DIFFERENCES AMONGST THREE TYPES OF COURSETAKERS IN CAREER AND TECHNICAL EDUCATION FOR ATTENDANCE AND MATH ACHIEVEMENT IN HIGH SCHOOL

by

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DISSERTATION ABSTRACT

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Doctor of Education

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Title: Differences Amongst Three Types of Coursetakers in Career and Technical Education for Attendance and Math Achievement in High School

The purpose of this study was to analyze the differences in attendance and academic achievement amongst three groups of career and technical education (CTE) students. CTE participants were divided into three groups based on levels of CTE participation and CTE occupational focus. The three groups were (a) coursetakers, (b) explorers, and (c) concentrators. The CTE students were enrolled during school years 2010–2011 to 2013–2014 and took the Oregon Assessment of Knowledge and Skills (OAKS) math test in their junior year. The analysis revealed no significant differences amongst the three groups, $p = .437$. The mean attendance for 4 years was nearly 96% for explorers and just over 94% for concentrators and coursetakers. No significant differences were found amongst CTE groups for overall GPA, $p = .675$, and for CTE GPA, $p < .086$. However, differences between overall GPA and CTE GPA were significant, $p < .000$, favoring CTE GPA. Nonsignificant differences on the OAKS math test, $p = .95$, were found for the three groups. This study also revealed that students susceptible to chronic absenteeism were heavily represented amongst the study participants; thus, the results may indicate that CTE encouraged positive peer relationships, enabling a higher attendance rate and allowing the cohort to achieve slightly better GPA and OAKS math

test scores than non-CTE students at this school. In particular, students who were identified as special education, minority, or economically disadvantaged did as well or better in attendance and academic achievement than did their other CTE counterparts.

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CHAPTER I

INTRODUCTION

Oregon high school class of 2013–2014 graduated over 31,000 students with regular diplomas, but there also were 10,500 high school dropouts and 4,000 high school students who did not finish on time (Oregon Department of Education [ODE], 2015). Most students who drop out also have poor attendance. A study by University of Utah researchers found that students who were chronically absent were 7.4 times more likely to drop out of high school (Utah Education Policy Center, 2012). Stone and Lewis (2012) wrote that "studies have found that increased enrollment in CTE courses is associated with lower dropout rates" (p. 9). The question facing Oregon and all other school districts throughout the United States is how to intervene before those students drop out. Based on studies like those of Stone and Lewis, one such intervention Oregon has chosen to fund is Career and Technical Education (CTE) as a way to connect students to learning and to employment opportunities in their communities.

CTE as Part of the Perkins Vocational and Technical Education Act

CTE has been funded federally through the Carl D. Perkins Vocational and Technical Education Act. The Perkins Act was authorized by the federal government and aimed to increase the quality of technical education within the United States in order to benefit the economy. Under the Perkins Act, the term *career and technical education* replaced the old term *vocational education*. The new law also included new requirements for programs of study that linked academic and technical content across secondary and postsecondary education and strengthened local accountability provisions that would ensure continuous program improvement. The Perkins Act provides almost $1.3 billion in

federal support for career and technical education programs in all 50 states, including support for integrated career pathways programs (ODE, 2008).

Additionally, the Perkins Act improved CTE curricula for academic achievement, technical skills achievement, and alignment with postsecondary technical education by focusing on best practices and by including preparation for high-skill, high-wage, and high-demand occupations. The Perkins Act helped to foster four approaches: (a) Tech Prep (combines high school and postsecondary education), (b) career clusters and pathways, (c) youth apprenticeships, and (d) dual enrollment (awarding postsecondary credit for high school CTE coursework) (Castellano, Sundell, Overman, & Aliaga, 2012).

CTE and Oregon

According to Kemple and Snipes (2000), when CTE was offered as part of an Oregon high school curriculum it engaged students who might be inclined to drop out of high school. Funding for CTE in schools was money well spent because more students stayed in school and found meaningful work afterward (Brown, 2002; Israel, Myers, Lamm, & Galindo-Gonzalez, 2012). The CTE Collaboration Task Force, reporting to the 2010 Oregon Legislative Assembly, discovered that for every dollar invested in secondary CTE programs, the state received seven times that amount in added tax revenues. Alternatively, dropouts reduced Oregon's tax revenue by more than $440 million per year from decreased tax revenue, higher Medicaid costs, and incarceration (ODE, 2015a). A recent federally funded study in 11 Oregon high schools showed improvements in math achievement and students' attitudes toward math with CTE enhancements and training for teachers (Pearson, Richardson & Sawyer, 2013). Since 2011, the Oregon legislature has directed $14 million to the high school CTE curriculum.

The ODE worked in tandem with Oregon's Bureau of Labor and Industries to award CTE grants to high schools throughout the state. In total, these CTE grants served more than 10,000 students through approximately 860 secondary programs that collaborated with 600 community college programs (ODE, 2014a).

CTE linked to Oregon graduation. In 2014 Oregon CTE students were 15.5% more likely to graduate high school in 4 years than all students statewide (ODE, 2016). CTE benefited students who have been historically underserved. Figure 1 shows that students participating in CTE had higher graduation rates (across all categories) compared with overall statewide graduation rates in 2014. Among minorities, the categories for Hispanic/Latino, Black/African American, and American Indian/Alaska Native had the highest percentages of graduation improvements, ranging from 21% to 24%. Economically disadvantaged students improved their graduation rate by 19%, and students with disabilities improved by 18%. These groups were highlighted by ODE as benefiting the most from CTE curriculum, while other groups improved between 9% and 14%.

Connecting CTE to Past Educational Practices

The notion that students learn more efficiently through hands-on techniques that involve them with the experience of their own learning goes back centuries. Around 450 B.C. the Chinese teacher and philosopher Confucius remarked, "Tell me, and I will forget. Show me, and I may remember. Involve me, and I will understand." In 1938 John

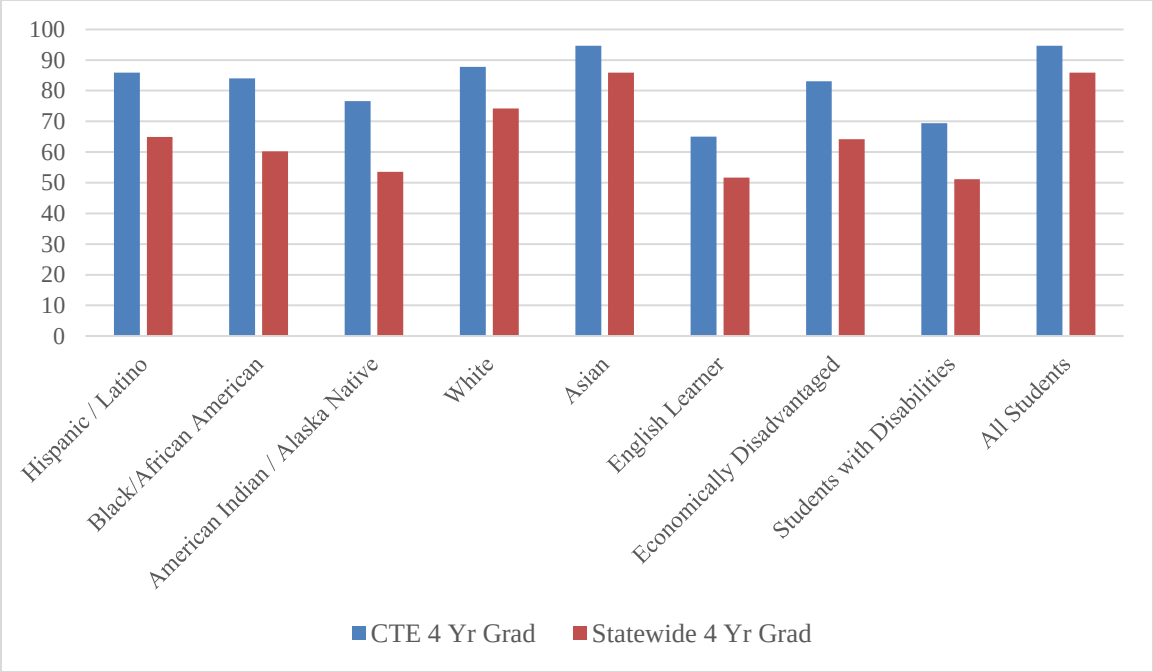

Figure 1. Comparison of Graduation Rate Percentage Between CTE and Statewide

Dewey wrote *Experience and Education*, which advocated for teachers to organize student experiences rather than to simply deliver knowledge. Dewey (1915) was a proponent of hands-on learning, later expressed as experiential education, and in his book, *The School and Society*, he advocated for the educator to cultivate students beyond just a mastery of facts and a disciplining of bodies. Furthermore, Dewey wanted teachers to prepare their students for ethical participation in society.

As students learn, they form relationships with their peers, teachers, family, and the community around them. This idea of focusing on the community and the surrounding environment that students are educated in was researched further by Bronfenbrenner (1993), who created the Ecological Framework Model. Bronfenbrenner hypothesized that to understand human development one must consider the entire social-ecological system in which student growth occurs. Bronfenbrenner's ecological model

consisted of social subsystems that helped to support and guide this growth. Those ecological model subsystems ranged from the microsystem, which referred to the relationship between a developing student and the immediate environment such as school and family (referred to as proximal processes), to a macrosystem that encompassed institutional patterns of culture, such as the economy, customs, and organizational bodies of knowledge. He also wrote about the crucial importance of proximal processes in development because it is by engaging in activities and interactions that students can make sense of their world. The CTE curriculum that I intend to research is a fine fit to Dewey's (1976) experiential education and for Bronfenbrenner's Ecological Framework Model.

Ecological Framework Model

Today's workforce needs skilled workers. Construction, health care, computer technology, manufacturing, and other businesses are finding it difficult to fill skilled entry-level job openings (Castellano, Stone, & Stringfield, 2005). All students have the potential to fill these openings if suitably prepared. An enriched CTE curriculum can engage students to stay in school and connect them to businesses in need of their education and skills (Castellano et al., 2005).

Local education leaders are working more closely with workforce development agencies and businesses through the encouragement of the federal government. The U.S. Department of Education has called for greatly increased funding of CTE programs (Duncan & Dann-Messier, 2012). At the state level, the Oregon Senate passed SB-253, also known as the 40-40-20 Plan, in 2014. This plan proposed that by 2025 40% of Oregonians would have baccalaureate degrees or higher, 40% of Oregonians would have

associate degrees or certificates in skilled occupations, and the remaining 20% would have high school diplomas or an equivalent. An unspoken goal then is zero dropouts by 2025, thereby guiding more students into skilled occupations.

CTE and an ecological framework. The framework for my research is modeled after that of Israel et al. (2012) in their study of CTE students in Florida public schools in which the academic achievement of these students was evaluated within three levels of CTE participation. Israel et al. applied Bronfenbrenner's Ecological Framework Model to their research in order to analyze the student, school, and community attributes. Israel et al. examined data on attendance, discipline, graduation rates, and student demographic information and compared student CTE choices of study, which were then divided into occupational clusters. In addition, Israel et al. described the nesting of students within schools and how schools are nested within the community.

The Ecological Framework Model employed by Israel et al. (2012) is important to my own proposed research in that it was comparable to issues uncovered in my literature review, and it reviewed the levels of students' participation in CTE. Similar to Israel et al., my research looked at student nesting within the occupational clusters and their level of CTE participation. Thus, the study by Israel et al. provided the framework of my proposal. My intent was to research how improvements in student attendance, at three levels of CTE participation, may connect to improved academic achievement (grade point average [GPA] and the Oregon Assessment of Knowledge and Skills [OAKS] math test), thus enabling a more solid commitment to school. Figure 2 is a visual display of the framework model I utilized in my research.

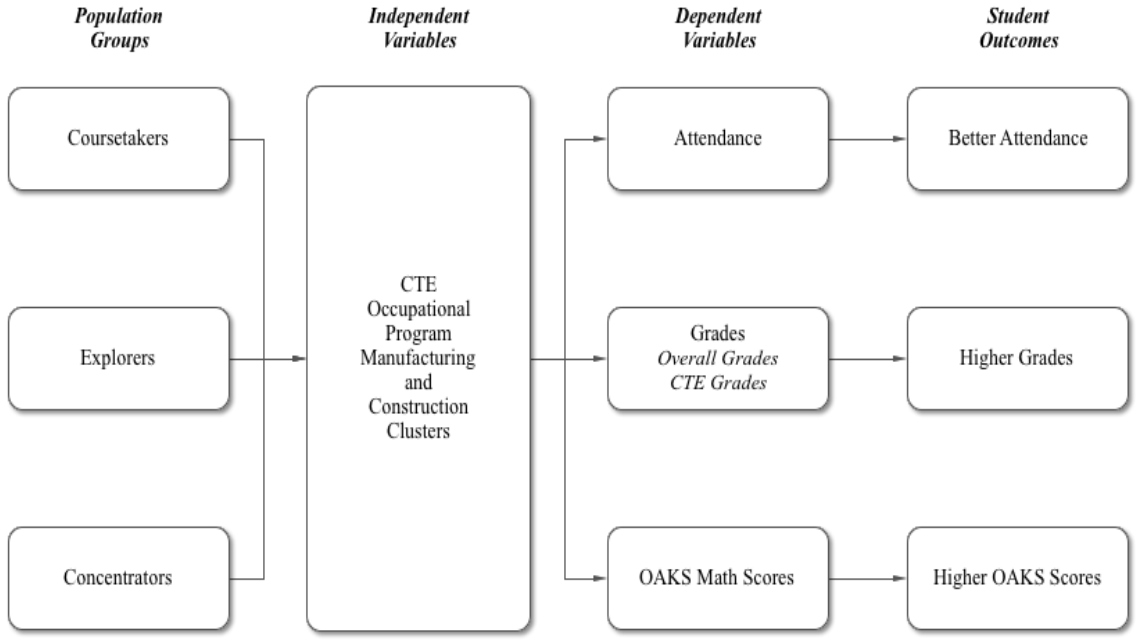

Figure 2. Ecological Theoretical Framework

Literature Review

There were two themes that I observed in the literature I reviewed: how CTE enrollment in high school affects (a) attendance and (b) academic achievement. Attendance is a research gap that I explored in my study as it relates to academic achievement. Attendance and academic achievement are logically correlated variables. One cannot be expected to have a higher GPA and passing marks on the OAKS test if one has poor school attendance. Moreover, I discovered that a research gap exists in how attendance behaviors and academic achievement affect CTE-enrolled groups of students. Rather than analyzing a more global behavior metric, I narrowed my focus to the topic of attendance due to the inadequate amount of research on the relationship between CTE and overall behavior issues.

Academic Achievement and CTE

Academic achievement is the performance outcome of education; it measures the extent to which the student, teacher, and school have achieved their educational goals. These measurements can be teacher records of the student's GPA, test scores, homework completion, and records of any state standardized tests (Castellano et al., 2012).

Educational factors for academic achievement and CTE. A key feature in the reviewed literature was that CTE enabled improvements to students' academic performance. Among the supporting research, Plank's (2001) study revealed significantly improved academic achievement in four test subjects of (a) math, (b) science, (c) reading, and (d) history. Using multiple regression analysis to compare academic achievement among CTE students in 8th grade and their academic achievement in 12th grade, Plank found that the adjusted R^2 in math academic achievement was more than 5% higher for CTE students than for students with a non-CTE course-taking trajectory. Higher academic achievement was also displayed by CTE students in science, reading, and history. Plank also discovered that the lowest dropout rates were found among students with a ratio of three CTE courses to four academic courses. Courses were measured by Carnegie units (1 hr/day, 5 days/week, 24 weeks/school year). Plank measured the math achievement of four groups of students according to academic and CTE concentrations: (a) only academic focus, (b) dual concentrators (academic and CTE), (c) no concentration in academic or CTE, and (d) only CTE focus. He established that the students' level of math academic performance on the eighth grade cognitive test was in the same order, with those taking only academic courses doing best, those taking only CTE courses doing worst, and dual concentrators (academics with CTE) not far behind those who were

taking only academic courses. Plank speculated that dual concentrators sacrificed higher level math classes as a result of taking CTE classes. Israel et al. (2012) noticed significant variability in the number of courses taken for specific CTE programs. On this basis, Israel et al. classified student groups by level of participation in the same way Levesque (2003) had done into three occupational clusters: (a) concentrators, (b) explorers, and (c) coursetakers.

Bae, Gray, and Yeager (2007) researched differences between CTE students' performance on statewide 11th grade math assessment tests to a comparison group of non-CTE students who had similar math proficiency scores in eighth grade. Bae et al. found no statistically significant differences in math test results between the two cohort groups of CTE and non-CTE students. This is important because the CTE students were taking math in the CTE program when they took this state assessment test in 11th grade. This study showed that both cohort groups performed equally well by taking math in CTE classes and by taking math in academic classes. Dougherty (2016) described his results as being counter to the assumption that poorly performing students are tracked into CTE programs. He observed that high math achievers were enrolled more often in three to six CTE courses and that middle achievers were overrepresented at all levels of CTE exposure.

Because all the studies looked at students' academic performance and how much it was enhanced by CTE coursework, a natural comparison is whether CTE-enrolled students also improved in their academic classes through CTE. Castellano, Stringfield, and Stone (2003) showed how CTE improves academic performance in other academic coursework, particularly in mathematics and science. Castellano et al. found that of 128

studies in the CTE literature that they reviewed, just 18 studies included student learning outcomes relating to knowledge or skills achievement.

Geographical factors for academic achievement and CTE. Studies by Castellano et al. (2012) and Loera, Nakamoto, Oh, and Rueda (2013) focused on urban school districts with large non-White student populations, and they encountered significant improvements to academic achievement. None of the studies concentrated specifically on rural settings, though the majority of the studies included both rural and urban students. In Oregon, research included both urban and rural settings, with 88% of the students being White. I also found research within a town or city, within a state, across a region of the United States, and some studies that were nationwide.

Demographic factors for academic achievement and CTE. Loera et al. (2013) targeted an ethnically diverse population of students. Research was also done that gathered academic performance data from questionnaires pulled from national longitudinal studies of thousands of students. Plank (2001) filtered data from the National Education Longitudinal Study of 1988 using two screens: (a) a public school screen and (b) a screen of students with 4 years of transcript data. Stone and Aliaga (2005) looked at ethnic, socioeconomic, and racial differences in GPA and graduation rates among public high schools across the nation. Yettick, Cline, and Young (2012) reviewed academic data from 16 states in the Southeast region of the United States by looking at assessment test results of 67,080 students. In summary, Loera et al., Plank, and Yettick et al. all found strong academic achievements among students enrolled in CTE curriculum. This is important because the sample sizes, the diversity among the students, and the variety of urban and rural settings all help to validate the positive assessment of CTE on academics.

All of the studies that included demographic factors concluded that a CTE curriculum improves student academic performance.

Sample size factors for academic achievement and CTE. The sample sizes of the reviewed studies ranged from small numbers of students in urban schools to very large longitudinal nationwide studies. The majority of the studies reviewed included more than 2,000 students. Stichler (2013) and Pearson et al. (2013) examined population of between 500 and 2,000 students. Loera et al. (2013) and Bae et al. (2007) focused on smaller groups with populations of less than 500 students. The research from all of these studies, large and small, validated the notion that CTE contributes to student academic achievement.

Outcome measures for academic achievement and CTE. The research on academic achievement included some combination of seven measures in their data analysis: (a) assessment tests, (b) teacher and student surveys, (c) coursework, (d) graduation rates, (e) pre- and/or posttesting, (f) GPA, and (g) transcripts. None of the research on academic achievement focused on only a single measure, but none included all seven measures. The most common combination was assessment tests, followed by surveys, coursework, and graduation rates. Three studies chose to include pre- and posttesting, GPA, and transcript data of students in their research.

Concentration of CTE coursework for academic achievement and CTE. Plank (2001) identified a point of too much or too little CTE concentrated coursework. From data in the National Education Longitudinal Study of 1988, he determined that the point at which the ratio is most ideal is three CTE credit hours to every four academic credit hours. Any more CTE coursework or any less will result in reduced academic

achievement and increased numbers of dropouts. Plank concluded that more research is needed with regard to the level of CTE focus, but he found that those students who had enhanced their coursework with CTE curriculum at the ideal ratio benefited the most. Two years after graduation, nearly all of these students were in postsecondary education or working, or both. Not surprisingly, the students at the ideal CTE level with an academic concentration were most likely to be in college full time, and students at the ideal CTE level with a CTE concentration were most likely to be in full-time employment.

Attendance and CTE

In February of last year, ODE published a report on school absenteeism in Oregon (ODE, 2015a). The report disclosed that 20% of all Oregon students are absent 3.5 weeks of school or more and that no other state in the country suffered from as much chronic absenteeism. The studies that I examined on attendance behaviors (Allen, 2010; Brown, 2000; Hagen, 2010; Miguel, 2013) looked specifically at attendance and its relationship with CTE. As Hagen described, attendance in CTE classes contributed to more stable ground for high school students, enabling them to make better decisions in school and in the postsecondary world.

The majority of research on attendance and CTE found strong correlations between CTE and improvements in attendance. This is important because students will not be instructed if they are not in class. The research performed by Miguel (2013) was the only study that did not find a connection between improved attendance and CTE instruction. However, Miguel mentioned small sample size as a limitation that may have

influenced the lack of statistically significant improvements to attendance of CTE students in his study.

Brown (2000) observed modest improvement between the more rigorous CTE Tech Prep and attendance among minority students. For example, African American CTE Tech Prep students had an attendance rate of 94.5% compared with 92.7% for non-CTE African American students. This is similar to the experience of others researching more rigorous academic standards (Pearson et al., 2013; Stone, Alfeld, & Pearson, 2008). Brown perceived evidence that school reform in Texas has made a positive impact on the attendance of minority students in CTE Tech Prep programs.

A study by Burke (2015) of a non-CTE cohort of grade 9 students in Oregon sought to identify the most predictable early indicators of graduating on time. The two best indicators were attendance and GPA.

> These results are consistent with other research, which has found that on-time graduation rates differ for students with different characteristics and that attendance and achievement in grades 8 and 9 have stronger associations with graduation outcomes than do race/ethnicity, special education status, English learner students status, and results of standardized tests of achievement in reading and math. (Burke, 2015, p. 4).

The beneficial influence of teachers and parents that Burke found in his research correlates with the Ecological Framework Model in which experiential learning is acquired through many layers of influence, such as that from peers, teachers, parents, and the community.

Geographical factors for attendance and CTE. The research done by Allen (2010) and Brown (2000) were statewide studies, while the research by Hagen (2010) and by Miguel (2013) targeted a single high school, one for its rural location and the other for its high percentage of minorities. Allen (2010) focused on five school districts in Virginia of which one district was urban, two were suburban, and two were rural.

Allen (2010) observed improvements to attendance in all districts and greatly improved academic performance. Brown's study (2000) included all public high schools throughout Texas. Brown also found higher attendance and lower dropout rates among CTE students and tracked students after high school to find that CTE students transitioned to workplace and college better than did non-CTE students. Academic performance was also higher, particularly for students enrolled in CTE Tech Prep coursework. Although not statewide, Hagen's study (2010) targeted a rural school in Indiana that was primarily attended by White students. Hagen's study noted improved attendance and higher graduation rates for CTE students with improved academic achievement across all student data. Miguel (2013) looked at a very large high school in California with combined campus locations throughout the San José, CA area. Miguel found that students who participated in CTE had improved attendance but were not significantly different from non-CTE students in academic achievement or credit completion. Districts in this area have had a very hard time attracting teachers to all schools but in particular to poorly performing schools because of the high cost of living in this area.

Sample size factors for attendance and CTE. Hagen's study (2010) included less than 500 students. The remaining studies on attendance had more than 2,000 to 3.4

million student records, with a very diverse population of students. Allen (2010) studied five school districts in Virginia with approximately 2,000 CTE students. Brown (2000) researched all public high schools in Texas, with 3.4 million student records of which nearly 250,000 were students involved in Tech Prep. Miguel (2013) studied a regional high school in the San José area with nearly 5,000 students.

Student diversity for attendance and CTE. The settings of the attendance studies reflected the diversity of the students researched. The smallest study, that by Hagen (2010), was conducted in a rural setting in Indiana that is 72% White and 21% Latino. One of the large studies (Miguel, 2013) was conducted in a densely populated urban area in California in which the students were 85% Hispanic, 12% Black, and just 2% White. Allen (2010) combined five school districts located in urban, suburban, and rural communities in Virginia. Brown (2000) researched all public schools in the state of Texas, in which the ethnic breakdown of the 10th to 12th grades averaged 51% White, 32% Hispanic, 14% African American, and 3% Asian–Pacific Islander and Native American combined. Allen did not provide a breakdown of student demographics.

Academic measures for attendance and CTE. The common measures in the reviewed literature were (a) assessment tests, (b) teacher and student surveys, (c) coursework, (d) graduation rates, (e) pre- and posttesting, (f) GPA, and (g) transcript data. All of the studies on attendance focused on the same measures except the measure of pre- and posttesting. Of the remaining six measures, the majority of attendance studies included coursework; half made use of surveys and graduation rates; and GPA, assessment tests, and student transcript data were included in at least one of the studies. The overall use of these measures was higher per attendance study than per academic

achievement study; the attendance studies made use of 2.5 measures per study whereas the academic studies made use of 2.08 measures per study.

Though the link between CTE and academic achievement has been well researched, very little research exists on improving attendance behavior with CTE. Even strict behavior recommendations for changes to regular curriculum have not been effective (National Center for Education Statistics, 2011; Viadero, 2001). Higher academic standards and stricter control of student attendance behavior may not be enough. In Oregon, the average attendance across all schools was 94%, but 15% of students were chronically absent (absent at least 10% of the time), reducing the overall rate of attendance (ODE, 2014b). Other states provided similar results. For example, a study at the University of Utah revealed that the average attendance for all schools in Utah was 95%, but 14% of Utah students were chronically absent (Utah Education Policy Center, 2012). For these reasons my study examined the effect of CTE on (a) attendance behavior and (b) academic achievement in order to add research to this gap.

Study Purpose and Research Questions

The purpose of my study was to identify to what extent three types of CTE groups affect attendance among students at a local high school and the extent to which the level of CTE coursework that students take influences students' academic performance. These relationships within a CTE setting are important to student experiential learning. John Dewey (1938) wrote about the importance of experiential relationships in the classroom and how they form other experiences sequentially, which then propels the student to learn more. When math is experienced in a CTE setting it enables the student to visualize how

a math concept can be applied. The literature review revealed the importance of contextualizing learning in order to apply math concepts to real-world situations.

My research questions involve and examination of quantitative data from students enrolled in two CTE occupational program clusters.

1. Is there a significant difference amongst CTE student groups (coursetakers, explorers, concentrators) for attendance?
2. Is there a significant difference amongst CTE student groups (coursetakers, explorers, concentrators) for (a) overall GPA and (b) CTE GPA?
3. Is there a significant difference between CTE students' overall GPA and their CTE GPA?
4. Is there a significant difference amongst CTE student groups (coursetakers, explorers, concentrators) for OAKS math scores?

My hypothesis was that attendance and academic achievement improve as the level of CTE participation increases. Israel et al. (2012) noted that a student's performance on the standardized science test tended to improve as the student's participation in CTE increased from coursetaker to explorer to concentrator. I predicted improvements to GPA according to the level of student CTE involvement. Based on the study by Israel et al., I also expected to see similar improvements to OAKS test results.

CHAPTER II

METHODS

High school attendance data, GPA (overall and CTE), and OAKS math test results were analyzed for trends among the three CTE student groups. The performance trends were analyzed over the 4-year time span of the study.

In order to assess the effect of CTE on students' attendance and academic achievement, a nonexperimental design was used to predict the changes to these three dependent variables: attendance, GPA, and OAKS test scores in math. The analysis was done on a cohort of 189 students enrolled in CTE coursework during all school years beginning with the 2010–2011 school year and ending with the 2013–2014 school year. The extant data were from two CTE program clusters of construction technology and manufacturing technology. My research cohort was defined as students who earned credits in one of these two CTE program clusters, had an 11th grade OAKS test score in math on record, and had GPA transcript data from the school through the 9th, 10th, 11th, and 12th grades, with 12th grade ending in 2014.

Dependent Variables

Attendance. Attendance records of CTE students were obtained for a local high school. This high school adheres to legal guidelines outlined in Oregon statutes. The high school, located in the Pacific Northwest, had a policy of not marking a student absent unless the student did not make it to the class for the final 10 min of instruction. This issue was alleviated by discipline referrals when it occurred frequently. These referrals were applied to unexcused absences as well as any single unexcused absence of a class. A letter was sent to parents when a student had accumulated absences in three class periods.

The school encouraged the use of prearranged absence forms before the absence so that arrangements for missed lessons and homework could be made with the teachers. When a student fell below 90% attendance, the student was considered at risk for earning credit towards graduation.

Academic achievement—GPA. Overall GPA data were pulled for the cohort from classes in the 9th, 10th, 11th, and 12th grades. Students' CTE grades were also pulled for CTE classes in the 9th, 10th, 11th, and 12th grades. The school generally has a percentage scale for grading with A = 90–100%, B = 80–89%, C = 70–79%, and F < 70%. No D grades were given to students. The grade weighting, in general, was 40% for homework and classwork and 60% for tests, projects, and quizzes.

Academic achievement—OAKS math test. Additional math achievement data came from the OAKS math test. The OAKS test is a required statewide summative assessment given to students in the 11th grade. Summative assessments are typically used for school accountability and program evaluation and to estimate achievement levels in groups of students. The test includes three disciplines of mathematics: (a) algebra, (b) geometry, and (c) statistics. The achievement levels are measured with scale scores that range from 214 (very low) to 251 (exceeding standards).To pass the OAKS math test, a student must reach a score of 236 (meets the standard). Passing the OAKS math test became part of the high school graduation requirements in 2014.

The OAKS test is administered to students primarily in an online format in which test items are selected according to the student's demonstrated ability. Some students opt to take the test using paper and pencil, particularly students that have an individual education plan. Students may take OAKS tests online up to three times during a 7-month

testing window. This testing window begins November 1 and ends May 31. All test items in the OAKS test have been developed by Oregon teachers and refined by Oregon education experts. Beginning in 2014, the primary requirement in OAKS mathematics standards was for students to demonstrate proficiency in applying mathematics in a variety of settings (ODE, 2012).

OAKS reliability. Reliability refers to the consistency, stability, and accuracy that is expected from OAKS test scores. Oregon has conducted several studies of reliability: (a) an analysis of the standard errors of measurement to show that the same overall proficiency is measured with the same reliability regardless of demographic group, (b) a comparison of Technology Enhanced Student Assessment forms from computer-based testing with tests that are done with paper and pencil, (c) a study of classification accuracy across the range of student proficiency, and (d) a study on the precision of cut scores (performance levels) in which a student exceeds, meets, or does not yet meet the grade-level content standards. The overall results provided evidence of reliability within each of the four categories (ODE, 2007).

OAKS validity. The Oregon statewide assessment system employs three methods for measuring the validity of its assessment testing: (a) content validity, (b) concurrent validity, and (c) criterion validity. Content validity is the degree to which an assessment measures the knowledge and skills it was designed to measure. Oregon's content standards describe what a student should know and be able to do. Oregon was one of the first states to participate in the Achieve, Inc., Benchmarking Initiative. This external review praised Oregon's assessments as doing a good job of measuring content and performance but uncovered one deficiency in which math standards could be made more

rigorous as students move into higher grade levels. Overall, Oregon's content standards have been approved by subject matter experts and vetted by representative committees (ODE, 2007).

Concurrent validity is the degree that a test measures what it claims to measure. For example, students who score high on a test should score high on other measures of the same construct. Thus, the extent that two measures address the same latent construct, scores for the same individual student should agree. This is measured by comparing student scores on Oregon's assessment tests with scores on other tests measuring the same construct. Using tests and scales from outside Oregon for comparisons, there was a high correlation among these measures and Oregon's own assessments. In math the correlation of scores in grade 10 was from .78 to .82, which provides strong evidence of concurrent validity (ODE, 2007).

Criterion validity is the extent to which a measure is related to an outcome. In this regard, it measures the connection between a student's performance on state assessment tests and (a) how well the student performs during the first year at college and (b) how likely the student is to meet criteria for employment eligibility. The results provided evidence of students' performance on the OAKS test and their performance in their freshman year of college 2 years later. The concordance results between students meeting state assessment standards and the percentage of students passing preemployment exams and passing preapprentice exams were 74.5% and 78.8%, respectively.

Independent Variable

The independent variable is CTE participation. There are three levels of CTE involvement: (a) coursetakers (low CTE participation, defined as having earned less than

three CTE credits), (b) explorers (moderate exploratory CTE participation, defined as having earned three or more credits in multiple occupational programs), and (c) concentrators (high focused CTE participation, defined as having earned three or more credits in a single occupational program). Two CTE occupational program clusters from the high school were examined: construction technology and manufacturing technology.

The results were not influenced by the study itself because these data already existed. That is, attendance data, GPA, and OAKS math test results cannot be adjusted; these extant data were pulled from student records.

Research Design

I employed a social comparative, nonexperimental design using longitudinal data for CTE-enrolled students during their 9th, 10th, 11th and 12th grades. Following the framework of Israel et al. (2012) I analyzed data on attendance, GPA, and the OAKS math test and how these data differed among three levels of CTE involvement. Data were drawn from students enrolled in construction and manufacturing CTE programs of study.

The CTE curriculum at the high school is the independent variable; students enrolled in CTE courses at the school formed this group. Students not enrolled during all grades during the time span between fall 2010 and spring 2014 were not included. Attendance records were used for the behavioral data. Overall GPA, CTE GPA, and the OAKS math test results were used for the academic achievement data. Another aspect of the analysis on academic achievement was a comparison of the two types of GPA during the specified 4-year span of time.

Setting and Demographics

The high school for this study was located in a working class city. This city prides itself on its roots in the logging industry and employs many workers in construction and manufacturing. The outer boundaries of the city have evolved into business parks that include a large regional medical center, call centers, and a focused development in tourism. This town has roughly 60,000 residents, but it is located next to a city with approximately 160,000 residents.

The high school is part of a medium-size school district. The total population of this school was 1,465, and the sample size was 189 students. The school had a racially diverse student body. According to the state report card for the school year 2013–2014, 84.3% of students attended 90% or more of enrolled days, substantially lower attendance than other schools in the region (ODE, 2014b). Demographic data on these students is summarized in Table 1.

Participants

The participants in my study were students from one high school who attended 9th, 10th, and 11th grades. Only students that had complete records of attendance and transcript data and took the OAKS math assessment test in 11th grade were included. Noble and Sawyer (2002) indicated that test data are more effective than GPA data, particularly when the GPA is between 3.0 and 4.0 (on a 4.0 scale). CTE student attendance data were collected from student records.

The total number of CTE-enrolled students that fulfilled my a priori requirements was 189 students. Because this school is located in a working class area the percentage of economically disadvantaged students was a factor. At this school 62% of all students

were identified as participants in the free-and-reduced meals program, nearly two thirds of the student body. However, for the CTE cohort in my study, the percentage was much larger (86%). Another statistic worth noting is the racial makeup of the school: at the time of my study this school had a student body that was 58% White and 28% Latino/Hispanic. In contrast, the number of other students of color in my study was lower (14%). A summary of these demographic data is presented in Table 1.

Table 1

Demographic Data

Variables		Number (%) of students			
		Concentrator	Explorer	Coursetaker	Total
Gender	Female	24 (36%)	7 (10%)	36 (54%)	67
	Male	32 (26%)	19 (16%)	71 (58%)	122
Hispanic	No	42 (28%)	21 (14%)	89 (58%)	152
	Yes	14 (38%)	5 (13%)	18 (49%)	37
White	No	5 (26%)	4 (21%)	10 (53%)	19
	Yes	51 (30%)	22 (13%)	97 (57%)	170
Poverty	No	4 (15%)	6 (23%)	16 (62%)	26
	Yes	52 (32%)	20 (12%)	91 (56%)	163
Exceptionality	No	53 (32%)	23 (14%)	91 (54%)	167
	Yes	3 (14%)	3 (14%)	16 (72%)	22

Procedure and Data Analysis

I submitted an application to the university institutional review board IRB to have my data collection protocol approved for all students at the high school. The cohort was CTE students who began 9th grade in fall 2010 and attended each grade at the school until spring 2014 and who took the OAKS test in 11th grade. By doing this, I excluded students without a match in following years as the students progressed through the 4 years of high school. Additionally, in order to complete the quantitative analyses, I prepared comparative data tables for the three CTE groups. I also compiled demographic data on all students included in this study.

I applied the appropriate parametric statistics for each question. For Question 1, I used a repeated-measures analysis of variance (rANOVA) to analyze whether CTE student groups (coursetakers, explorers, and concentrators) differed by attendance years (Creswell, 2014). For Question 2a, I utilized an rANOVA to evaluate whether overall GPA differed by CTE groups For Question 2b, I used an ANOVA to investigate whether CTE GPA differed by CTE group. For Question 3, I measured differences between overall GPA and CTE GPA using a *t* test. For Question 4, I utilized an ANOVA to evaluate whether OAKS math test results differed by CTE group.

Study Time Aspect

The nature of this study is longitudinal because it allows for data collection over an extended period of time (Babbie, 2010). A longitudinal view affords the advantage of being able to track changes in data over time (Babbie, 2010).

The student records for review were limited to students who were enrolled in a CTE course during 9th, 10th, 11th, and 12th grades. The timeline for review began with

the 9th grade class enrolled during the 2010–2011 school year and ended with the 12th grade class enrolled during the 2013–2014 school year.

Extant data on attendance were collected from student records at the school district during the specified time span, which was also used for the two types of GPA collected for the 9th to 12th graders.

The OAKS math test is offered to all 11th grade students. The OAKS math test results were collected only for students who attended all four grades during the specified time span (fall 2010 to spring 2014) and were obtained from student records at the district office.

CHAPTER III

RESULTS

Question 1 Results

Question 1 examined whether there was a significant difference amongst CTE student groups for attendance. Table 2 shows attendance patterns by year for the CTE student groups of concentrators, explorers, and coursetakers. The table shows a slight decrease, from 95% to 93%, in attendance for all groups over the 4-year period.

Table 2

Descriptive Statistics for Attendance by Year

Attendance year	*N*	Attendance %	
		M	*SD*
ATT 201011	189	0.954	0.048
ATT 201112	189	0.946	0.067
ATT 201213	189	0.942	0.061
ATT 201314	189	0.933	0.095

Table 3 shows the attendance statistics for CTE student groups (concentrators, explorers, and coursetakers) by school year attended. Attendance decreased for all groups over time. Concentrators and coursetakers started with a mean attendance of 95%, which declined by 2% to a mean attendance of 93% in 12th grade. Explorers started with a slightly higher percentage mean attendance at 96% but only declined by 1% to a mean attendance of 95% in 12th grade.

Table 3

Descriptive Statistics for Attendance by Year by Group

Attendance year	Group	*N*	Attendance %	
			M	*SD*
ATT 201011	Concentrator	56	0.953	0.042
	Explorer	26	0.960	0.043
	Coursetaker	107	0.953	0.052
	Total	189	0.954	0.048
ATT 201112	Concentrator	56	0.950	0.042
	Explorer	26	0.957	0.052
	Coursetaker	107	0.941	0.080
	Total	189	0.946	0.067
ATT 201213	Concentrator	56	0.938	0.065
	Explorer	26	0.958	0.051
	Coursetaker	107	0.940	0.061
	Total	189	0.942	0.061
ATT 201314	Concentrator	56	0.929	0.110
	Explorer	26	0.948	0.085
	Coursetaker	107	0.931	0.090
	Total	189	0.933	0.095

The within-groups tests for attendance indicated whether there was a significant difference for attendance between the different time points. The interaction for

Attendance × Group was not significant, $p = .927$. However, there was a significant main effect for attendance, $p = .025$. Thus, an overall difference by year existed for attendance across time, but not by group. This also was noted in Table 3, where attendance for all groups decreased from start to finish. See Table 4 for complete rANOVA statistics. Interpretation of the partial ε^2 value, that is the effect size, is easiest when the decimal point is visually moved two places to the right in each case. The result can be interpreted as percentages of variance associated with each of the main effects, the interaction, and the error. Starting with attendance, the ε^2 value of .017 indicates that a mere 1.70% of the variance was accounted for by attendance, whereas the Attendance × Group interaction accounted for a negligible percent (0.3%), and the remaining percentage was accounted for by error.

Table 4

Tests of Within-Group Effects for Attendance

Source	Type III SS	*df*	*MS*	*F*	*p*	Partial ε^2
Attendance	0.027	3	0.009	3.126	.025	.017
Attendance × Group	0.005	6	0.001	0.319	.927	.003
Error (attendance)	1.604	558	0.003			

The rANOVA for the between-groups effect serves as a method of interpreting the main effect for the group. Table 5 shows no significant main effect for group, $p =$

.437. The partial ε^2 statistic for group (.009) indicates that only 0.90% of the variance was accounted for by group and the remaining percentage was accounted for by error.

Table 5

Tests of Between-Group Effects for Attendance

Source	Type III SS	*df*	*MS*	*F*	*p*	Partial ε^2
Intercept	491.187	1	491.187	44883.071	.000	.996
Group	0.018	2	0.009	0.833	.437	.009
Error	2.036	186	0.011			

Question 1 Summary

The rANOVA showed no interaction was present between CTE groups and attendance, $p = 0.437$. A main effect for Attendance × Year was significant, $p = 0.025$. However, there was no significant main effect for group. Explorers had mean attendance for 4 years at nearly 96%, whereas concentrators and coursetakers together had just over 94% attendance; however, the effect of explorers on the total mean for the whole group was minimal because they accounted for less than 14% of the total number of participants. Effect size, as calculated by the partial ε^2, showed that a mere 1.70% of the variance was accounted for by attendance, 0.3% by Attendance × Group, and only 0.90% by group.

Question 2 Results

Question 2a. Question 2a examined whether there was a significant difference amongst CTE student groups for overall GPA. Table 6 shows the overall GPA by groups

(concentrators, explorers, and coursetakers). Explorers had the highest overall GPA, followed by coursetakers and then concentrators.

Table 6

Descriptive Statistics for Overall GPA by Group

Group	*N*	GPA	
		M	*SD*
Concentrator	56	2.441	0.816
Explorer	26	2.767	0.722
Coursetaker	107	2.610	0.668

Table 7 shows the overall GPA statistics for CTE student groups (concentrators, explorers, and coursetakers) by school year attended. Overall GPA decreased for all groups during sophomore and junior years but increased in the senior year. The overall GPA for concentrators and explorers both declined by more than 7% from freshmen to sophomore year. The overall GPA for coursetakers also declined from freshmen to sophomore year, but by just 4%. However, the coursetakers' overall GPA dropped another 2.5% in their junior year. In contrast, overall GPA for concentrators and explorers improved by approximately 3% their junior year. In the senior year the overall GPA for all groups improved, but the concentrators group was the only group to achieve their highest overall GPA (2.94) in the senior year compared with 2.91 in their freshmen year.

Table 8 provides within-group statistics for overall GPA. The rANOVA revealed a nonsignificant interaction, $p = 0.532$, for Overall GPA × Group. However, a main effect

Table 7

Descriptive Statistics for Overall GPA by Year by Group

Attendance year	Group	*N*	GPA	
			M	*SD*
GPA 2010.11	Concentrator	56	2.913	0.67
	Explorer	26	2.954	0.577
	Coursetaker	107	2.855	0.684
GPA 2011.12	Concentrator	56	2.704	0.629
	Explorer	26	2.716	0.471
	Coursetaker	107	2.731	0.621
GPA 2012.13	Concentrator	56	2.788	0.639
	Explorer	26	2.785	0.566
	Coursetaker	107	2.659	0.611
GPA 2013.14	Concentrator	56	2.944	0.577
	Explorer	26	2.847	0.584
	Coursetaker	107	2.817	0.639

for overall GPA was found, $p < .000$. The effect size, measured by the partial ε^2 statistic, for overall GPA was .040, which indicated that only 4.00% of the variance was accounted for by group. The partial ε^2 for the nonsignificant interaction was .009, which indicated that only 0.9% of the variance was accounted for by this interaction, and the remaining percentage was accounted for by error.

Table 8

Tests of Within-Group Effects for Overall GPA

Source	Type III SS	*df*	*MS*	*F*	*p*	Partial ε^2
Overall GPA	3.553	3	1.184	7.692	.000	.040
Overall GPA × Group	0.785	6	0.131	0.850	.532	.009
Error (overall GPA)	85.911	558	0.154			

Table 9 provides between-group statistics for overall GPA. The rANOVA revealed a nonsignificant main effect, $p = .675$, for groups. The partial ε^2 statistic for group was .02. Thus, only 2.00% of the variance was accounted for by group and the remaining percentage was accounted for by error.

Table 9

Tests of Between-Group Effects for Overall GPA

Source	Type III SS	*df*	*MS*	*F*	*p*	Partial ε^2
Intercept	4327.303	1	4327.303	3923.560	.000	.910
Group	0.869	2	0.434	0.394	.675	.020
Error	205.140	186	1.103			

Question 2b. Question 2b examined whether there was a significant difference amongst CTE student groups for the cumulative CTE GPA. Table 10 shows the CTE GPA by groups (concentrators, explorers, and coursetakers). Explorers had the highest mean CTE GPA, followed by concentrators and then coursetakers.

Table 10

Descriptive Statistics for CTE GPA by Group

Group	*N*	CTE GPA	
		M	*SD*
Concentrator	56	2.892	0.804
Explorer	26	3.129	0.778
Coursetaker	107	2.730	0.895

Table 11 provides the between-group effects for CTE GPA. The ANOVA revealed a nonsignificant main effect for group, $p = .086$. The partial ε^2 statistic for group was .026. Thus, only 2.60% of the variance was accounted for by group, and the remaining percentage was accounted for by error.

Table 11

Tests of Between-Group Effects for CTE GPA

Source	Type III SS	*df*	*MS*	*F*	*p*	Partial ε^2
Intercept	1166.284	1	1166.284	1600.138	0.000	.896
Group	3.620	2	1.810	2.483	0.086	.026
Error	135.569	186	0.729			

Question 2 Summary

The ANOVA statistics showed no interaction was present between CTE groups for their cumulative Overall GPA. A significant main effect, $p < 0.000$, for cumulative Overall GPA was found, but it only accounted for 4% of the variance. No main effect was found by group ($p = 0.675$), though; and its effect size was small ($\beta = 0.02$). No significant differences for CTE GPA for Group was found, $p < 0.086$, and its effect size also was small ($\beta = 0.26$). On the other hand, the *t*-Test assessing the difference between Overall GPA versus CTE GPA was significant, $p < 0.000$. Its effect size, Cohen's $d = 0.31$, was interpreted as a small effect.

Question 3 Results

Question 3 examined whether there was a significant difference between the cumulative overall GPA and CTE GPA. Table 12 shows that the CTE GPA was higher ($M = 2.833$).

Table 12

Descriptive Statistics for Overall GPA versus CTE GPA

GPA type	*N*	*M*	*SD*
Overall	189	2.581	0.726
CTE	189	2.833	0.860

The *t* test revealed significant differences ($p < .000$) between the two types of GPA. The students' CTE GPA was significantly higher than their overall GPA. Cohen's *d* was 0.31, which is interpreted as a small effect. Although a significant *p* value was

found, there was only a 10% change between the two GPAs. Like the interpretation for Cohen's *d*, the change percentage also was considered small. See Table 13 for complete statistics for CTE GPA.

Table 13

t Test for Overall GPA versus CTE GPA

Measure	*M*	*SD*	*t*	*df*	*p*
Overall GPA vs CTE GPA	0.251	0.625	5.530	188	0.000

Question 3 Summary

The *t* test revealed a significant difference ($p < .000$) between the CTE GPA and the overall GPA among CTE students. The difference favored their CTE GPA. Although there was a significant difference, the Cohen's *d* value of 0.31 was interpreted as a small effect.

Question 4 Results

Question 4 examined whether there was a significant difference amongst the three CTE student groups for OAKS math test scores. Table 14 shows the mean scores of the CTE student groups (concentrators, explorers, and coursetakers) on the OAKS math test. Coursetakers had the highest score, followed by explorers and concentrators, who were not far behind. A requirement to pass the OAKS math test is a score of 236.

Table 14

Descriptive Statistics for OAKS Math Test by Group

Group	*N*	OAKS math score	
		M	*SD*
Concentrator	56	236.839	7.382
Explorer	26	237.077	4.298
Coursetaker	107	237.150	4.962
Total	189	237.048	5.683

See Table 15 for complete statistics for the OAKS math test. The ANOVA for the OAKS math test scores revealed nonsignificant differences, $p = .947$, amongst the three groups. Moreover, the partial ε^2 statistic for group was .001. Thus, approximately 0.10% of the variance was accounted for by group, and the remaining percentage was accounted for by error.

Table 15

Tests of Between-Group Effects for OAKS Math Test

Source	Type III SS	*df*	*MS*	*F*	*p*	Partial ε^2
Intercept	7699969.934	1	7699969.934	235984.958	.000	.999
Group	3.564	2	1.782	0.055	.947	.001
Error	6069.007	186	32.629			

Question Four Summary

The ANOVA showed no interaction between CTE groups and the OAKS math test scores. The main effect for the OAKS math test was nonsignificant, $p = .95$. None of the three groups was more than 0.09% from the group mean score of 237.05. Effect size, as measured by the partial ε^2 statistic, for group was .001, which indicated that approximately 0.10% of the variance was accounted for by group, and the remaining percentage was accounted for by error.

CHAPTER IV

DISCUSSION

Data from the three CTE groups for attendance, GPA, and OAKS test scores on math were examined for significant differences and in relation to previously published research findings. The purpose of reviewing the data was to identify (a) how CTE affected attendance amongst the three groups and (b) how CTE influenced academic achievement amongst the three groups. I employed Bronfenbrenner's Ecological Framework Model to my research in order to situate the CTE students' place in the school and community. My hypothesis, that attendance and academic achievement improves as the level of CTE participation increases, was not supported.

Using my results, I explored why attendance showed a slight decline over time for all three CTE groups, why overall GPA was not significantly different amongst groups, and why the mean overall GPA was highest for explorers. I also analyzed why CTE GPA was higher than overall GPA for the cohort. Although mean scores on the OAKS math section was highest for coursetakers, no significant mean score differences existed amongst the three groups. I also examined how the GPA data compared with Plank's (2001) assertion that explorers will receive significantly higher grades than the other two groups because they are taking more academic classes.

Large differences existed in the number of students within the three CTE groups. About one third (30%) of the 189 students in my sample were concentrators, more than half (56%) were coursetakers, and just 26 students (14%) were explorers. Thus, results disaggregated by groups should be interpreted cautiously. My data showed that the two CTE occupational clusters (construction and manufacturing) were popular among

students at this high school and that CTE classes benefited the cohort compared to non-CTE students. This may be an example of how student nesting occurs within a school, as described in the Ecological Framework Model. Bronfenbrenner (1993) identified how the nesting of student groups occurs within schools and how schools are nested within the community. This is a result of how development occurs through more complex human interactions between individuals and other persons. The nested interactions are progressively more complex between students and parents, then students and peers, then students and teachers, etc. Thus, my research indicates a nested desire among most students who are male and White, do not need special education, and are economically disadvantaged to include a combination of CTE and academic curriculum.

Across all three CTE groups, my demographic evaluation revealed that a majority of them were White males (non-Hispanic) who were economically disadvantaged and were not receiving special education services. Over 30 years ago the federal government began funding programs designed to teach technical skills. Over time programs such as Tech Prep, career pathways, youth apprenticeships, dual enrollments, and Programs of Study have been started in response to the labor market's need for more highly skilled workers (Castellano et al., 2012). In Oregon a large majority of economically disadvantaged students are drawn to these opportunities. The ODE (2016) published *The CTE Achievement Gap,* which showed 83.1% of 4-year CTE graduates were economically disadvantaged compared with 64.2% statewide. The statewide data were very close to the data I found for the cohort in my study high school, with the economically disadvantaged student population at 62%, but my CTE cohort was slightly higher, at 86%. In this regard, my study appears to match the typical statewide patterns

for CTE students. Another way to interpret my findings is that CTE students attained status and positive reinforcement by participating in these CTE programs. Israel et al. (2012) wrote that "status attainment theorists posit that the process by which individuals obtain positions in educational, occupational, and other status hierarchies is a function of the individuals' socioeconomic background and innate ability, as well as mediating factors (e.g., aspirations and significant other influences)" (p. 5). At the high school selected for my research, the Israel et al. model mirrored the nested employment choices within a working class city. While my results mirrored the nested employment choices, groupings students into coursetakers, explorers, and concentrators using Israel et al.'s definition may not have been precise enough. Those groupings should be further evaluated to better delineate these three distinctly different groups. By refining the student groupings, differences may be more discernable. The validation of Israel et al.'s three groups should also be tested. It might be that only two or maybe four groups better distinguish the different student groupings.

Review of Findings Related to the Literature Review

Question 1. My first research question examined whether CTE student groups were significantly different in attendance. Mean attendance dropped for the cohort from 95.4% to 93.3% over the 4 years of data. However, this was not a significant main effect for time, $p = .927$. The mean across the 4-year period was highest for explorers at 95.6%, whereas the other two groups were slightly higher than 94%. A minimal decline in attendance occurred over the 4-year period for all three groups but was less for explorers. Attendance for explorers was very close to 96% the first 3 years and was 94.8% their senior year (see Figure 3 for attendance by CTE groups over the 4-year period).

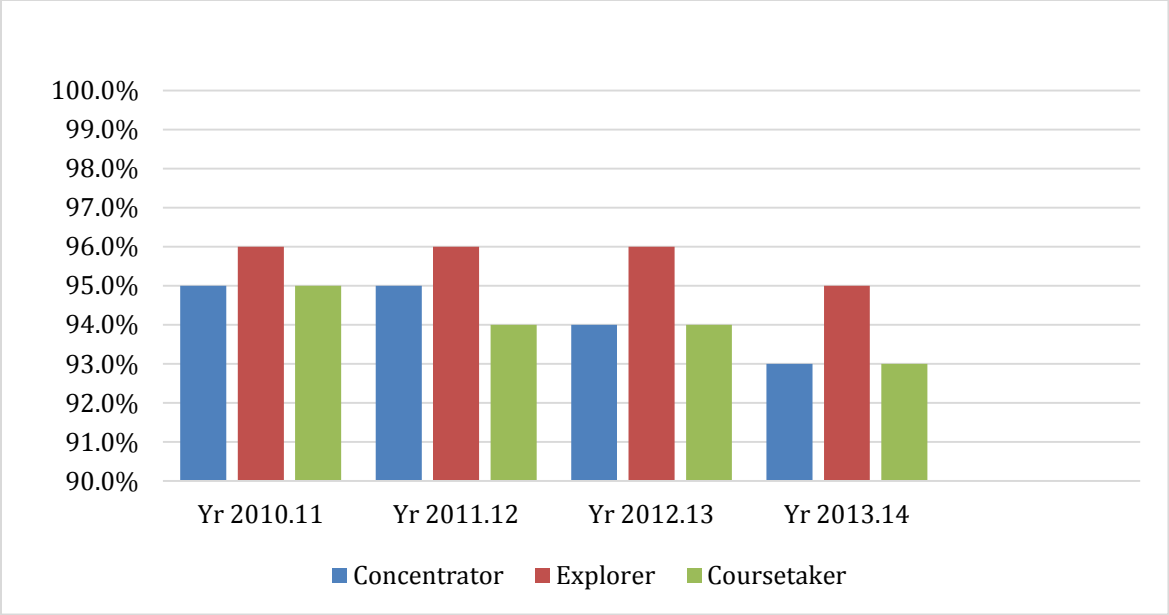

Figure 3. Attendance by Year by Group

Most of the research on attendance described significant improvements for attendance amongst CTE participants (Allen, 2010; Brown, 2000; Hagen, 2010), although Miguel (2013) found no observable impact of CTE participation and attendance. Miguel noted that attendance rates can be greatly impacted by the size of the sample; his study consisted of 170 CTE students, close to the number of CTE student participants (189) in my study.

My research on CTE attendance showed that there was not a significant difference amongst the CTE participant groups or over the time between 9th and 12th grades, p = .927. There was a very slight and consistent decline over time for attendance percentages among all CTE groups from 95.4% during freshmen year to 93.3% during senior year. However, the senior attendance of 93.3% for the cohort was higher than the overall ODE (2015) Report Card reported attendance of 92.6% for the high school and not far from the statewide rate for all students of 94.2%. The state's data show a very similar decline in

attendance rates for all students, from freshmen to senior year, with a 93.8% attendance rate during the freshmen year to an attendance rate during their senior year of 91.1% (ODE, 2014b). My data showed that attendance among the cohort was higher than the statewide attendance rate for all Oregon students by 1.6% for the freshman year and 2.2% for the senior year. Brown (2000) found similar results in her study of CTE students in all public high schools in Texas, in which the mean attendance was roughly 94.4% for CTE students, about 1% higher than that of non-CTE students. In other words, although CTE students did not maintain their freshman attendance percentages, attendance rates of those same CTE students were similar to the overall ODE (2015) reported attendance rates for non-CTE students. Although I cannot conclusively state that CTE caused the CTE students to at least maintain attendance rates similar to their non-CTE peers, it would be beneficial to study this issue for causation.

Another relevant comparison is that within this cohort, 86% of the students were economically disadvantaged, but their attendance rate of 93.5% was slightly higher than the average 93.2% attendance rate for all of Oregon's economically disadvantaged students and also better than their high school 2014 attendance rate of 91.3% for economically disadvantaged students (ODE, 2014b). In 2014, 68% of all students at this high school were identified as economically disadvantaged compared with the statewide rate of 51%. My data may indicate that CTE helps to reduce chronic absenteeism for this particular group of students. Data from Utah on chronic absenteeism revealed that from four predictor groups (racial minority, English language learner, special education, and economically disadvantaged), the students who were economically disadvantaged had the highest predictor rate of chronic absenteeism and were nearly twice as likely to be

chronically absent as were nonmembers of these groups (Utah Education Policy Center, 2012). In Oregon, one in five students are economically disadvantaged, and 19.9% of economically disadvantaged students are identified as chronically absent (ODE, 2014b).

Question 2. My second research question investigated whether significant differences existed amongst CTE student groups for (a) overall GPA and (b) CTE GPA. My overall GPA statistic was somewhat similar to Plank's (2001) findings on explorers, who were shown to have the highest academic achievement with the highest overall GPA at 2.767 and the highest CTE GPA at 3.129. The largest group, coursetakers, had an overall GPA of 2.610, and concentrators had the second highest marks in CTE GPA at 2.892. Plank reasoned that explorers took fewer CTE classes than concentrators, allowing them to take more academic coursework. Plank's data came from the National Education Longitudinal Study of 1988, for which approximately 25,000 students from 1,000 schools across the United States were surveyed. Figure 4 shows the differences between overall GPA for the four measured years.

Figure 4. Mean Overall GPA by Year for All Groups

When analyzing the mean CTE GPA, explorers had the highest at 3.129, concentrators had a mean CTE GPA of 2.892, and coursetakers had a mean CTE GPA of 2.730. Thus, more CTE coursework will improve students' CTE GPA. Figure 5 shows the differences between groups for CTE GPA during all 4 years.

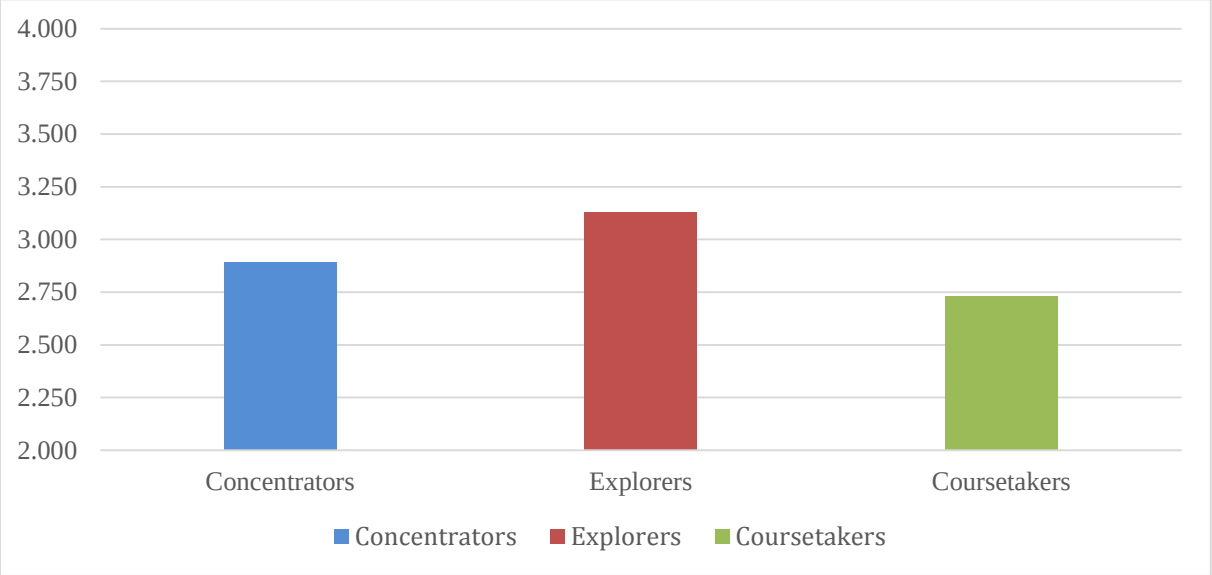

Figure 5. Mean CTE GPA by Group for All 4 Years

My research on CTE GPA showed nonsignificant differences amongst the three groups. In other words, the CTE GPA for all three CTE groups was better than their overall GPA. The overall GPA and the CTE GPA were highest for the explorer group. Burke (2015) connected higher attendance to higher grades and higher grades to higher graduation rates. Thus, CTE seems to encourage interest in students to attend class and become engaged to school, nesting within a community of learning rather than a population of students that may drop out (Israel et al., 2012).

A study on predictive outcomes of ninth graders in Oregon showed that for students with a GPA between 2.0 and 3.0, at least 88% of them would graduate and that the closer the GPA was to 3.0, the higher the rate of graduation. Ninth graders with a

GPA of 3.5 or higher had a 99% graduation rate (Burke, 2015). In 2013–2014 the high school I studied had an overall graduation rate of 73%, and the overall rate for Oregon was 72% (ODE, 2015a). Based on Burke's analysis, about 88% of this cohort would graduate from high school, but the actual percentage would likely be higher because the overall GPA and CTE GPA were closer to 3.0. Student experience in CTE was enhanced because CTE aligns educational content with real life, which results in more meaningful experiences for students. As Castellano et al. (2012) wrote "school needed to become more relevant to the lives of students and ... school and occupation needed to be blended in preparing all students for meaningful citizenship and vocations" (p. 80).

Question 3. My third research question examined whether there was a significant difference between overall GPA and CTE GPA. There was a significant difference between the overall GPA and the CTE GPA, $p = .00$. The overall GPA for the cohort was 2.581, and the CTE GPA for the cohort was 2.833. The caveat here is that CTE GPA is part of the overall GPA, and I could not parse these grades out in the data I received. Thus, CTE GPA inflated the overall GPA in my study. Figure 6 shows the mean overall GPA and the mean CTE GPA for all three groups.

In accordance with my supposition, researchers have shown that CTE improves the overall GPA (Castellano et al., 2012; Miguel, 2013; Stone & Aliaga, 2005). My own data validated this finding. For example, in the first year the concentrator group began with an overall GPA of 2.913 and the explorer group overall GPA was 2.954, but in the senior year the concentrator group overall GPA was 2.944 and the explorer group overall GPA was 2.847. Figure 7 shows a comparison of the overall GPA and CTE GPA for each group.

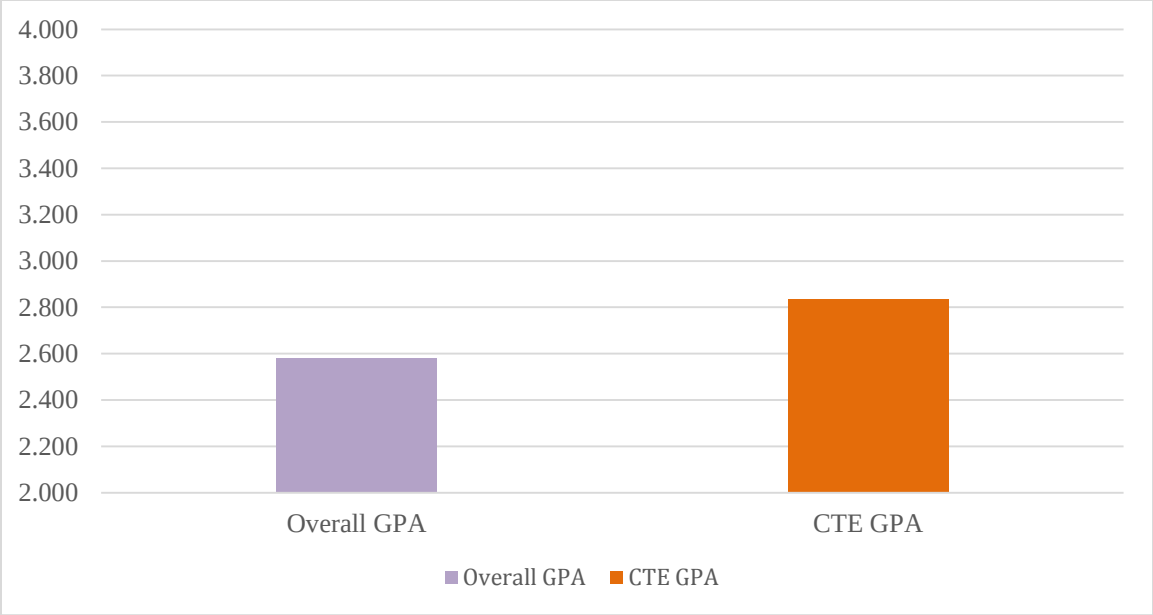

Figure 6. Mean Overall GPA versus Mean CTE GPA for All Groups

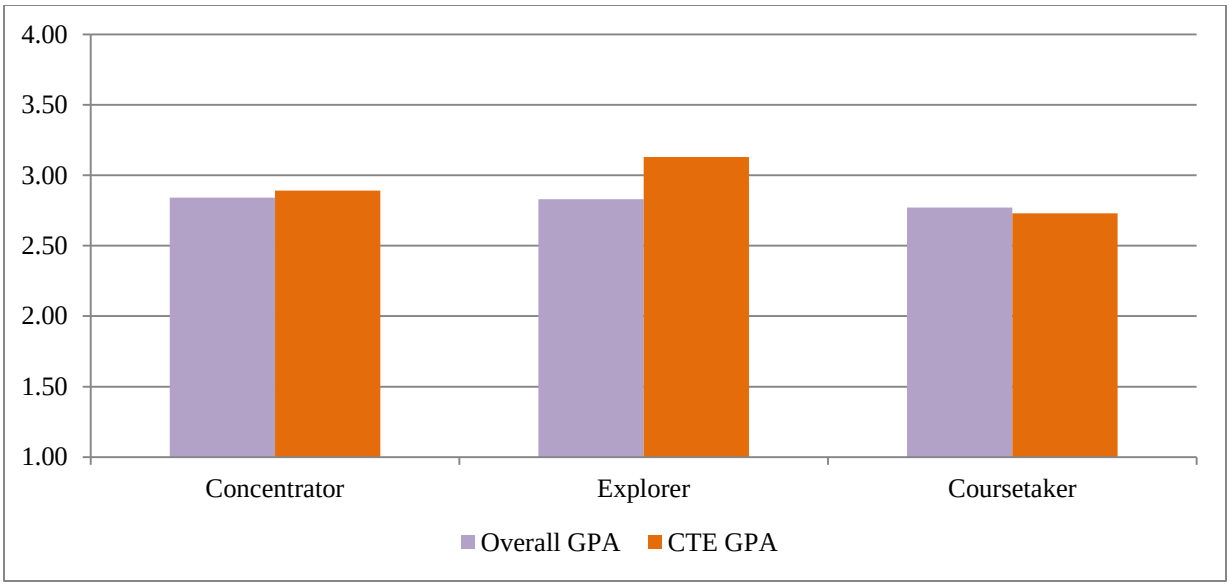

Figure 7. Overall GPA and CTE GPA by Group

There was a difference between the overall GPA of 2.581 and the CTE GPA of 2.833. Castellano et al. (2012) wrote that research has shown mixed results on overall GPA versus CTE GPA, but Stone et al. (2008) found significant academic achievement gains in CTE programs. Hagen (2010) found no statistically significant difference

between overall GPA and CTE GPA.

My research on CTE GPA indicated no significant differences amongst the three groups. However, the lack of differences for GPA across CTE groups can be analyzed from a different perspective. The *t* test revealed a significant difference between CTE GPA and the overall GPA for CTE students, $p = .00$. In other words, the CTE GPA for all three CTE groups was higher than their overall GPA.

Question 4. With my fourth research question I looked at whether significant differences existed in OAKS math scores for the three CTE student groups. Although coursetakers received the highest OAKS math mean score, there was no significant differences amongst all three groups, $p = .95$. Israel et al. (2012) found no clear pattern for improved test results for occupational clusters that did not emphasize science and math, but for the occupational clusters that emphasized agriculture, health, science, technology, engineering, and mathematics they found evidence of improved performance on standardized assessment tests. Plank (2001) discovered the greatest improvement on assessment test scores when a ratio of three CTE classes to four academic classes was maintained; I did not test for this ratio in my research. The results of OAKS math test scores by group are shown in Figure 8.

My research on OAKS test scores in the math section also showed nonsignificant differences amongst the three CTE groups. The OAKS math test is consistently used across all Oregon schools to measure students' learning and is given to all 11th graders regardless of a math ability or level of math class. A limitation, though, is that students not passing are encouraged to retake the test, and there are no data available on repeat test takers.

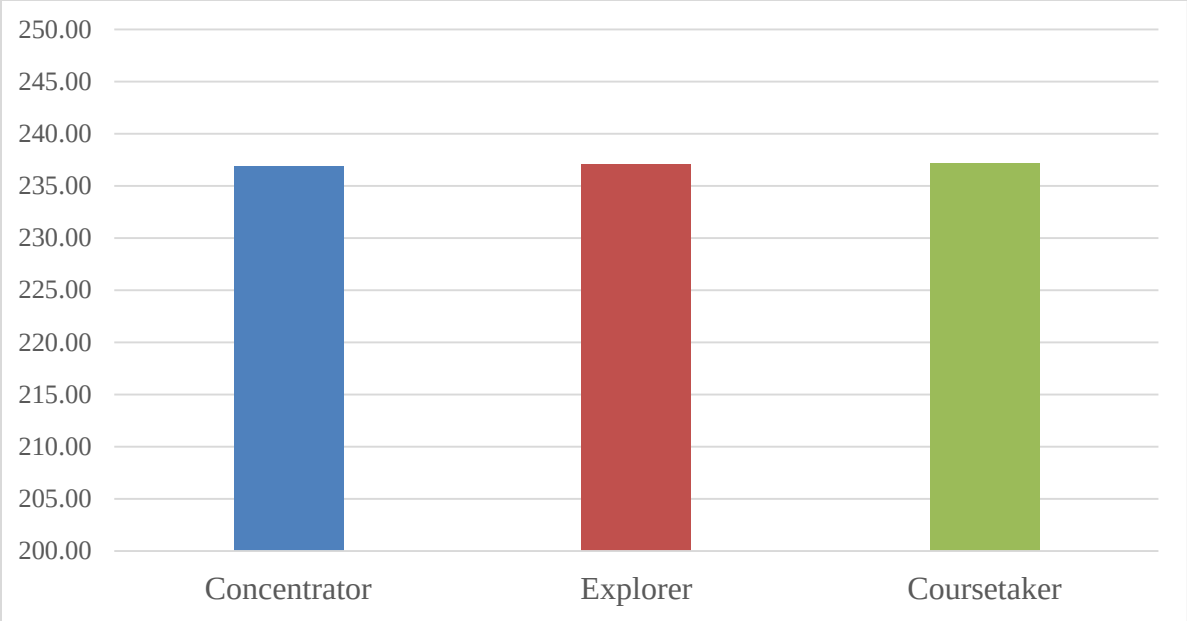

Figure 8. OAKS Math Score by Group

Coursetakers received the highest OAKS math test scores, but again the differences between the three CTE group test results were nonsignificant. All three CTE groups in the cohort had a mean score that met the state's OAKS test standard of 236 in math by scoring as follows: coursetakers, 237.150; explorers, 237.077; concentrators, 236.857. The mean OAKS math score for my CTE cohort was 237.053. This contrasts with the research by Israel et al. (2012), who found that CTE concentrators had significantly higher test scores than did the other two groups, albeit in science. The reason for the contrast may be the science-heavy curriculum within the CTE occupational clusters chosen for the Israel et al. study. In these clusters, science was the primary focus, which naturally improved performance on a science assessment test. Plank's (2001) research on CTE groups found the highest test scores from dual concentrators (equivalent to coursetakers) and the lowest for CTE concentrators. Bozick and Dalton (2013) attained results similar to those of Plank on CTE groups; thus, both studies support my data on

test results. Research by Castellano et al. (2012) on state assessment testing of CTE students did not divide these students into groups, but primarily CTE students performed better on state tests than did their non-CTE peers. My data support this finding; 75% of the CTE cohort in my study passed the OAKS math test compared with 41% for all OAKS math test takers at this high school and 70% statewide. In addition, the students in my cohort who were identified as economically disadvantaged had a mean score of 236.975, and 74% of these students passed the test. Because it appears that CTE encourages higher rates of attendance, the cohort students who passed the OAKS math test had a mean attendance rate of 95.1% compared with those who did not pass, with an attendance rate of 92.2%.

Limitations

Before determining that the intervention of CTE can affect the outcomes of attendance and academic achievement, there are certain factors that are threats to the validity of the conclusions (Creswell, 2014). This section will identify the two threats to validity that are external and internal.

Internal validity threats. Threats to internal validity emerge when the researcher's ability to draw correct inferences from data about the population occur in an experiment (Creswell, 2014). Although a longitudinal study strengthens the time aspect around data, it creates weaknesses to internal validity because the maturity of the participants changed from the 9th to the 12th grade. Participants that dropped out of high school before the beginning of the 11th grade may have affected the mortality rate of the sample because the OAKS math test was given in the 11th grade. My study did not investigate the CTE course taking trajectory of students who dropped out during their

freshmen, sophomore, or junior year. My study was limited to students who attended all 4 years and thus did not include students who participated in CTE but left before completing the study's 4-year period. If student mobility is significant it will increase sample mortality and reduce internal validity of the data (Creswell, 2014). However, including dropouts in my study would have created a more cumbersome design that would have its own internal validity threats.

My student sample was a nonrandom convenience sample because I used extant data from naturally formed groups, that is, the three CTE groups of concentrators, explorers, and coursetakers. By using extant data from these groups there was no control over the calculation for attendance or for the grade calculation that affects the overall GPA and the CTE GPA. Therefore, the accuracy and consistency of extant data from attendance and GPA may have an effect on internal validity of the study (Merriam, 2009).

From the ODE report on absenteeism (2015), the high school I collected data from was shown to have an absenteeism rate of nearly 24%. Hagen (2010) found limitations in his data because of the way that absenteeism is reported. As absenteeism becomes more of an issue in reducing dropout rates, it will be imperative that schools obtain more accurate attendance data.

With academic data, similar issues may exist for reliable GPA records, such as the consistency of school policies and data collection at the district office. Also, the OAKS math test is given at one point in time (11th grade), and this limits the reliability of the exam results because it is not also given during the 9th, 10th, and 12th grades (Kane, 1992; Messick, 1995).

External validity. Threats to external validity happen when there are incorrect inferences from sample data to other persons, settings, and past or future settings (Creswell, 2014). The interaction of the selection and treatment of data fortify the external validity because these are extant data. However, generalizations cannot be drawn to individuals who do not have the characteristics of the participants. Thus, the results of my study cannot be generalized to all high schools, only to a high school with similar demographics and size and with similar CTE class offerings.

Construct validity. A mono-operational bias of construct definition exists with regard to the OAKS math test. I evaluated the math construct in my study using only the OAKS math test. Although I used only a single math test, this becomes more problematic because it assesses only that math construct at a single point in time. The test legitimacy rests on assumptions about the possible outcomes of the test (Kane, 1992). Inclusion of alternative measures such as the ACT WorkKeys, Essential Skills work samples, the SAT, and the ACT tests may add more credibility as opposed to a single test. Also, because students likely were aware of the importance of the test they could have made adjustments to their focus and preparation, affecting the outcome. As Messick (1995) pointed out, this focus may limit the relevancy of the measure because the outcome does not represent an evaluative summary or empirical survey of a student's overall ability. Because the single test represents a singular moment, we cannot generalize what a student's overall ability may be.

Practical Implications: Research to Practice

The practical implications cover three areas: (a) attendance, (b) GPA, and (c) the OAKS math test. The school was located in a working class city. Most of the residents

are low-income workers, and this is mirrored in the CTE student population of my study. Experiential learning may have contributed to student learning because it is hands on. Students are more likely to bond with other students within a network of trust, and this network may have contributed to continued attendance. When students choose to attend class, they increase the odds that they will learn, building competence and confidence. The results of my study show that the CTE students performed as well or better than the rest of the high school students. The most important finding in my study is that students who were expected to do poorly did not: the nonsignificant results were a significantly positive achievement. The high school in my study has found success in attracting low-income students into the two CTE programs I researched (construction technology and manufacturing technology). Other examples of CTE programs for these students can be in health care, computer technology, business programs, and culinary and hospitality arts. By expanding CTE program choices the school provides valuable options to students because an experiential learning environment may increase attendance rates and academic outcomes to economically disadvantaged students.

Attendance. Interest in CTE programs may have contributed to high class attendance, which stayed consistently high within the cohort over time. The Ecological Framework Model may offer an explanation of why this is possible. CTE may allow students to connect to peers, teachers, school, and the community, and this reinforcement encourages a higher level of student understanding as to why they are in school. In this model of human development, Bronfenbrenner (1993) understood that for student growth to occur the entire ecological system needed to be taken into account.

Bishop and Mane (2004) showed that "in country after country, introducing CTE options at the secondary level helped spur expansions of secondary school attendance" (p. 384). Their research revealed that CTE created a positive feedback cycle that induced students to stay in school and move seamlessly into the labor force. The ODE (2016) found that CTE students in the graduating class of 2014 had a graduation rate that was 15.5% higher than that for all Oregon students, and for economically disadvantaged students the difference was even higher: an 18.9% higher graduation rate for CTE students.

Some researchers such as Brown (2000), Hagen (2010), and Miguel (2013) have already shown that CTE is somehow linked to increased attendance for student groups that typically do not have patterns for high attendance rates. I recommend that the high school consider reviewing attendance records of ninth grade students and present CTE as a model of success to the students and parents. By doing this, they can encourage students toward a CTE nest that brings like-minded students together who can be engaged through experiential learning.

GPA. Though I could not separate CTE GPA from overall GPA results in my study, the CTE GPA was higher (M = 2.83) than their overall GPA (M = 2.58). Logically, one could argue that CTE students' overall GPA would have been even lower if their CTE GPA had not been included, creating an even greater and more significant difference. This may indicate that CTE has helped students to become more engaged and, as a result, has increased the possibility that they earn higher grades.

An option for the high school may be to reward dual credits to students enrolled in CTE programs of study. Dual credits are given for CTE study and for a core academic

subject when a student enrolls in a CTE class. This approach will reward students for their CTE participation and encourage others to enroll in CTE programs of study. The dual credit option, also called credit equivalency, is currently a topic under discussion at the ODE. By applying academic and technical skills to real-world activities, students might be more motivated to learn and will thereby achieve a higher GPA as a result.

OAKS math test. Although my research indicated no differences amongst CTE student groups, it also showed that participating in CTE did not negatively affect students' math test scores. It is important to note that the mean scores on the OAKS math section for all three groups of this cohort were above the threshold for passing the test (ODE, 2015b). I also found that students who had a passing mark on the test also had a rate of attendance that was almost 3% higher than that for students not passing the test.

The requirement to pass the OAKS math test is 236, and the mean for all CTE students in this cohort was 237.053. ODE does not publish the state or high school mean scores, only percentiles of students passing or not passing. Additionally, there is no information published by ODE that shows a CTE category of performance on the OAKS math test. Within my cohort, 74.6% passed this test, whereas only 59.4% of all students at the high school passed. Just 56.5% of all the economically disadvantaged students at this high school passed the test, but 74.8% of the economically disadvantaged students in the cohort passed. These results add a reasonable link indicating that the experiential learning environment in a CTE class has helped economically disadvantaged students to apply their math knowledge on standardized math tests.

The process of math learning in a CTE class is different from that found in a traditional math class. A traditional math class generally uses a passive approach to math

learning and does not necessarily engage students as active problem solvers as much as in a CTE class. Math taught in a CTE class employs hands-on learning of abstract math concepts. CTE students may retain math concepts better than other students who learn passively. Currently, Oregon higher education is working with the ODE to update the high school math requirements so that advanced algebra (Algebra 2) is not required for all students but that some students can choose to take a CTE math-enhanced course that aligns with their CTE interests. CTE math seems to have benefitted students in the cohort, and the difference between the performance on the OAKS math test for CTE students and the rest of the students at this high school indicates that CTE may lead to higher marks. This high school should encourage more CTE math participation so that more students go beyond mere memorization of math facts and have the opportunity to apply math to real-world work that they are interested in.

Future Research

Expand study to all CTE programs. My study used two CTE programs of study, construction technology and manufacturing technology. Both programs lead to well-paid jobs that currently have a high demand for workers (Lane Workforce Partnership, 2015). There are other high school CTE programs in technology and health care that require a more demanding mathematics skill set, and it would be interesting to see how these types of programs compare with construction and manufacturing. This high school has additional CTE programs of study that could allow additional comparisons between occupational clusters, thus allowing for more demographic research, because the majority of CTE students in my study were White and male.

Compare CTE across geographical areas. I focused on one high school in a working class city, and comparing these results to a more urban high school may have merit. Studying CTE occupational programs that align to the community needs would conform to the Ecological Framework Model used in my research. For example, manufacturing technology in a smaller working class city compared with Tech Prep CTE programs in schools in the larger cities of Beaverton or Portland could be done. This comparison would also allow for follow-up research to be done several years after these students graduate from high school. The data would be enriched by comparing the regional employment opportunities that encircle each high school's CTE program offerings, whether the curriculum offered is in line with those employment opportunities, and whether there is more interest in CTE when the courses are more connected with the community's workforce needs.

Seek to understand CTE participation. I believe that a qualitative study that interviews students as to why they are drawn to certain types of CTE programs of study would be valuable. Students could be interviewed using a questionnaire that represents the aspects of the Ecological Framework Model. For example, how do peer and teacher relationships allow them to improve their attendance and advance their academic performance? The connections may be different for students with peers and students with teachers, why students engage in their schools, and how students become participating citizens of their community. Hearing this information from the students' perspective may allow for improvements to curriculum. This information can be compared with variations according to gender, race, socioeconomic status, etc., and may allow for changes to how the curriculum is introduced and taught. Also, interviews of non-CTE students about

what may attract them to enroll in CTE coursework could improve the dynamics of peer-to-peer relationships and broaden the benefit CTE has to offer to more students.

Extension of My Research

The majority of my research findings were nonsignificant amongst CTE groups within the cohort across grades and the large-scale math test. However, there are possible suggestions within my data that this high school's CTE manufacturing and construction strands benefitted certain student groups more than others. Within my study the CTE cohort was 65% male and 86% economically disadvantaged. Also, 10% were minority and 12% received special education services. Thus, expansion of my research could further explore three areas: (a) students in special education, (b) minority students, and (c) economically disadvantaged students.

Students in special education. Few researchers have looked at attracting students in special education to CTE programs, and this was not a focus of my research. However, I found that at this high school 12% of the overall population were special education students, and the same percentage of my CTE cohort were identified as special education students. A study by the Utah Education Policy Center (2012) on chronic absenteeism found a 10% dropout rate among special education students (a lower percentage than for other groups) but also found that students in special education were the second highest predictor group for chronic absenteeism, behind economically disadvantaged students.

In my study, the attendance of special education CTE participants was in line with the rest of the cohort, at 93.5%. The overall GPA for this group was 2.679, and the CTE GPA was 2.770. The OAKS math mean test result for these students was 237.182, slightly better than the cohort's mean test result of 237.053. Although not a focus of my

research, these results suggest that CTE participation may contribute to positive outcomes for special education students. In Dougherty's (2016) study 12% of all students were special education students, but 14% were taking seven or more CTE courses. He indicated that educators were directing special education students into CTE because of the positive outcomes. For these reasons, the high school in my study might find benefits from guiding special education students into CTE programs. For example, special education students should meet at least once with a career counselor to get matched to a CTE occupational interest, which may become part of the transition plan required in their individual educational plan. Using CTE classes, student with disabilities could identify a career path that followed their preference because CTE occupational fields are so wide and varied. For example, students with disabilities could choose from occupational fields in health care, business, culinary arts, graphic design, etc., which are all in demand and generate family levels of income.

Minority students. Prior studies have looked at attracting minorities to CTE programs and found improved academic achievement (Castellano et al., 2012; Loera et al., 2013). The history of placing minorities into jobs of hard labor through cheap labor and discrimination has been well documented, and some of that mentality continues even today (Gordon, 2014). In my study, underrepresented groups made up 28% of the overall student population at this school, and less than 20% were part of my CTE cohort. The two occupational clusters in my study were manufacturing and construction, and this may have affected the demographic statistic of the cohort because the majority of vocational education teachers were White males, and well-paid manufacturing and construction jobs have mostly gone to White males (Gordon, 2014).

It is difficult to direct students of color into some CTE programs because of the risk of racial profiling. On the other hand, my study shows that CTE improves outcomes for attendance and academic achievement among all students. CTE programs of study have moved away from vocational education to a broader spectrum of choices, and these may promote training for high-wage and high-demand careers. Dougherty (2016) wrote that modern CTE programs can prepare students for careers in rapidly expanding industries and can lead to higher education. Following this concept, the high school in my study should look at expanding CTE program offerings that correspond to future high-wage and high-demand careers by surveying minority community groups and businesses. Currently in Oregon high-demand careers can be found in health care and are not just limited to hands-on patient care but include medical health care management. Computer system analyst positions also are in high demand in Oregon.

Economically disadvantaged students. Dougherty (2016) showed that CTE provided the greatest benefit to children from low-income families. With regard to economically disadvantaged students, research on chronic absenteeism showed that being poor was the highest predictor of chronic absenteeism, and students who were chronically absent were 7.4 times more likely to drop out of school (Utah Education Policy Center, 2012). All but 26 of the 189 students in my study were economically disadvantaged, yet the rate of attendance for all three groups was higher than the overall attendance rate for the school (ODE, 2014b), paralleling Dougherty's finding on low-income students. In my study, economically disadvantaged students exhibited progressively higher participation at the concentrator and coursetaker levels. There may be an opportunity for the school to guide economically disadvantaged students from the coursetaker group (the largest

group) to concentrators, as this group may benefit from counselor assistance that may not be received at home. This type of focus may enable and inspire further education after high school in careers of their choice. See Table 16 for participation percentages of economically disadvantaged students.

Table 16

Percentage of Participation for Economically Disadvantaged Students by Group

Group	Total number of students	Number of economically disadvantaged students	Percentage of total
Concentrator	56	52	93%
Explorer	26	20	77%
Coursetaker	107	91	85%
Totals	189	163	86%

Conclusion

I employed Bronfenbrenner's (1993) Ecological Framework Model to my research in order to situate the place of CTE students among peers and in the school. The framework for this study was modeled after Israel et al.'s (2012) research that evaluated students according to three levels of CTE participation. From the results, I described my rationalization as to why attendance showed a slight decline over time for all three CTE groups. I then analyzed why overall GPA was not significantly different amongst the groups and why CTE GPA was higher than overall GPA for the cohort. I showed that mean scores on the OAKS math test were not significantly different amongst the three groups. Although the majority of findings were nonsignificant, there was evidence that

CTE improves attendance, GPA, and OAKS math test scores for students who are at risk for chronic absenteeism and poor academic achievement. Students who were identified as special education, minority, or economically disadvantaged did as well or better than students who were not in any of these groups. Dewey (1976) stressed the importance of experiential hands-on learning in which some students are better able to apply contextualized learning in real-world situations. The findings in my study affirm that CTE can benefit students who learn experientially, improving attendance through peer engagement and achieving academic success through confidence.

REFERENCES CITED

Allen, K. (2010). The perceptions of career and technical education (CTE) teachers on the influence of CTE on student education. Blacksburg, VA: Virginia Polytechnic Institute and State University.

Babbie, E. (2010). The practice of social research. Belmont, CA: Wadsworth.

Bae, S. H., Gray, K., & Yeager, G. (2007). A retrospective cohort comparison of career and technical education participants and non-participants on a state-mandated proficiency test. *Career and Technical Education Research, 32*(1), 9–22.

Bishop, J. H., & Mane, F. (2004). The impacts of career-technical education on high school labor market success. *Economics of Education Review, 23*(4), 381–402.

Bozick, R., & Dalton, B. (2013). Balancing career and technical education with academic coursework the consequences for mathematics achievement in high school. *Educational Evaluation and Policy Analysis, 35*(2), 123–138.

Bronfenbrenner, U. (1993). Ecological models of human development. In M. Gauvain & M. Cole (Eds.), *Readings on the development of children* (2nd ed., pp. 37–43). New York, NY: Freeman.

Brown, C. (2000). A comparison of selected outcomes of secondary tech prep participants and non-participants in Texas. *Journal of Vocational Education Research, 25*(3), 273–295.

Burke, A. (2015). Early identification of high school graduation outcomes in Oregon leadership network schools. Regional Education Laboratory at Education Northwest. Retrieved from http://ies.ed.gov/ncee/edlabs/regions/northwest/pdf/REL_2015079.pdf

Castellano, M., Stringfield, S., & Stone, J. (2003). Secondary career and technical education and comprehensive school reform: Implications for research and practice. *Review of Educational Research, 73*(2), 231–272.

Castellano, M., Stone, J., & Stringfield, S. (2005). Earning industry-recognized credentials in high school: Exploring research and policy issues. *Journal of Career and Technical Education, 21*(2), 7–34.

Castellano, M., Sundell, K., Overman, L., & Aliaga, O. (2012). Do career and technical education programs of study improve student achievement? Preliminary analyses from a rigorous longitudinal study. *International Journal of Educational Reform, 21*(2), 98–118.

Creswell, J. (2014). Research design: Qualitative, quantitative, and mixed methods approaches. Thousand Oaks, CA: Sage.

Dewey, J. (1915). The school and society. Chicago, IL: University of Chicago Press.

Dewey, J. (1938). Experience and education. New York, NY: Collier Books.

Dougherty, M., (2016). Career and technical education in high school: Does it improve student outcomes? Washington, DC: Thomas B. Fordham Institute.

Duncan, A., & Dann-Messier, B. (2012). Investing in America's future: A blueprint for transforming career and technical education. Washington, DC: U.S. Department of Education and the Office of Vocational and Adult Education.

Gordon, H. (2014). The history and growth of career and technical education in America. Long Grove, IL: Waveland Press.

Hagen, S. (2010). The effects of mandated career and technical education (CTE) on the college and career preparation of high school students. *West Lafayette, IN: Purdue University.*

Israel, G., Myers, B., Lamm, A., & Galindo-Gonzalez, S. (2012). CTE students and science achievement: Does type of coursework and occupational cluster matter? *Career and Technical Education Research, 37*(1), 3–20.

Kane, M. (1992). An argument-based approach to validity. *Psychological Bulletin, 112*(3), 527–535.

Kemple, J., & Snipes, J. (2000). Career academies: Impacts on students' engagement and performance in high school. New York, NY: Manpower Demonstration Research.

Lane Workforce Partnership. (2015). Labor trends in Lane county. Retrieved from http://www.laneworkforce.org/labor-trends/lane-county-employment/

Levesque, K. (2003) Trends in high school vocational/technical course taking: 1982-1998. Statistical Analysis Report (No. NCES 2003-025. Washington, DC: National Center for Education Statistics.

Loera, G., Nakamoto, J., Oh, Y. J., & Rueda, R. (2013). Factors that promote motivation and academic engagement in a career technical education context. *Career and Technical Education Research, 38*(3), 173–190.

Merriam, S. (2009). Qualitative research. San Francisco, CA: John Wiley & Sons.

Messick, S. (1995). Validity of psychological assessment: Validation of inferences from persons' responses and performances as scientific inquiry into score meaning. *American Psychologist*, *50*(9), 741–749.

Miguel, M. (2013). The effects of career technical education on student outcomes in a high-minority urban school district. Ann Arbor, MI: ProQuest.

National Center for Education Statistics. (2011). Trends in high school dropout and completion rates in the United States: 1972–2009. Retrieved from http://nces.ed.gov/pubs2012/2012006.pdf

Noble, J. & Sawyer, R. (2002). Predicting different levels of academic success in college using high school GPA and ACT. composite score. Iowa City, IA: ACT Research Report Series.

Oregon Department of Education. (2007). Technical manuals volume 4. Testing—student assessment. Retrieved from http://www.ode.state.or.us/search/page/?=1305

Oregon Department of Education. (2008). The Oregon career and technical education study. Retrieved from http://www.ode.state.or.us/teachlearn/pte/oregonctereport.pdf

Oregon Department of Education. (2012). 2012-2013 math assessment update. Retrieved from http://www.ode.state.or.us/wma/teachlearn/testing/admin/math_update_201213.pdf

Oregon Department of Education. (2014a). Major investment in career technical education will expand hands-on learning to 140 schools. Retrieved from https://www.oregon.gov/boli/Audio%20and%20video/1_7_14_Major%20investment%20in%20career%20technical%20education%20will%20expand%20hands-on%20learning%20to%20140%20schools.pdf

Oregon Department of Education. (2014b). State level attendance and chronic absenteeism rates 2013-14. Accountability Measures. Retrieved from http://www.ode.state.or.us/search/page/?id=471

Oregon Department of Education. (2015a). Education leaders reflect on grad rates, reaffirm commitment to long-term system reforms. Announcements. Retrieved from http://www.ode.state.or.us/news/announcements/announcement.aspx?ID=9624

Oregon Department of Education. (2015b). ODE report card download. Retrieved from http://www.ode.state.or.us/data/reportcard/reports.aspx

Oregon Department of Education. (2016). The CTE achievement gap: CTE students are 15.5% more likely to graduate high school. Retrieved from http://www.ode.state.or.us/superintendent/priorities/1.6_2-cte-students-graduate-at-higher-rates-%281%29.pdf

Pearson, D., Richardson, G. B., & Sawyer, J. M. (2013). The Oregon Applied Academics Project: Final report. Louisville, KY: National Research Center for Career and Technical Education.

Plank, S. (2001). Career and technical education in the balance: An analysis of high school persistence, academic achievement, and postsecondary destinations. Atlanta, GA: National Research Center for Career and Technical Education.

Stichler, J. C. (2013). The impact of career and technical education on the achievement of at risk students. Houston, TX: University of Houston.

Stone, J., Alfeld, C., & Pearson, D. (2008). Rigor and relevance: Enhancing high school students' math skills through career and technical education. *American Educational Research Journal, 45*(3), 767–795.

Stone, J., & Aliaga, O. (2005). Career and technical education and school-to-work at the end of the 20th century: Participation and outcomes. *Career and Technical Education Research, 30*(2), 125–144.

Stone, J., & Lewis, M. (2012). College and career ready in the 21st century: Making high school matter. New York, NY: Teachers College Press.

Utah Education Policy Center. (2012). Research brief: chronic absenteeism. Retrieved from http://www.utahdataalliance.org/downloads/ChronicAbsenteeismResearchBrief.pdf

Viadero, D. (2001). Smaller is better: Studies show benefits of intimate settings, but schools continue to grow. *Education Week*, *21*(13), 28-29.

Yettick, H., Cline, F., & Young, J. (2012). Dual goals: The academic achievement of college prep students with career majors. Boulder, CO: University of Colorado.

ADDITIONAL SOURCES

Aragon, S., Alfeld, C., & Hansen, D. (2013). Benefits of career and technical student organizations' on female and racial minority students' psychosocial and achievement outcomes. *Career and Technical Education Research, 38*(2), 105–124.

Castellano, M., Stone, J., & Stringfield, S. (2002). Career and technical education reforms and comprehensive school reforms in high schools: Their impact on education outcomes for at-risk youth. *The Highlight Zone: Research at Work, 8,* 1–8.

Conley, D., Beach, P., Thier, M., Lench, S., & Chadwick, K. (2014). Measures for a college and career indicator: Career preparedness assessments. Eugene, OR: Educational Policy Improvement Center.

Ernst, J., & Moye, J. (2013). Social adjustment of at-risk technology education students. *Journal of Technical Education, 24*(2), 2–13.

Furlong, M., Whipple, A., St. Jean, G., Simental, J., Soliz, A., & Punthuna, S. (2003). Multiple contexts of school engagement: Moving toward a unifying framework for educational research and practice. *The California School Psychologist, 8,* 99–113.

Gentry, M., Peters, S., & Mann, R. (2007). Differences between general and talented students' perceptions of their career and technical education experiences compared to their traditional high school experiences. *Journal of Advanced Academics, 18*(3), 372–401.

Kelly, S., & Price, H. (2009). Vocational education: A clean slate for disengaged students? *Social Science Research, 38,* 810–825.

Maxwell, J. (2012). Qualitative research design: An interactive approach. Los Angeles, CA: Sage.

Oregon Legislature, Joint Special Committee on Public Education Appropriation. (2013). Report on adequacy of public education funding, as required by article VIII, section 8, of the Oregon constitution. Retrieved from https://www.oregonlegislature.gov/citizen_engagement/Reports/educationFunding_2013.

Packard, B., Leach, M., Ruiz, Y., Nelson, C., & DiCocco, H. (2012). School-to-work transition of career and technical education graduates. *The Career Development Quarterly*, 60, 134–144.

Sinclair, M., Christenson, S., Lehr, C., & Anderson, A. (2003). Facilitating student engagement: Lessons learned from check and connect longitudinal studies. *The California School Psychologist, 8,* 29–41.

Stern, D., Dayton, C., Paik, I. W., Weisberg, A., & Evans, J. (1988). Combining academic and vocational courses in an integrated program to reduce high school dropout rates: second-year results from replications of the California Peninsula Academies. *Educational Evaluation and Policy Analysis, 10*(2), 161–170.

Wonacott, M. E. (2003). History and evolution of vocational and career-technical education. A compilation. Washington, DC: Office of Educational Research and Improvement.