (*SD = .40)*, the answers were all incredibly close to the mean. The scoring system for the question was from answering with a one, for poor through a five for excellent.

Student comments regarding the relevancy of the curriculum are as follows:

"The strengths of this course would be that I was able to learn Microsoft in only a few months and that I can use this class when I go into the workforce."

"I believe I have a good understanding of Excel, and I believe I can apply what I learned to a potential career (end of course survey, 2019)*."*

When coupling this data with the student comments made on the end-of-course survey, it was apparent from both data sets that the majority of the students enrolled in the course were aware of its relevancy. When the researcher examined the importance of Microsoft Excel to the workplace, they found that managers need these spreadsheets from their employees for several reasons. Some of these included the ability to create equations

that can evaluate a variety of different data sets, such as balancing inventory and keeping up with costs associated with manufacturing, to name a few (Career Insights, 2018). Students who can envision the application of their knowledge in the future are more likely to be motivated than those who do not feel they will use what they learned in their postsecondary endeavors (Gulikers, Bastiaens, Kirschner, & Kester, 2006).

An excerpt from the researcher journal on day five discusses a conversation about the relevancy of the content. *"Today's class discussion surrounded relevancy. We discussed how Microsoft Excel is used in the workplace and defined technical vocabulary that would be used when working in the spreadsheets. One term in particular that we talked about was inventory. While inventory does not indicate a process in Microsoft Excel, it is a vital workplace term that students will need to know. Keeping up with inventory in Excel is important for many different organizations and companies, including small businesses, as it is a means of tracking equipment, office supplies, and a variety of other assets. Students were not aware that they could create spreadsheets to perform those functions in a business setting* (journal, 2019)*."*

Research Limitations

Limitations that occurred regarding the study included the sample size. Having twenty-four students in the dual credit BCIS course on campus could increase the likelihood of error. The researcher wanted to produce meaningful data and used the entire population of the course. However, they concluded that the intervention might not have been as effective on a larger scale.

Conclusion

This chapter intended to outline the results collected and present them in a way that was quickly interpreted by the reader. The data from the quantitative and qualitative aspects of the research, along with the researcher journal, were utilized to build conclusive evidence that a technical vocabulary intervention, when implemented in a pretest, intervention, posttest atmosphere, would produce an increase in student comprehension. Because of the researcher's approach to introducing a technical vocabulary intervention, the experimental group students were able to improve their comprehension of Microsoft Excel and perform tasks in the application using higher-order thinking skills that the control group did not have due to the lack of technical vocabulary intervention. The students in the experimental group felt that they had positive interactions in the classroom that lead them to comprehend the curriculum presented and were able to navigate the tasks assigned successfully.

The researcher was able to provide students with a skill that will be used in a myriad of settings in the workplace, enabling them to become successful employees, business owners, and members of organizations in their postsecondary endeavors. By providing students with positive perceptions regarding their learning, the researcher created an atmosphere conducive to learning and assisted the students in becoming productive members of teams and productive members of society.

Chapter V

Summary, Conclusion, and Recommendations

Introduction

The purpose of this study was to determine how implementing a pretest, technical vocabulary intervention, and posttest design would increase the passing rate of a posttest exam for dual credit Business Computer Applications (BCIS) students. The success rate was measured by conducting a *t-test* for a pretest and posttest with a control group versus an experimental group. The researcher used archival data for both the control and the experimental groups.

The research focused on the technical vocabulary intervention implemented for the experimental group that included a visual introduction to the term through a digital whiteboard in the classroom that the students viewed as they began class. Then, they initiated a discussion between the students and the researcher. Finally, the term was implemented by the researcher, demonstrating how the students may use it in a Microsoft Excel worksheet. At any time during the intervention, the students were encouraged to discuss the term, or ask questions about how they were using it, and why they were using it in that manner. At the end of the Microsoft Excel unit, the students took the posttest to measure improvement.

I chose to conduct this study to determine if a technical vocabulary intervention would be beneficial for my students, and ultimately enable them to successfully navigate a posttest for Microsoft Excel. I believed it would be a way to ensure the accomplishment of the content for my students and provide them with a life long skill that they could use in the workplace or their postsecondary endeavors. I felt that students who could utilize

this Microsoft Office program would be more easily hireable, and more likely to remain in an office setting when entering the workforce. I wanted to make sure that my students had the best chance possible to succeed, and have the best chance possible to attain their future goals. Still, there is much to learn regarding student success. However, there is great promise indicated in the results of this study.

Significance of the Study

This study was significant because it assisted secondary students in a dual credit classroom to successfully navigate Microsoft Excel by learning the technical vocabulary needed to pass their posttest assessments effectively. The benefit of providing them with a technical vocabulary intervention assisted the students in gaining a skill that would provide them with the knowledge necessary to succeed in the workplace. Gaining knowledge of how to navigate a pretest, technical vocabulary intervention, and posttest effectively could ultimately benefit not only the students but all researchers who utilize this method in their classrooms. This study also was significant due to the individuality of it, as the researcher did not find this research in any publication. Technical vocabulary in a dual credit Career and Technical Education classroom was unique, as there was a gap in research regarding this topic, which I have hoped to fill partially.

Also of significance was that inequities in technology did not prohibit students from learning this skill. Students in this district are, in most instances, disadvantaged, and may not have access to technology outside of the classroom (2018-2019 Economically Disadvantaged Students, 2020). By providing these students with technology in the classroom, they were able to learn Microsoft Exel, a skill that is of great importance in the workplace. One of the benefits of learning Microsoft Excel is

that students are more able to manipulate large amounts of data, providing employers with higher-skilled employees. These employees are more efficient, making them valued members of an organization (Post University, 2018; Career Insights, 2018). Other benefits include better organizational skills, as it is easier to organize data into a worksheet (Microsoft, n.d.; Post University, 2018; Career Insights, 2018). Having a higher skillset than others applying for positions enables students to gain employment more quickly (Career Insights, 2018; Post University, 2018).

I learned that providing students with technical vocabulary throughout the course assisted students in the experimental group in earning higher scores, a higher mean, and higher course satisfaction than those in the control group.

Summary of the Findings

While utilizing a convergent parallel mixed-methods methodology, this research sought to determine if an intervention in technical vocabulary in a pretest, technical vocabulary intervention, posttest design would assist students in passing their posttest exam in Microsoft Excel. This method presented the opportunity for the researcher to examine the research questions, both quantitatively and qualitatively, then triangulating the results (Creswell & Clark, 2018; Teddlie & Tashakkori, 2008). Using mixed-methods also allowed the researcher the benefit of confirming the results quantitatively and qualitatively (Creswell J. W., Educational research: planning, conducting, and evaluating quantitative and qualitative research, 2012).

When evaluating the quantitative results, the researcher completed a two-tailed *t*-test through IBM SPSS Statistics, a statistical calculation program that assists the user in calculating quantitative data correctly for accurate results (Field, 2018; IBM, n.d.). The

resulting calculations indicated that the control group's posttest mean (M = 74.64, SD = 14.985) was lower than the experimental group's posttest mean (M = 87.13, SD = 8.482), indicating a gain in student knowledge through the intervention (Field, 2018). The standard deviation was reduced from the control group posttest ($SD = 14.985$) to the experimental group posttest (SD = 8.482), meaning that the student score deviation from the mean was decreased in the experimental group, indicated a greater knowledge of the material. Also, the p-value (p = .001) indicates that the null hypothesis can be dropped (Field, 2018; IBM, n.d.).

The intervention was a technical vocabulary intervention. The researcher introduced a technical vocabulary term each day of instruction during the Microsoft Excel unit. Introducing the terminology was done via a digital word wall on the classroom whiteboard that students viewed upon entry to the classroom. Once class commenced, the researcher discussed the meaning of the technical vocabulary term with the participants and demonstrated how to use the term when applying it to a corresponding task in the Microsoft Excel program, exposing the participants to the word in three different ways. It measured student perception of the intervention in comments provided in an end-of-course voluntary survey that students had the opportunity to complete. This survey also provided other information that was coded by the researcher.

The qualitative data from the survey was coded into common themes. The researcher gathered the data by adding three questions to the voluntary end-of-course survey the students were encouraged to complete. The three questions were:

1. What level of knowledge of Microsoft Excel did you have prior to the Excel pretest?

2. What do you believe your level of knowledge to be after the Microsoft Excel pretest?
3. Do you feel the content presented after the Excel pretest prepared you for the Excel posttest?

The researcher designed these questions to assist them in determining student perceptions regarding Microsoft Excel, which they then coded into themes. The themes were hand-coded and were determined to be as follows:

1. Student perception of the teaching method
2. Student perception of their level of knowledge
3. Direct interaction with the instructor
4. Student perception of content relevance

Once the instructor began interpreting the themes, the comments of the students and the entries into the researcher journal, they were triangulated with the quantitative data questions in the survey, and the results of the two-tailed t-test. The results of each of the themes were that the students responded favorably to the teaching method, their perceptions of their level of knowledge, their interaction with the researcher, and the content relevance. These positive results indicated that the intervention was successful.

Implications for Practice

We can serve students with inequities in technology through participating in a dual credit Business Computer Applications (BCIS) course that is utilizing this research so that they may gain knowledge of Microsoft Excel with a technical vocabulary intervention. They would be able to participate in a classroom, thus having access to technology that would allow them to gain a valuable skill that is marketable in the workplace. By reproducing this study in other dual credit Business Computer

Applications (BCIS) classes, teachers could ultimately produce the same results. In doing so, they would be able to provide students with the opportunity to gain knowledge of Microsoft Excel. Doing so could drastically impact their achievement while they garner new techniques to promote success.

Recommendations for Future Study

A recommendation for future studies consists of determining how many students could become certified in Microsoft Excel through a certification program. Certiport is one of these programs. It is an online testing service that offers industry-recognized Microsoft Office certifications (Certiport, n.d.). Gaining a Microsoft Excel qualification could be the edge that a student needs in the competitive post-secondary job market that sets them apart from other applicants (Microsoft, n.d.). It will assist the student in establishing their skill set for future employers, and possibly gaining a higher starting wage. Doing so could be most beneficial for low-income students, possibly providing them with an opportunity to break the cycle of poverty.

An additional recommendation for future study that includes gaining a Microsoft Excel industry certification would be researching the number of students who gained employment after graduation quantitatively. Measuring the number of students who hold this Microsoft Excel certification who become employed immediately after graduation may indicate if the certification increases the chances of becoming employed versus those students who do not gain the certification. We may gain valuable insights by collecting this knowledge.

Student growth in a high-school level Business Information Management (BIM) class could be measured using the pretest, intervention, posttest method used by the

researcher. A BIM course is a high school level course where students learn Microsoft Office products, including Microsoft Excel (Plano Independent School District, n.d.). Students in a high school version of the researcher's dual credit course could benefit from a technical vocabulary intervention allowing them to gain a higher level of knowledge in Microsoft Excel. Additionally, future research could measure the viability of this study. Researching the impact on the participants of the technical vocabulary intervention in a school setting will allow future instructors to gain a better understanding of participant needs in order to navigate these programs successfully.

Lastly, this study may be duplicated using other Microsoft Office products. These products include Microsoft Word (word processing software), Microsoft Access (database management software), Microsoft Powerpoint (presentation software), and Microsoft Outlook(email software) (Microsoft, n.d.). Measuring student progress in each of these applications by utilizing the methods the researcher used could lead to insight into how effective the technical vocabulary intervention could be in each of the applications in the Microsoft suite.

Conclusion

Exploring a technical vocabulary intervention in a pretest, intervention, posttest scenario offered the researcher with a way to measure student improvement in Microsoft Excel. Performing this research has also allowed the researcher to provide insight to teachers on how the impact of a technical vocabulary intervention may improve student performance on posttest exams. This research may help others to understand which methods might work and what could lead to finding successful ways to assist students to learn challenging technical vocabulary. Success is not promised based on the

recommendation to implement a technical vocabulary intervention, or that student scores will increase upon implementation. However, this study does provide promising research into implementing an effective technical vocabulary intervention might in the classroom.

Creating a culture of learning in the classroom is vital to student learning. Based on the results of both the quantitative and qualitative results, they have shown that the researcher's students responded successfully to the intervention while cultivating a relationship of learning. It is the hope of the researcher that others may benefit from this study and implement this technical vocabulary intervention in their classroom successfully. Thus leading to a better comprehension of the material, and a better understanding of how to effectively promote student knowledge.

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Appendix A

Institutional Review Board

University of Houston

UNIVERSITY of HOUSTON

DIVISION OF RESEARCH
Institutional Review Boards

APPROVAL OF SUBMISSION

January 28, 2020

Shannon Ramirez

slramirez2@uh.edu

Dear Shannon Ramirez:

On January 28, 2020, the IRB reviewed the following submission:

Type of Review:	Initial Study
Title of Study:	The effect of Disciplinary Literacy Intervention in The Form of Pretest/Intervention/Posttest in a Dual Credit Classroom
Investigator:	Shannon Ramirez
IRB ID:	STUDY00002057
Funding/ Proposed Funding:	Name: Unfunded
Award ID:	
Award Title:	
IND, IDE, or HDE:	None
Documents Reviewed:	• Revised IRB with Section 16 updates. , Category: IRB Protocol; • District Research Approval, Category: IRB Protocol;
Review Category:	Exempt
Committee Name:	Not Applicable
IRB Coordinator:	Sandra Arntz

The IRB approved the study on January 28, 2020 ; recruitment and procedures detailed within the approved protocol may now be initiated.

As this study was approved under an exempt or expedited process, recently revised regulatory requirements do not require the submission of annual continuing review documentation. However, it is critical that the following submissions are made to the IRB to ensure continued compliance:

- Modifications to the protocol prior to initiating any changes (for example, the addition of study personnel, updated recruitment materials, change in study design, requests for additional subjects)

UNIVERSITY of HOUSTON
DIVISION OF RESEARCH
Institutional Review Boards

- Reportable New Information/Unanticipated Problems Involving Risks to Subjects or Others
- Study Closure

Unless a waiver has been granted by the IRB, use the stamped consent form approved by the IRB to document consent. The approved version may be downloaded from the documents tab.

In conducting this study, you are required to follow the requirements listed in the Investigator Manual (HRP-103), which can be found by navigating to the IRB Library within the IRB system.

Sincerely,

Research Integrity and Oversight (RIO) Office
University of Houston, Division of Research
713 743 9204
cphs@central.uh.edu
http://www.uh.edu/research/compliance/irb-cphs/

Appendix B

Campus Approval Letter

GOOSE CREEK CONSOLIDATED INDEPENDENT SCHOOL DISTRICT

APPLICATION FOR RESEARCH OR EVALUATION

Please type and complete all sections of the application.

1. General Information:

Date Submitted:	
Submitted by:	Shannon Ramirez
Proposed Project Starting Date:	I will be using archival data from Fall 2019.
Proposed Project Ending Date:	I will be using archival data from Fall 2019.
Overall Project Purpose: (e.g., thesis, journal publication)	Dissertation for an Ed.D. in Professional Leadership at the University of Houston.
Are you proposing implementation of a program?	☐ Yes X No
If yes, what type of program?	☐ Curriculum or Instruction Methods Program (e.g., reading or science instruction using new methods or materials) ☐ Student Services Program (e.g., pregnancy prevention or student mentoring) ☐Professional Development ☐ Other Program, type:
If your project will implement a program, please briefly describe it here, and attach a copy of your proposed curriculum and or other program materials.	N/A

For GCCISD Use Only	
Date Received: (completed by GCCISD)	
District program approval signatures (GCCISD use only) Based on the information/ process described above, the following recommendations are made:	☒ Approval ☐ Revision and Resubmission (attach explanation) ☐ Denial (attach explanation) Administrator Signature Superintendent Signature 1-13-2020 Date

2. Main project contact person/student if class project, thesis, or dissertation

Name:	Shannon Ramirez
Address:	6001 Wallisville, Baytown, Texas, 77521
Phone:	(281)389-8929
Email Address:	Shannon.ramirez@gccisd.net

3. Project director/supervision professor if class project, thesis, or dissertation

Name:	Dr. Laveria Hutchison
Address:	3657 Cullen Blvd, Houston, TX 77204, Houston, TX 77004
Phone:	(713)743-4958
Email Address:	lhutchison@uh.edu

Appendix C

Sample of Digital Journal Entries

Day One: Today was the first day of Microsoft Excel. I began with the term worksheet and cell on the whiteboard. When the students came in the classroom, they began commenting on if they were going to be doing a worksheet, and if not, were they going to be locked in a cell. They were all joking and laughing about being "locked up," and I told them not to joke about it, that everything they did for the next three to four weeks was going to involve worksheets and cells. They groaned and asked why they had to do worksheets, that they were boring. I then explained to the students that a worksheet in Microsoft Excel is the actual page you input data in, and the cell was not a jail cell or a living cell like in biology, but it was the box that data is input in on the Excel worksheet. They were interested at that point, so they got the buy-in to become interested in what Excel is all about. All in all, I would say it was a good day.

Day Two: I introduced a class discussion today about the toolbar, but I called it a "ribbon." None of the students comprehended that a ribbon and a toolbar defined the same term. We had a class discussion regarding the terminology, and held a question and answer conversation. We discussed that a toolbar was like a toolbox for Microsoft Excel and that the ribbon held the tools just like the toolbox. When discussing these words in a new way, I could see by the students' expressions that they understood what the technical vocabulary meant, and how it was applied.

Day three: I asked for student feedback regarding the method of instruction I was using. I asked them to tell me if it was helpful or if it would be better understood by employing a different method. Student input was, "I thought that the way you taught it helped me to understand the term drop-down much better. I did not even know what that was or how to use it until you showed me." A second student said, "I cannot believe you

made that so I could understand it. I have always had trouble learning different ways to do something, and the word that you talked to us about tells you how to do that."

Day Four: Today's fire drill lost our instruction. We only completed the training that was not fully completed yesterday.

Day Five: Today's class discussion surrounded relevancy. We discussed how Microsoft Excel is used in the workplace and defined technical vocabulary that would be used when working in the spreadsheets. One term in particular that we talked about was inventory. While inventory does not indicate a process in Microsoft Excel, it is a vital workplace term that students will need to know. Keeping up with inventory in Excel is essential for many different organizations and companies, including small businesses, as it is a means of tracking equipment, office supplies, and a variety of other assets. Students were not aware that they could create spreadsheets to perform those functions in a business setting.

Day Six: Today, I talked to the class about what they thought about their knowledge level, to determine what their perception of it was. One student started to discuss how they felt their knowledge had grown because they understood what Microsoft Excel was asking them to do. I asked the student why they felt that was, and the student responded by indicating that the knowledge of the vocabulary made utilizing the application much more comfortable. A second student entered the discussion and said that it was not until they began to understand what the words meant that they were able to manipulate Microsoft Excel.

Day Seven: Today, we learned about inserting charts and graphs. The student technical vocabulary word of the day was wrap text. I told them what it meant, we talked

about what could happen if you do not wrap text, and then I demonstrated typing in a cell and showed them how it continued on one line across the worksheet. Then I clicked the wrap text button, and the students were amazed, lol. One student said, “It is just like my grandpa says, you learn something new every day!”

Day Ten: The students are getting discouraged with the vast amount of formulas and terms they do not understand in Excel. I tried to encourage them not to give up and to remain focused! They were just not happy, one student more so than others. I asked what I could do to help, and the student said they did not know where to begin. I asked the class where they were stuck and determined that they were all having trouble with the same concept, applying sparklines. I initiated a brain break, where the students stood up, stretched, and interaCTEd with each other on a personal level, to give them time to refocus. I then discussed the technical vocabulary term sparkline with the class, indicating that it was just a little chart that is inside a cell that represents data. I talked to them about how they could be used in a real-world context, such as increases or decreases in productivity. Once they understood what they were, we then applied the process of adding sparklines in the cells in a way that assisted the students with an understanding of how to perform the task.

List of Tables

Student perception of the teaching method	Methods of teaching and instruction
Student perception of their level of knowledge	The level of knowledge is the student comprehension of the learning that occurred during the intervention.
Direct interaction by the researcher	The level of interaction the researcher had with the students directly during instruction.
The students' perception of the relevance of the content	The level of relevancy the students believed Microsoft Excel would have in real-world applications.

Table 1 Emerging Themes

List of Figures

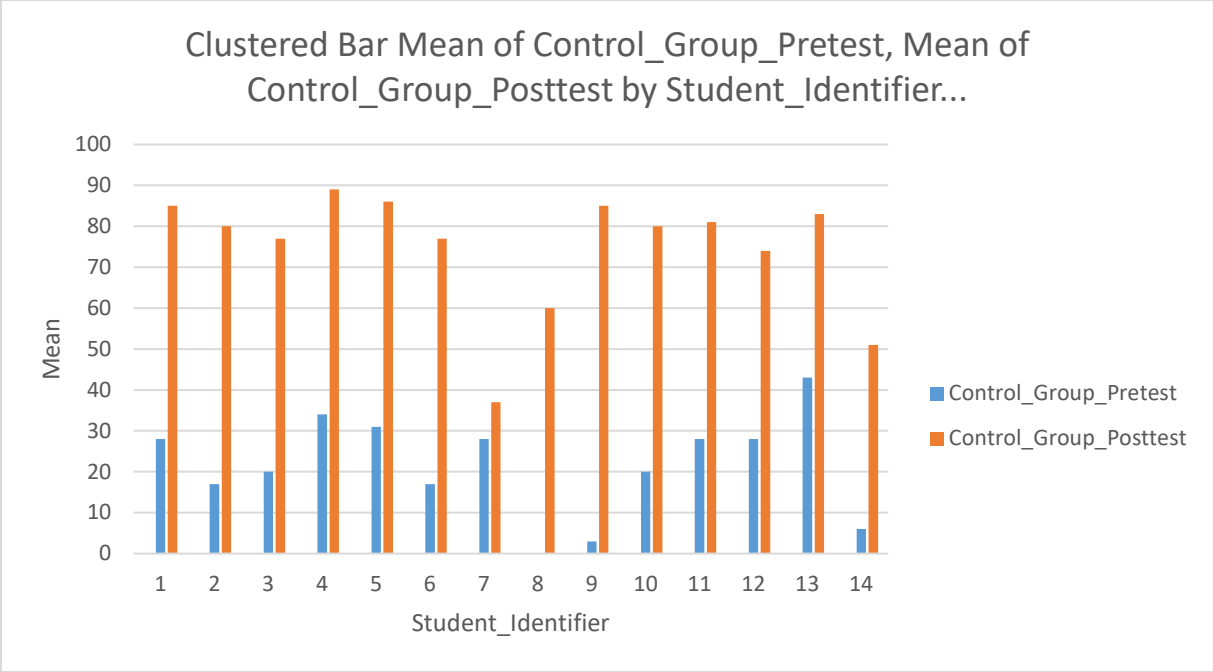

Figure 11 Control Group Pretest vs. Posttest Score Chart

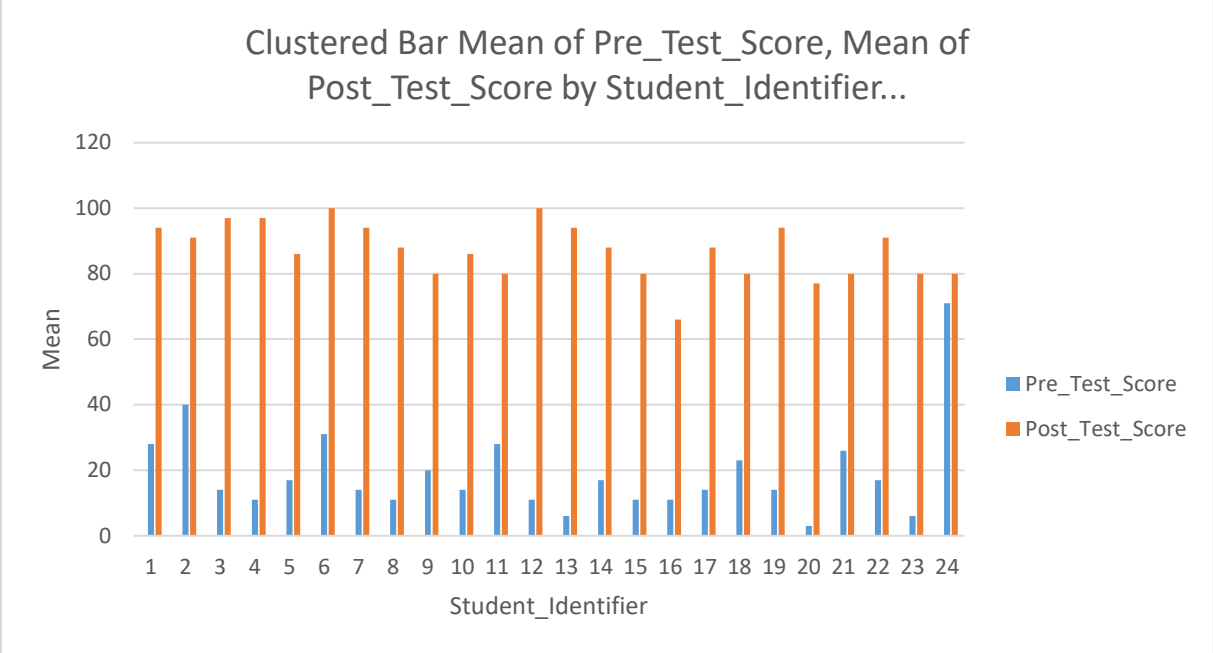

Figure 12 Experimental Group Pretest vs. Posttest Score Chart

Bootstrap for Paired Samples Test

			Bootstrap[a]				
						95% Confidence Interval	
		Mean	Bias	Std. Error	Sig. (2-tailed)	Lower	Upper
Pair 1	ExperimentalGroupExcel PosttestScores - ExperimentalGroupExcel 1PretestScores	65.04545	.15827	3.89046	.001	57.22843	72.18066

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

Figure 13 Experimental Bootstrap chart with the p-value

Paired Samples Statistics

				Bootstrap[a]			
						95% Confidence Interval	
			Statistic	Bias	Std. Error	Lower	Upper
Pair 1	Control_Group_Pretest	Mean	21.64	-.01	3.15	15.29	27.43
		N	14				
		Std. Deviation	12.301	-.617	1.980	7.407	15.260
		Std. Error Mean	3.288				
	Control_Group_Posttest	Mean	74.64	-.27	4.07	65.65	81.21
		N	14				
		Std. Deviation	14.985	-.818	3.798	5.469	20.453
		Std. Error Mean	4.005				

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

Figure 14 Control Group Mean and Standard Deviation

Paired Samples Statistics

				Bootstrap[a]			
						95% Confidence Interval	
			Statistic	Bias	Std. Error	Lower	Upper
Pair 1	Pre_Test_Score	Mean	19.08	-.14	2.71	14.38	25.00
		N	24				
		Std. Deviation	14.093	-1.036	3.950	6.440	20.192
		Std. Error Mean	2.877				
	Post_Test_Score	Mean	87.13	.10	1.70	83.79	90.46
		N	24				
		Std. Deviation	8.482	-.338	1.153	6.083	10.650
		Std. Error Mean	1.731				

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

Figure 15 Experimental Group Mean and Standard Deviation

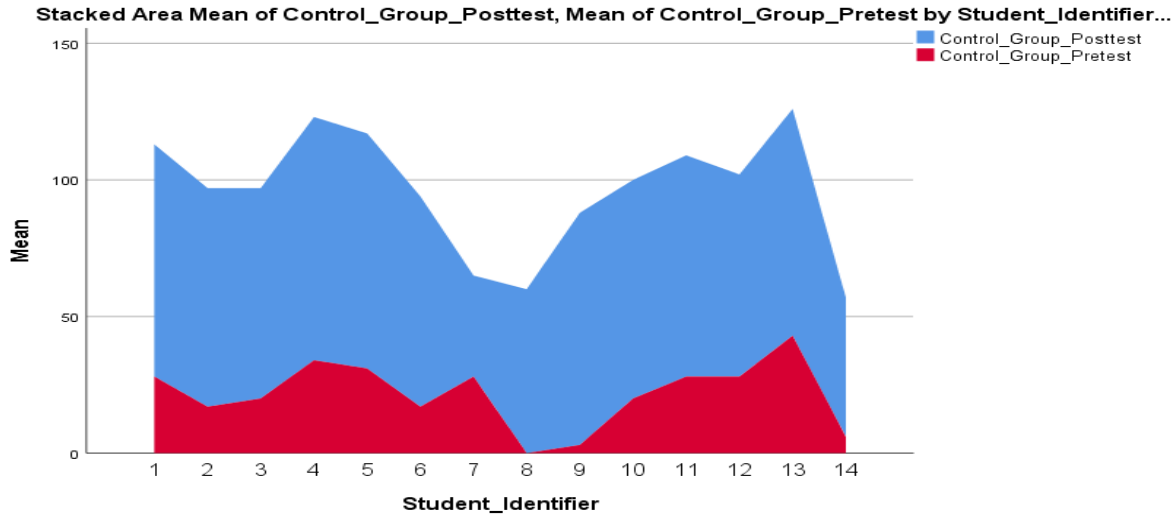

Figure 16 Control Group Stack Chart of Pretest and Posttest Mean

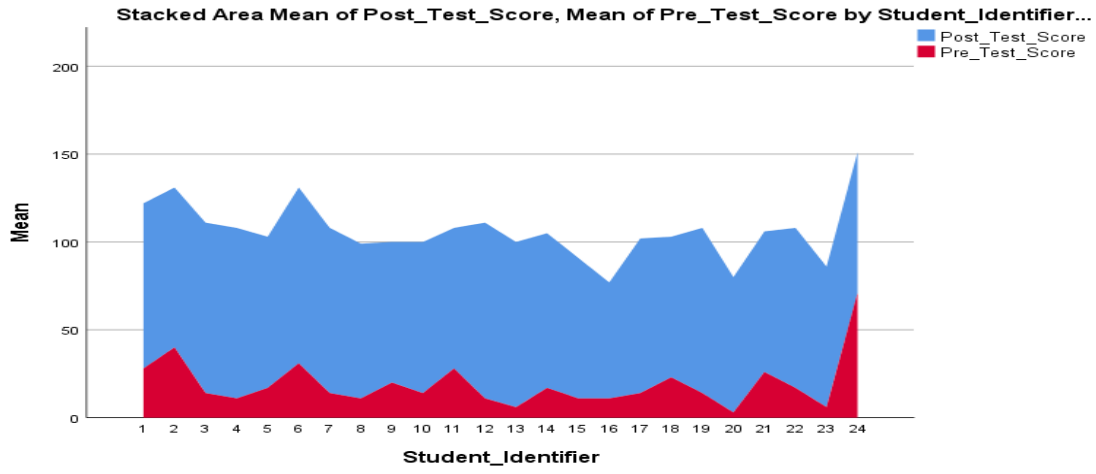

Figure 17 Experimental Group Stack Chart of Pretest and Posttest Mean

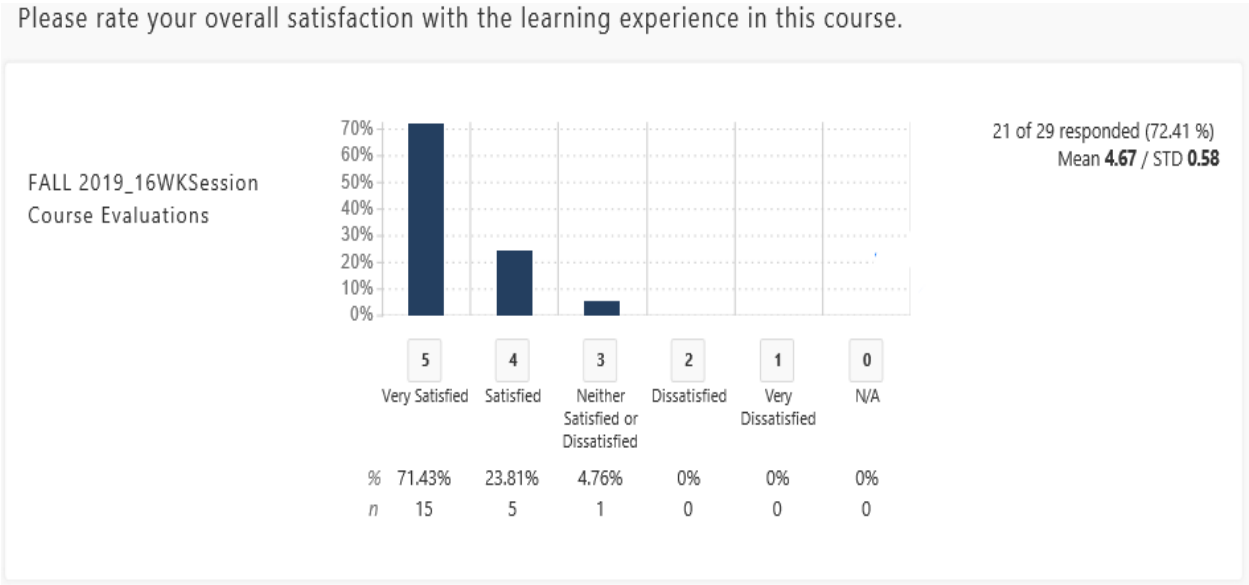

Figure 18 Overall Course Satisfaction

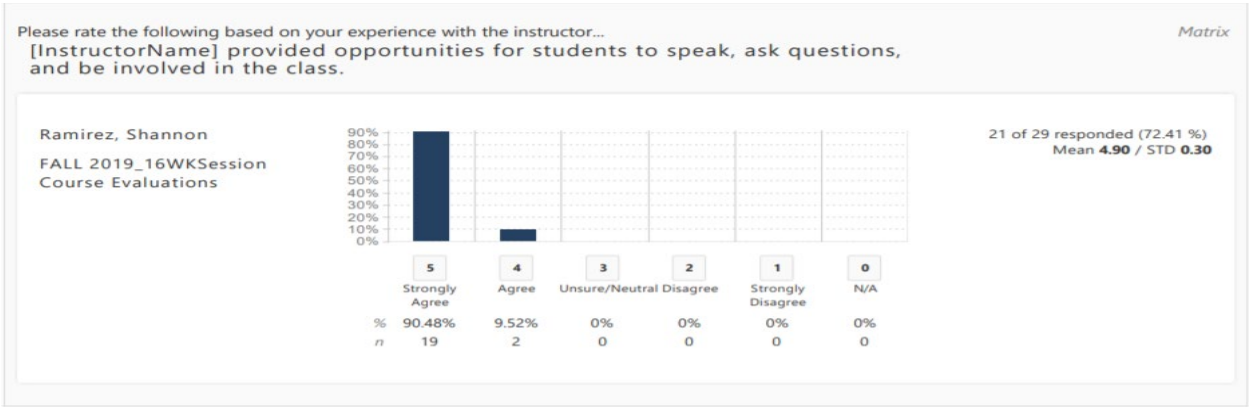

Figure 19: Student Opportunity to Speak, Ask Questions, and be Involved in Class

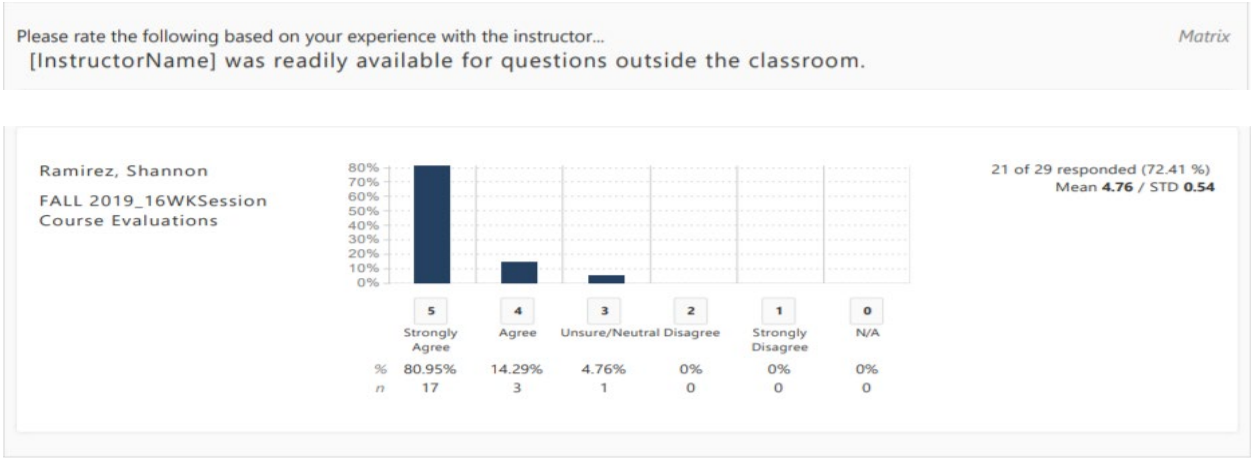

Figure 20: Researcher was Readily Available for Questions Outside the Classroom

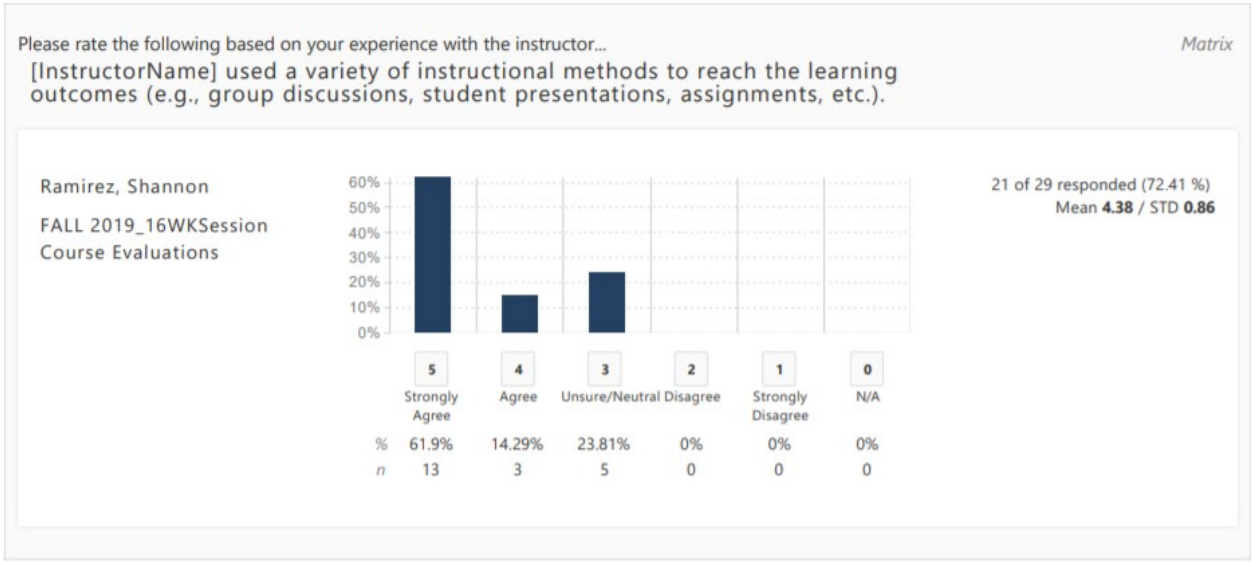

Figure 21Variety of Instructional Methods