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Evaluating the Impact of a Flexible Delivery Model in Advanced Manufacturing Technologies on Key Stakeholders

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EVALUATING THE IMPACT OF A FLEXIBLE DELIVERY MODEL IN ADVANCED MANUFACTURING TECHNOLOGIES ON KEY STAKEHOLDERS

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Community colleges in the United States play a critical role in preparing students for employment in the workforce. Nationally, there is a severe shortage of trained workers to fill positions within the manufacturing industry. Manufacturers need to replace workers who retire and add employees to expand their businesses and the economy. State Community and Technical College (SCTC) began looking for ways to increase the number of students enrolled in manufacturing-related programs and increase the number of employees ready to meet the needs of employers.

To increase access to its programs, the success of students in the programs, and to increase the number of trained workers heading into the workforce, SCTC developed a plan to address the needs of students and industry by changing the way technical education was offered in the Advanced Manufacturing Technologies division to a blended learning model, SCTCFLEX. The SCTCFLEX model is an innovative and unique approach to technical education designed to create a student-centered, flexible, and accessible approach to technical education. SCTCFLEX combines online digital learning with flexible laboratory meeting times, where the primary emphasis is on mastering the course competencies needed in the workforce.

The purpose of this qualitative case study was to explore how effective the SCTCFLEX model implemented at SCTC in the Applied Manufacturing Technologies

division was at meeting its stated outcomes through the perspective of the following stakeholders: administrators, faculty, and students. The study uncovered strengths in the SCTCFLEX model and revealed practical recommendations to consider when implementing a blended learning model in technical education.

CHAPTER I

INTRODUCTION

Community colleges in the United States play a critical role in preparing students for employment in the workforce. Lowry and Thomas-Anderson (2017) assert that the community college courses offered with the highest national economic impact are related to career and technical education (CTE). In Kentucky, a particular priority has been placed, by Governor Matt Bevin, on increasing jobs related to engineering and manufacturing. However, Giffi et al. (2018) found there is a severe shortage of trained workers to fill those positions. To encourage more students to enroll in technical programs in 2018, Governor Bevin established a scholarship that provides free tuition to students enrolled in two-year technical programs focusing on several industry sectors. The Work Ready Kentucky Scholarship was designed to encourage students to pursue programs that lead to high-wage and high-demand jobs that are currently available in the state. Additionally, the scholarship's intent was to attract more industry to Kentucky because of the increased availability of highly trained potential employees (Mudd, 2018).

The shortage of trained workers ready to go into the workforce is not a problem in only Kentucky. Giffi et al. (2015) estimate there will be almost 3.5 million manufacturing jobs nationally needing to be filled over the next ten years with two million of those jobs going unfilled due to the lack of trained employees. In 2018 the number of estimated unfilled jobs rose to 2.4 million (Giffi et al., 2018). The situation for manufacturing is two-fold: how to train existing employees and how to anticipate the need for adding additional skilled employees. Manufacturers need to replace workers who retire and to add employees to expand their businesses and, ultimately, the economy.

Skilled employees are essential for the American workforce to be able to compete successfully in a global economy (Giffi et al., 2018).

STATEMENT OF THE PROBLEM

Technical education has historically focused on face-to-face training heavily dedicated to mastering skills in a laboratory setting. According to Macquire, Starobin, Laanan, and Friedel (2012), many students, particularly nontraditional and minority students, have trouble meeting the time demands required to succeed in technical programs. Technical education is time-intensive. Technical courses often have a 1:2 ratio of classroom hours to laboratory hours with some courses meeting for 90-120 hours per semester. A full-time student may be enrolled in as many as five courses per semester. Moreover, in the community college setting in which most technical programs exist, the majority of students are employed at least part time. Often the student is employed in a related field with working hours that may fluctuate, putting a further burden on students to attend classes consistently and to be prepared for their courses.

State Community and Technical College (SCTC) faculty believe students need a foundational knowledge of the subject material before entering the laboratory environment. However, SCTC faculty within the Advanced Manufacturing Technologies division (AMT) found that students frequently come unprepared for class and have not completed the preliminary readings or assignments. The students' lack of preparation creates a scenario where instructors spend additional time and resources ensuring these students have the necessary information to complete the laboratory. Also, students who are unprepared generally are less successful, and the faculty feel these students were wasting costly laboratory supplies (Basil, 2017).

This problem was further elaborated on by Basil's (2017) research that revealed manufacturing companies in the south-central Kentucky region schedule their employees using a "swing shift" model which alternates a worker's shift assignment on a routine basis. Therefore, these shifts put these students and workers in a position to have to choose between their already scheduled classes and their jobs.

Through the research, Basil (2017) identified the following trends: "students were often unprepared for the class; students' work and home responsibilities were competing with their education; faculty members were spending considerable time preparing students for lab through a faculty-centered lecture-based format" (pg. 8). Additionally, the current faculty and space utilization did not support local workforce needs for additional workers and afforded little opportunity for expansion (Basil, 2017).

BACKGROUND OF THE STUDY

This study focuses on one technical and community college in Kentucky with a mission to train more students to help alleviate the skills shortage. SCTC was established in 1939 to train industrial workers during World War II. SCTC is located in a medium-size town geographically located between two much larger cities along a major interstate. Although SCTC's mission has grown over the years from solely providing technical education to include improving the quality of life of its students through education focused on career development, community partnerships, and economic growth, technical training and education continue to be a significant focus of the institution.

In response to the growing demand from industry, the community, and state government to increase the number of trained workers produced in the manufacturing sector and to address the concerns found in Basil's (2017) study, SCTC began exploring

ways to more effectively offer programs within the AMT division. In an effort to increase access to its programs, the success of students in the programs, and to increase the number of trained workers heading into the workforce, the division leadership engaged the AMT faculty in the development of a plan to address the needs of students and industry by changing the way technical education was offered in the AMT division to a Competency-Based Education Blended Learning (CBEBL) model. The CBEBL model, now known as SCTCFLEX, is an innovative and unique approach to technical education designed to create a student-centered, flexible, and accessible approach to technical education. SCTCFLEX combines online digital learning with laboratory-based experiences in which the primary emphasis is on mastering the course competencies needed in the workforce.

The SCTCFLEX model is a significant departure from the way the AMT division offered education programs. Traditionally, each course within the AMT division met two days each week with a portion of the class time spent in the classroom with the instructor providing course content related to the subject and a portion of the class time spent in the laboratory setting demonstrating the course competencies. In contrast to the traditional format, the SCTCFLEX model takes advantage of computer-mediated content delivery technologies to replace the traditional faculty-centered lecture with a modular web-based delivery system that includes virtual lab simulations, audio/video-recorded lectures, along with other relevant multimedia interactive activities that include substantive faculty interaction.

An important part of the SCTCFLEX model includes several checkpoints imbedded in each module to allow students to assess their understanding and mastery of

the course competencies. For each SCTCFLEX course, students complete the modules online and attend the laboratory portion of the class once per week. There are no lab sessions on Monday or Fridays to allow students the flexibility to work or complete their online assignments. After reviewing the online content, students must successfully complete a lab qualifying assessment before each lab session. Following the lab session, each week students have a final exit exam that includes content from the online modules and the lab session.

To implement the model AMT faculty received extensive professional development to help them create practical online modules for content that had traditionally been delivered by the instructor in a lecture format (Basil, 2017). Students must show proficiency in the subject before attending the lab portion of the course. Due to the significant changes required to implement the SCTCFLEX model, implementation was initiated in three distinct phases. Phase one focused on researching and identifying the needs and challenges of faculty, students, and industry: and from that process, the online competency-based modules were developed.

Phase two of the program involved the expansion of the SCTCFLEX model to more programs within the AMT division. Phase three of implementation concentrated on offering laboratory sections of the courses in a variety of times that are flexible to allow students to easily select a different laboratory time to accommodate personal or work schedule changes. Out of the three phases, phase three separates SCTC's model from most competency-based technical programs.

The SCTCFLEX program goals stated by SCTC and submitted as part of an Entrepreneurial Innovation Initiative for Non-Traditional Students Grant included: to

make AMT courses/programs more accessible to students; increase students' flexibility to handle life and work constraints while taking classes; and better engage students in their learning through the following goals:

1. To more efficiently utilize faculty and space to expand options for students and accelerate student progression toward completion; and
2. Finally, to increase enrollment, retention, and credentials granted in AMT, specifically the nontraditional student.

The way a student experiences SCTCFLEX includes participating in online learning activities and in-class laboratory activities. The student participates in online activities through the learning management system (LMS). Each course has similar components, which begin with an overview of the learning module followed by lecture content that includes pre-instructional, instructional, and post-instructional activities. Following the completion of the online lesson and activities, the student completes a lab qualifying exam that assesses the learning outcomes for the module and determines the students' preparedness for in-class lab activities. The student then meets on campus for the lab session, which also includes a pre-instructional, instructional, and post-instructional component. The learning module concludes with the student completing a module exit exam.

PURPOSE OF THE STUDY AND RESEARCH QUESTIONS

The purpose of this qualitative case study is to explore how well the SCTCFLEX model meets its stated outcomes through the perspective of the following stakeholders: administrators, faculty, and students. Additionally, the study seeks to discover the barriers and challenges experienced in implementing the SKYFLEX model.

The research focuses on providing insight into the following three questions:

1. What types of barriers, challenges, and successes did administrators experience when implementing an alternative program delivery model in a lab-based technical program? (Administration perspective)
2. How do faculty perceive the program's impact on students' learning outcomes and lab performance? (Faculty perspective)
3. How do students perceive the impact of this program on their access to courses/training and their success in the program? (Student perspective)

SIGNIFICANCE OF THE STUDY

The findings of this study will add to the limited body of research that currently exists relating to postsecondary online learning and technical education, specifically in manufacturing. The growing demand for community colleges to produce more students to meet the demands of industry with the same or fewer resources justifies the need for further research and innovation in technical education. The findings of this study will be able to inform technical programs across the nation of critical points to consider in redesigning technical education utilizing a blended learning model.

METHODS

This mixed-methods case study uses grounded theory as the framework to review a technical education division at SCTC that has implemented a blended learning format for traditional lecture-laboratory programs (SCTCFLEX). The population for the study includes one division or college unit within a community and technical college. Three stakeholder populations are sampled and include administrators involved in the development of the SCTCFLEX model, faculty teaching within the SCTCFLEX model,

and students enrolled in the courses utilizing the SCTCFLEX model within the AMT division. The selection of administrators is restricted to three senior administrators with direct involvement in the development of the program and faculty members with direct student experience teaching both before SCTCFLEX implementation and after. The selection of students for this study involved purposeful sampling of students who are enrolled in courses utilizing the SCTCFLEX model and volunteered to participate in the study. The researcher did not rely on faculty to recommend students, as this may have influenced the results.

The measures used for this study focus on the emic perspective of administrators, faculty, and students and include interviews, a survey, and focus groups. The researcher administered a survey to student volunteers and conducted focus groups with interested students. The researcher served as the interviewer.

Data from the interviews and focus groups are analyzed using a grounded theory approach. The interviews were transcribed and coded to highlight common themes found within the data. The process began with open coding, and then further themes were developed using axial coding. The transcription were reviewed by the administrators and faculty interviewed for validity.

Some students may have felt pressured to voice positive opinions of the SCTCFLEX model due to the small ratio of faculty to students. They may have been concerned that voicing a negative opinion would reflect poorly on their instructor and therefore have repercussions for them. The identity of all administrators, faculty, and students are hidden in the data, and the interviews, and focus group discussions are kept private.

DEFINITION OF TERMS

Emic. Analysis of cultural phenomena from the perspective within the group or research subject ("Emic," n.d.)

High-wage high demand jobs. Jobs paying more than $23.60 per hour with expected increases in positions available (Truman, 2019)

Learning Management System. Online system used to facilitate educational activities (Pappas, 2017)

LIMITATIONS

The purpose of this study is to explore the effectiveness of one innovative program redesign at one community and technical college located in the south during one semester. The findings of this study are specific to that program and may not be generalizable to other programs, disciplines, or colleges.

All administrators involved in the program development were invited to participate. All faculty who have experience teaching in the AMT division before and after the new model was implemented were asked to participate in an individual interview. All students enrolled in the program were invited to participate in the survey and the focus groups.

The researcher is employed at the institution and, thus, bias may pose a threat to internal validity. Faculty and students who volunteered to be interviewed may have a more positive view of the SCTCLEX model than those who did not volunteer.

SUMMARY

This study examinse the effectiveness of a SCTCFLEX model using a mixed methods case study approach. Interviews were conducted with administration, faculty,

and students to determine their perceptions of how well the SKYFLEX model is meeting its stated goals. Data were evaluated using open and axial coding to look for common themes emerging as factors influencing the perceived effectiveness of the model. Administrator perspectives were obtained through interviews to evaluate implementation barriers and challenges.

Chapter II provides a review of the relevant literature topics relating to access and participation in technical education, technical education effectiveness, and online learning and success in technical education and technical education models. Chapter III includes a comprehensive description of the methodology used in the study. Chapter IV provides the findings of the study. Chapter V contains a summary of the study findings, conclusions, and recommendations.

CHAPTER II

INTRODUCTION

The purpose of this literature review is to research the relevant published literature that provides insight into the problem of the significant skills gap in the U.S. workforce in related technical fields, specifically manufacturing. Additionally, the research seeks to determine what factors influence students to pursue or not pursue manufacturing-related careers, and how training institutions are attempting to bridge the skills gap through effective practices in blended and online learning.

METHODS

The literature selected for this study includes a variety of peer-reviewed journals and scholarly articles related to manufacturing and training programs for lab-based subjects in higher education and CTE programs in the upper levels of secondary institutions, and blended and online learning in lab-based programs. The search parameters included the keywords: *blended and online learning, career and technical education, technical, career and technical education leadership, minority students, and manufacturing*. Peer-reviewed articles were selected first, but other articles are included for current statistical information related to manufacturing if the research provided relevant information. The search excluded articles published before 2000, as technology utilization in the classroom and technical education has improved dramatically in the last several years. The primary search engine was the Educational Resources Information Center (ERIC).

A limited amount of literature exists related to online teaching in technical fields, especially manufacturing. The research for this review is organized by sources critical to

investigating the problem, seeking solutions to the problem that include blended and online learning, identifying factors prohibiting institutions from implementing blended and online learning formats, educating the leadership needed to bring innovation to career and technical education (CTE) including blended and online learning, and promoting effective practices in blended and online learning.

Factors Dissuading Students From Pursuing Manufacturing Related Careers

In a study sponsored by The Manufacturing Institute and Deloitte, Giffi et al. (2015), estimate that there will be almost 3.5 million manufacturing jobs needing to be filled over the next 10 years with two million of those jobs going unfilled due to the lack of trained employees. The qualitative study utilizes data obtained from surveys sent to manufacturing executives; economic data from the U.S. Department of Labor (DOL), and Bureau of Labor Statistics (BLS); and published studies conducted by other professional polling companies such as Gallup. The methodology for the study is not specific in how the executives were selected, how many were selected, and what survey questions were used.

The researchers in the Giffi et al. (2015) study found the majority of respondents reported a significant problem with recruiting and training skilled employees, with many stating they are continually increasing their wages in the hopes of attracting enough skilled employees. They found the problem to be two-fold: how to train existing employees and how to anticipate the need for adding additional skilled employees to be able to replace workers who retire and to be able to grow their businesses and, ultimately, the economy. Skilled employees are essential for the American workforce to be able to compete successfully in a global economy. Almost half of the executives surveyed responded that they are considering bringing back manufacturing operations to the U.S.

(known as reshoring) that had moved overseas since the incentives to go offshore are diminishing. The executives state a significant factor in the decision of whether to reshore was the availability of a skilled workforce.

The researchers express that the need for increased numbers of students pursuing programs providing the skills needed for today's manufacturing jobs is clear (Giffi et al., 2015). Therefore, the question must be asked, If the economic demand is high, and the wages are good why more students are not pursuing careers in manufacturing-related programs? According to the researchers, several factors influence the number of students in the pipeline for manufacturing-related careers, and a lot can be done by industry and higher education working together to diminish the skills gap.

Producing more skilled workers needs a multifaceted approach (Giffi et al., 2015). First, the negative image of working in a factory that is prevalent in our society needs to change in order to attract highly competent workers. Many people view working in a factory as physically demanding, unfulfilling, and dirty. The industry has many high paying jobs, and many of those positions do not require a bachelor's or master's degree and pay much more than several jobs that do require advanced degrees. Manufacturers want to dispel the belief that manufacturing is not a good career choice. Modern factories rarely resemble the dark, dirty places from decades ago. If the stereotype changes, the industry hopes more young people will consider a career in the manufacturing industry.

Second, according to Gaffi et al. (2015), the industry needs to work more closely with schools and community colleges. Apprenticeships and programs combining classroom education and on-the-job training fell 40% over 10 years (2003-2013). The majority of the executives surveyed (72 %) stated that involvement with schools and

community colleges is effective in training and recruiting new employees. To increase the number of skilled workers, the U.S. government and the manufacturing industry have implemented several grant-based programs and are supportive of apprenticeship programs within community colleges.

In an article by Koontz (2000) the author looked at the reasons students are not choosing careers in manufacturing-related fields. This article reinforces the findings of Giffi et al. (2015) in which many people cite the opinion that manufacturing-related programs, like a precision machining program, are not modern and do not fit with what the youth of today are looking for in a career. Koontz wrote that many people envision, "grey, dated, old technology, what dad or grandpa used to do, dirty, grey-haired teacher," (pg. 4) as descriptors of programs. These descriptors are in direct opposition to students' beliefs and goals they hold about their future career. Koontz also presented two other factors that influence students not to choose a career in manufacturing: mothers and guidance counselors. The author stated that mothers are a "…primary deterrent to students picking machining as an area of study, according to a study in Ohio" (pg. 4) perhaps based on the previously stated perceptions of manufacturing working conditions. Additionally, school counselors often deter students from choosing careers in manufacturing based on their belief that the industry is in decline and that more opportunities are available in the service industry. However, Koontz stated this is an erroneous belief as the manufacturing industry has consistently represented between 20-23% of the Gross Domestic Product (GDP) for the last 50 years.

Koontz (2000) recommended several strategies to improve the number of students pursuing manufacturing-related careers. First, schools should start introducing careers to

students by middle school. They should allow students to learn experientially and encourage active learning techniques to combat stereotypes that manufacturing is boring. Schools should look for inexpensive options through technology to reduce the expensive cost of materials and machines. Also, programs should integrate technology and blended learning into their curricula to reach this generation of students who are comfortable using technology and to provide more flexible learning opportunities. Koontz concluded that students in a blended learning setting will be more interested in learning the material and will learn technical terms faster and at their own pace.

In a study by Eighmy (2009), the author discussed the increase in the number of high-skilled workers needed in manufacturing even though the total number of people employed in manufacturing has diminished. Low-skilled positions have been replaced with modern technology that needs highly skilled workers to operate and maintain. Eighmy analyzed 10-year completion trends of manufacturing programs in community and technical colleges in the Great Lake and Plains regions and included two-year degrees, certificates, and diploma programs. Eighmy used an analytical method that involved data mining in researching existing data in three stages: "(a) initial exploration, (b) model building or pattern identification, and (c) application of the model to data to generate new knowledge" (pg. 32). The researcher identified 41 programs to be included in the study that had transferable skills related to manufacturing and excluded programs without graduates, those that had a very narrow focus of skills, and programs that included skills that were not transferable such as leatherworking.

Eighmy (2009) found that the overall completion rates for the manufacturing programs had a short-term decline of 5.7% and a long-term decline of 3.8%. The number

of graduates in 2005 was the lowest in 10 years. These numbers are contrary to the needs expressed by the manufacturing community. Eighmy concluded that there has been no real effort to increase the number of graduates and recruit students into manufacturing programs, and community colleges need to partner with industry to get positive information out to students beginning early in their educational career (seventh-eighth grade). Eighmy looks to future research to understand the reason behind the fall in the number of graduates in the studied programs and points to the need for colleges to identify trends in program length, the types of programs added or closed, and how customized industry training can play a role in closing the skills gap.

DeFeo (2015) hoped to explain why students were not pursuing careers in CTE fields through a study that surveyed 1,134 high school students enrolled in CTE college credit-bearing courses at their local high schools. Defeo sought to determine students' motivation to enroll in the CTE courses. Additionally, DeFeo sought to establish whether the student linked taking the technical courses to a future career in the related industry. The researcher analyzed the students' reasons for selecting CTE courses instead of college preparatory courses and found many students enrolled in CTE courses had not connected enrolling in the CTE courses to a future career in the field.

The data were collected from students in one district with more than 50,000 students and a variety of CTE course offerings. The district articulated credit for CTE courses through several higher education institutions. The method of data collection was included as part of a warm-up activity before a career exploration session in 64 classrooms across the district. Students were asked structured questions, and they responded verbally.

The data revealed the students stated they were taking the courses for a variety of reasons such as lack of other options, they thought they would learn something useful, and placement by a school counselor. Many students were unaware of the specific information related to the career that utilized the skills developed in their CTE courses. The majority of students who responded were aware of the course objectives and skills needed to complete the course successfully but lacked knowledge of the career in which the skills were applied. DeFeo concluded that just starting CTE courses at an earlier age not enough. Students who lack the knowledge of the career related to their CTE courses were less likely to persist in that career. DeFeo also noted that with such a substantial investment in resources to operate CTE courses, the failure of students to persist in those careers is a substantial economic burden for the school district and is indicative of a larger national problem. DeFeo encouraged schools to include career planning as an essential part of introductory CTE courses. Schools and teachers should develop career-specific interest and knowledge along with skills (DeFeo, 2015).

To dig deeper into the interest and skills gap and to understand why more students are not pursuing manufacturing careers and/or are not graduating, one study, by Lester, Struthers, & Yamanaka (2017) looked at disparities in CTE enrollment based on gender. Enrollment in manufacturing-related programs in the community and technical colleges is predominantly male. The researchers considered the differences in community college technical program enrollment based on gender.

Lester et al. (2017) found that enrollment in many CTE programs falls along traditional gender lines. Although nationally women make up the majority of CTE enrollment, their enrollment is concentrated in "historically feminized fields" and outside

of healthcare, these fields tend to be lower-paying than other fields (Lester et al., 2017, pg. 67). For occupations that are defined as nontraditional for women, such as welding, heating and air conditioning, and automotive technician, women make up less than 25% of CTE enrollment. Lester et al. (2017) found that often women who enroll in programs that are nontraditional for women feel out of place and reported experiencing the negative effects of masculine subcultures, teacher bias, and a lack of gender-appropriate role models.

Additionally, Lester et al. (2017) discussed a frequent disconnect between male CTE instructors and female students that involves pedagogy and curriculum design. They posited female students tend to prefer teamwork and collaboration, and instructors who facilitate learning. Many CTE instructors use an authoritarian style of instruction which the male students, who make up the majority of the student population, prefer. They also found instructors, perhaps inadvertently, using terminology that was overtly disparaging to females, such as referring to the male students as men and the female students as girls. Moreover, the lack of female CTE instructors outside of traditionally female occupations demonstrates to female students that few females are employed in the occupation (Lester et al., 2017).

The lack of a sufficient number of females enrolling in male-dominated CTE programs is a critical concern in light of the estimated gap in the number of trained employees to fill the skills gap. Lester et al. (2017) considered three areas to improve and increase the number of females enrolling in these programs. The first area is to open a discussion on pedagogy that is inclusive to all genders and focused on student engagement and knowledge retention. Professional development for CTE instructors is

often focused on technical skill enhancement and rarely includes pedagogy related subjects. The benefit of this type of professional development improves the experience for all students, not just females (Lester et al., 2017).

The second area of improvement noted by Lester et al. (2017) is to provide instructors with bias workshops and sessions on bias awareness. While the authors conclude that instructors are often unintentionally displaying gender biases such as the use of gender language and a masculine classroom climate, the impact on female students remains negative. Workshops related to eliminating bias, like the enhancement of pedagogy, improve the experience for all students, not just females.

The third area cited by Lester et al. (2017) relates to partnering with female role models active in the occupation to serve as mentors. The authors noted that women in CTE classrooms benefit by having other females in the class and as role models. Additionally, since students often select their CTE program while still in high school, the authors suggested having female role models as part of the program recruitment plan is shown to be effective in increasing female CTE enrollments in nontraditional programs (Lester et al., 2017).

Adding to the discussion on gender and minority CTE enrollment and completion, Maguire, Starobin, Laanan, and Friedel (2012) looked at factors that influence the earnings of community college students in manufacturing/science, technology, engineering and math (STEM) related careers. The researchers found that earnings are heavily influenced by gender, age, and economic status, among other factors. The study was intended to answer the questions of who is leaving without a credential, what are the median earnings of students who worked full time, and of the students who worked full-

time in manufacturing-related careers "…to what extent do their background characteristics, highest credential received, and annual gain in earning predict their fifth-year median annual earnings?" (Maguire et al., 2012, pg. 240).

For this study, Maquire et al. (2012) used three types of data from the Iowa Department of Education, the Iowa Workforce Development UI wage data, and the NSC postsecondary student degree and enrollment verification system. The sample consisted initially of 95,349 students who were enrolled in Iowa's community colleges in 2001-2002. After the exclusion of several factors, the final sample size was 33,515 students. The data to assess earnings for this study were taken the first, third, fourth, and fifth year after leaving the community college.

The research findings from the Maguire et al. (2012) study revealed that for women to receive equal pay in manufacturing-related fields, it is more important that they receive an associate degree than for men. Women also represented a larger number of students who left without a degree or credential. While the study found that male students may benefit from training without obtaining a credential, this did not hold true for women. However, the study found that women who completed their degrees were able to reduce the wage gap compared to men. The authors indicated that further research is needed to determine why women drop out of manufacturing-related community college programs at a higher rate than men (Macquire et al., 2012).

A study by Fletcher (2012) considered the differences in occupational choices based on the high school track in which a student is placed. A track is the general path a student follows throughout his or her high school career. Known as tracking, this is a common practice in secondary education in the U.S. The research included students

enrolled in the following tracks: college preparatory, general, and CTE. The quantitative study included data from post-graduation employment statistics obtained from the National Longitudinal Survey of Youth from 1997 to 2006, which included 7,065 participants born from 1980 to 1984.

Fletcher (2012) found that the high school track in which is enrolled heavily influences their future career choice and income ability. The majority of students in the college preparatory track choose careers in higher prestige white-collar positions whereas students in the general track frequently chose fields in traditionally lower prestige blue-collar positions. An interesting finding revealed that students enrolled in CTE tracks are more likely to pursue careers in science, technology, engineering, and math (STEM) related careers than the other tracks (Fletcher, 2012).

Fletcher (2012) also found that the tracks and career choices are heavily divided among gender and racial demographics, with gender being the most significant variable in earning potential. Whites are much more likely to be in STEM positions and Business Management and Administration positions. African Americans and Hispanics are more likely to be employed in lower prestige jobs and are less represented in industries that did not share their cultural or racial background. The study revealed wage and opportunity gaps for females and minorities who are more likely to choose service or support positions that typically have lower wages (Fletcher, 2012).

Fletcher (2012) concluded that placing students in tracks in high school predicts their future career choice and earning potential. Therefore, high school districts should be aware of limiting options or recommending lower potential income tracks for females and minority students and make efforts to encourage diversity in tracks, especially college preparatory and CTE.

Increasing the number of students enrolling in and completing programs in CTE and manufacturing is vital to meet the demand for skilled workers in the next few years (Gaffi et al., 2015). Research has indicated some issues with recruitment and retention of students into the programs can be addressed to increase the number of total students into the programs and specifically women and minorities. The industry and higher education may be overlooking a significant part of the workforce, women and minorities, which could be a great resource in filling the skills gap.

Is Blended and Online Learning Part of the Answer to Bridging the Skills Gap?

This question is not one that is easily answered. However, the literature shows there is a growing demand for manufacturing program curricula to include a blended learning format. Blended learning helps to remove several barriers for students pursuing manufacturing careers. First, blended learning utilizing technology is a format many traditional students understand and embrace. Today's students are used to living with technology and expect it to enhance their educational experience. Second, blended learning may help to address some of the obstacles faced by students who are struggling to attend college due to family and work time constraints. Technical education is time-intensive. Technical courses often have a 1:2 ratio of classroom hours to laboratory hours with some courses meeting for 90-120 hours per semester. A full-time student may be enrolled in as many as five courses per semester, the equivalent of a full-time job.

Additionally, students who are employed in a factory setting while attending courses may have their shift hours changed in the middle of the semester, creating a scenario in which the student must choose between their job and continuing their education. Blended learning, where a student learns some of the material outside of the classroom on their schedule, could reduce the amount of time students must be present helping these students persist and be more successful.

The literature on blended and online learning at the four-year level is extensive. However, research at the community college level is not as vast, especially in studying technical programs' use of blended and online delivery formats. Horvitz's (2016) study of eight National Science Foundation funded projects utilizing blended and online learning at community colleges found five critical elements to review before implementing a blended or online technical program. Horvitz asked the key personnel of all eight projects to contribute to the research by submitting an article discussing their program's opportunities and challenges, what outcomes were realized, and what ideas their project gave them in directing future research. Based on their responses, Horvitz identified five focus areas for administrators and institutional leaders to consider before implementing a blended or online learning format.

The first focus area Horvitz (2016) centerd on how to decide if a technical program should be blended or entirely online. The answer, according to the research, is dependent on several factors. At the top of the list, program leaders must decide if parts of the material need a hands-on component or if there is sufficient technology to offer the material entirely online. Additionally, industry professionals and potential employers may make recommendations regarding how an online format prepares students for the

work environment. Some careers, although technical, lend themselves better to online simulations and training than other careers.

Horvitz's (2016) second focus area was concentrated on administrators understanding the importance of technical programs partnering with industry. Industry leaders are usually a key stakeholder in many technical programs as they help to guide curriculum and are the planned employer of program students. Additionally, many technical programs are required to have an advisory board by regional and programmatic accreditors comprised of industry professionals to provide input on the program curriculum. A blended learning format often helps to meet the needs of the industry to train existing employees by reducing the amount of downtime necessary for training. However, an online format may have advantages over a blended learning format due to some employees not being able to leave their position to come to class even once per week. Programs must decide how to balance the needs of students and employers while ensuring a sound educational experience for the student.

The third focus area Horvitz (2016) found was ensuring administrators and faculty are using sound educational strategies to enhance outcomes. In blended or online learning the emphasis must be placed on education strategies that promote problem-solving skills and collaboration with peers. Many publishers create useful resources that can be included in online and blended learning as a means to improve learning outcomes. Horvitz stated that further research is needed in this area.

The fourth focus involves if administrators can sustain programs once grant funding is finished. Each of the programs included in the research was part of a grant funded by the NSF. These programs were able to purchase specialized equipment

beneficial in online education that programs without grant funding may not be able to afford. However, Horvitz (2016) urged administrators to seek industry partners who may be able to subsidize equipment costs, primarily if they are benefitting from a pipeline of potential employees.

Finally, Horvitz's (2016) fifth area of focus looked at how to best support nontraditional students in blended or online programs. Nontraditional students may be working full time, and some may not have access to high-speed internet or may not have the digital literacy skills needed to be successful. Also, while blended learning formats may provide some flexibility to students who are working, some students still may not be able to attend class due to work constraints. Work shifts that fluctuate are frequent in some industries, causing some students to have to drop out after the semester is in progress. For programs that must have a hands-on component, the next area of experimental research should be on how to schedule labs with flexible meeting times to accommodate students with shift changes.

Fletcher and Gordon (2017) found in their study of career and technical education (CTE) programs in the U.S. that the development of online courses is a major trend. The researchers used a quantitative survey design, and participants included deans, department chairs, or program coordinators of career and technical education programs. Their sample was taken from the University of Texas at Austin's website listing of all colleges in the U.S. and surrounding territories. Out of 394 people who received the survey, 139 responded, which the researchers noted as a slightly lower response rate than average. The researchers utilized frequencies, means, standard deviations, and ranges to analyze several of the questions. They also reviewed one open-response question and

coded each response to summarize the themes. They found that 88% of undergraduate programs offered face-to-face courses, and 57% offered some form of blended or online courses. This represented an increase from their review of existing data and was seen as a trend in CTE programs.

Fletcher and Gordon (2017) recommend that CTE faculty "embrace online and blended learning modalities because the need to increase the range of delivery modes for teaching is unavoidable" (pg. 248). Additionally, the researchers recommend administrators fully support CTE faculty in pursuing professional development opportunities and provide incentives to faculty to develop online or blended formats. Finally, the researchers encouraged CTE administrators and faculty members to view online and blended learning formats as a way to maximize student learning and to help nontraditional students balance challenges associated with school attendance.

Benson et al. (2008) in their research sought to understand how prominent distance education is in CTE programs, the institutional influences and outcomes in undergraduate CTE programs, and which institutions and students participate in online or blended learning courses and programs. Their method was a descriptive analysis, and their sample was randomly selected from a nationally representative database of members of the American Association of Community Colleges. The participants were administrators of CTE and were asked to answer questions regarding the frequency of blended and online learning in their CTE programs. Five hundred fifty-two institutions were asked to answer a 14-question survey. After several rounds of data collection, the response rate was calculated at 53%.

The findings from the Benson et al. (2008) study reflect that community colleges are utilizing distance learning to better reach their CTE students and to increase access and convenience. They found that by increasing access and convenience colleges and students had "increased freedom from time constraints (82.0%), access to new audiences (79.1%), access to skills-based courses (67.5%), and increasing enrollments (67.5%)" (Benson et al., 2008, pg 682). These were all viewed as positive indicators of meeting the fundamental mission of community college to remove barriers and increase access. Additionally, distance learning courses and programs were found to attract more students who were employed part time and single parents in comparison to classes offered face-to-face.

Barriers to Implementation of CTE Blended and Online Learning

A case study by Vogt (2014) evaluated a program at a community college in Manitoba, Canada, that designed and implemented a blended learning model of program delivery, which included an apprenticeship component. The program was developed in response to the shortage of skilled employees in this area. The content for the program was designed to be delivered through the internet to apprentices at any site, no matter how remote. A benefit for the student was the ability to remain with their community and families throughout their training instead of needing to travel to one of Manitoba's community colleges, often a great distance.

Vogt (2014) used a qualitative methodology to explore the experiences of the program designers through interviews with open-ended questions. The study did not define how the participants were selected but specified that once selected, the participants received an email inviting them to participate. The participants included program administrators, subject matter experts, instructional designers, and apprentices. Twenty-eight people participated in the study.

Vogt (2014) reported that even though training on implementing a blended learning format had been completed by the subject matter experts and faculty, they remained "skeptical" (pg. 93) regarding the implementation of a blended learning format. Faculty reported that they felt unprepared to deliver content virtually, which is an abrupt change from the traditional face-to-face delivery formats most of the instructors were using. The researcher stressed that faculty should be given ample time to train appropriately and to feel comfortable using the technology needed for online delivery.

The Vogt (2014) study also found the attrition rate for the program was zero and that, although faculty and subject matter experts were concerned about program quality, students performed as well or better on their evaluations as apprentices in face-to-face programs. The authors pointed to the use of student engagement techniques that promoted interaction and additional learning time not available to students in face-to-face programs.

Vogt (2014) gave five recommendations for practice, which included institutions should have a clearly stated plan regarding their blended learning programs. Additionally, program development should include subject matter experts and adequate training, preparation, and ongoing support for faculty. Administrators were encouraged

to be flexible in creating a blended or online learning format as each institution has different specific needs. Finally, programs should be designed with the needs of the audience in mind.

Mitchell (2017) summarized the trends in CTE online education in community colleges. Mitchell found the majority of research available cited the benefits of online education, which included "reaching more nontraditional students, reducing time constraints for courses, increasing access for new audiences, and increasing student access to academic courses" (pg. 337). However, it was noted that the most common reasons for not offering more CTE courses online related to the disinterest of faculty and to a lack of skill in developing online courses.

Although Mitchell (2017) found a high number of CTE programs offering at least one course online, the number of online CTE programs was not as high as expected. Difficulties in developing adequate virtual laboratory replacements were cited as the primary reason for not putting a program online. Though research has shown that online lab activities can be a good alternative, many CTE programs are hesitant to make the change.

While blended learning courses may be a step in the right direction to increase enrollment in manufacturing-related careers, it still holds challenges. McCormack and Zieman (2017) reviewed a NSF grant program, the Technological Education for the Rural Community (TERC) Project, which incorporated problem-based learning in math courses required for students enrolled in an industrial maintenance technician program. The grant was to address the barrier of deficiencies in student's math skills that were being realized following graduation from the program once they were employed. Faculty from math,

engineering, physics, and manufacturing engineering programs collaborated along with industry leaders to develop the math course with specific content to improving math skills for industrial technicians. The program content was offered in a hybrid format to better meet student's scheduling needs.

McCormack and Zieman (2017) concluded that while blended learning has significant benefits, it still excludes many students whose work schedules are not flexible. Also, many manufacturers operate on a shifting schedule where workers may work days one week and nights the next week. Additionally, the authors found that many students lack basic knowledge foundational skills such as units of measurements or how to use a calculator. These types of challenges are easier to address in a course meeting face to face but become more difficult with less time in a hybrid format. The faculty met this challenge by creating online tutorials covering some of the basic math concepts. Finally, McCormick and Zieman conclude that more research is needed in creating a more flexible delivery format that meets the variety of lifestyles of modern students

Leading the Change in Career and Technical Education

The previously discussed research investigated the skills gap and points to blended and online learning as one way to help bridge the gap. In order to accomplish a significant change in the way the majority of manufacturing programs are taught, it is essential for career and technical education leaders to be watching the trends and looking at overall program effectiveness, which includes ensuring increased access. Viviano (2012) wrote that CTE leaders are just like other leaders; faculty, staff, students, and community partners are expecting them to exhibit essential leadership characteristics. He noted trust as one of the foundational characteristics expected of good CTE leaders,

Trust is earned through the development of the character and leadership skills of

> supervisors and their ability to be honest, regardless of consequences, to always be looking at current initiatives and trends in education, to coach, inspire, instill enthusiasm, and of course demonstrate proficiency and skill in leadership. (Viviano, 2012, pg. 51)

One can make an argument that in today's CTE environment a true leader must be innovative and aggressively promoting blended and online delivery formats. The skills gap demands that CTE programs rethink the way CTE programs and courses have been taught in the past. Viviano (2012) went further to state that the curricula has to be aligned with industry needs and include flexible scheduling. Institutional and program leaders must be encouraging and supporting faculty and programs to improve and innovate continually.

Viviano (2012) painted a clear picture of what a CTE leader should be. Nevertheless, good leaders need leadership training. Many CTE leaders and program administrators rise through the faculty ranks and receive no formal leadership training. While many exhibit tremendous leadership and innovation, others may not. Clark and Cole (2015) studied CTE administrator preparation in the U.S. to determine the status of the programs and the needs for training. They found that preparation for CTE administrators is sorely lacking and is "approaching a critical shortage" (pg. 63).

Clark and Cole (2015) built their descriptive study around the conceptual framework of authentic leadership. They sought to answer the questions regarding the requirements for CTE administrator preparation, and what is the perception of the quality of the programs from CTE state directors. The authors used purposeful sampling and selected 51 state CTE directors. Twenty-four CTE directors completed the survey. They

found no formal system of preparing or certifying CTE administrators in the states who responded. No unified level of competency could be gleaned from the survey as each state prepares its leaders independently. The researchers found that the state administrators believed that program planning, development, and evaluation were essential skills for CTE leaders to possess. The respondents also noted that work experience in the field of the program they are administering is important as well as competence in instructional management. Clark and Cole concluded that the lack of appropriately trained CTE leaders harms career and technical education in general and is not in the best interests of students.

Another study addressing CTE leadership by Suarez (2012) sought to link the beliefs of New York State Career and Technical Education Board of Cooperative Education Services administrators regarding technology to the way those beliefs impact their leadership behaviors. The study was qualitative, and a purposeful sampling selected the five participants from both rural and urban boards. The author conducted in-depth interviews, and the participants had an opportunity to complete a self-review survey to determine their technology competencies.

Suarez (2012) found that the beliefs expressed by the administrators regarding technology were different from the actual use of technology in the CTE classroom. The CTE administrators took their leadership responsibilities seriously and wanted to be using the newest technologies. They expressed an understanding that technology utilization is a must for 21st learners. The researcher concluded:

> Learning is no longer limited to a bricks-and-mortar environment wherein students are restricted by schedules, programs, seat time requirements, and other

> antiquated learning mandates. The 21st century boasts of an instructional environment that can provide students and teachers with the opportunity to utilize technology to facilitate learning without time or space restrictions (Suarez, 2012, pg. 167).

Effective leadership is critical in CTE programs. However, the research shows that training for administrators and leaders in CTE is haphazard; and while many leaders want to be effective, they may lack the skills needed to move their programs forward to meet the needs of changing student demographics and industry needs. Innovating career and technical education, especially in the manufacturing trades, is vital in order to lessen the skills gap. Leaders and administrators of CTE programs need similar leadership training, as expected of all administrators in higher education.

Effective Practices in Blended and Online Learning in Career and Technical Education

Patrick and Sturgis (2015) outlined the effectiveness of blended learning models in competency-based education and discuss that a blended learning model can offer the best of both face-to-face and online learning. As institutions consider moving toward a blended learning format, some guidelines will help them choose a model that is best for their students. First, one must consider what is the institution's approach to learning and decide what components could be offered online. The next consideration relates to how this model can help increase access for our underserved students? In the case of CTE and manufacturing programs, the research has shown that students who are employed and women are currently underserved in this area. Finally, administrators must determine the problem to be solved, and how blended and online learning can be a part of the solution.

Auster (2016) found in a study of students enrolled in an introductory sociology course that blended learning works best when the online activity is directly related to an individual assignment. For example, the instructor in the survey utilized screencast technology that further explained how to complete a related assignment. In this qualitative study, students completed two surveys to gather information on their perceptions regarding blended learning, one at the beginning of the course and one at the end. Ninety percent of the students responded to the surveys (88 students). The results showed that the majority of students felt that blended learning improved their overall positive attitude toward the course and may have increased engagement with the course content.

Tran (2016) found in a quantitative study of blended learning in a computer and information technology program in Vietnam that used a technology acceptance model as the conceptual framework, that student participants (396) had a greater acceptance of blended learning when increased faculty-student interaction occurred. Additionally, the technology must be simple and easy to use. Tran also concluded that a blended learning format should provide students with flexibility and the ability to customize their learning experience. For example, students could be given several items to complete, and the student can select which assignment best fits their learning needs.

While it seems that a blended or online learning format might lower faculty-student interactions, high-quality faculty-student interactions are critical to the success of students in blended learning formats. Dang, Zhang, Ravindran, and Osmonbekov (2016) studied the factors that influence student learning in a freshman-level computer literacy course at a major university. Almost 1,000 students enrolled in a computer literacy

course were sent a survey toward the end of the semester, and extra credit (1%) was provided if the students participated, and 583 students completed the survey. The results showed that instructor characteristics had a significant impact on both male and female perceptions of their course accomplishments and course enjoyment. This increased their positive attitude toward the blended learning model. The researchers state that faculty should "…be aware of the influential power of their characteristics and try to improve them, as well as make sure there is enough effective support to students' learning" (Dang et al., 2016, pg. 127). As with good teaching in any format, students respond better when they perceive the instructor enjoys teaching the course and is approachable.

DISCUSSION

By 2025 the research has shown that two million high skilled and high wage manufacturing jobs may go unfilled due to the lack of skilled workers (Giffi et al., 2015). The programs needed to train current workers and create a pipeline of potential employees currently exist in the community colleges. Many CTE programs have empty seats and low completion rates. Nontraditional students, especially working students, women, and minorities, would benefit from these good jobs to support their families comfortably. However, the current content delivery method of the majority of CTE programs excludes these students due to the lack of flexibility needed by nontraditional students to balance life with school and work. Progressive leadership training and a change in thinking are needed to force the utilization of existing technology to open up opportunities for all students to pursue manufacturing-related training at any time and any place. A short-term solution would be to provide flexibility in an existing lab-based course that would allow students different options to attend.

Blended and online learning formats are a step toward creating a flexible learning environment, but more research is needed to address how to facilitate traditionally hands-on activities online effectively. Additionally, positive interactions with faculty and peers remain a significant factor in student success that should not be lost because the content is online. CTE faculty must be provided with professional development activities to teach them how to engage with students and promote positive interactions online.

CHAPTER III

METHODOLOGY

The purpose of this chapter is to discuss the research methodology for this qualitative case study regarding the effectiveness of the SCTCFLEX model in meeting its stated goals of increasing student access, efficiently using facilities, and increasing completion rates of students enrolled in the SCTCLEX model at SCTC. The study used a grounded theory approach, which allowed for a better understanding of the perceptions of key stakeholders involved in the implementation of the SCTCFLEX model: administrators, faculty, and students. This chapter discusses the grounded theory approach and the constructivist paradigm in detail. This chapter includes a discussion of the methodology, the study participants, the procedures followed in the study, how the data were analyzed, trustworthiness, and ethical concerns.

RESEARCH QUESTIONS

The research will focus on providing insight into the following three questions:

1. What types of barriers, challenges, and successes did administrators experience when implementing an alternative program delivery model in a lab-based technical program? (Administration perspective)
2. How do faculty perceive the program's impact on students' learning outcomes and lab performance? (Faculty perspective)
3. How do students perceive the impact of this program on their access to courses/training and their success in the program? (Student perspective)

METHODS

Mertens and Wilson (2012) describe case study designs as appropriate when the research is focused on an in-depth study of one specific thing such as one phenomenon, one individual, one event, one group of individuals, or, in this research, one academic program at one community college. Case studies set out to explain and contextualize a particular circumstance. Case studies are data-rich and should include a triangulation of the data from multiple sources. According to Yin (2018), a case study is conducted when the research will lead to a greater understanding of the important aspects relevant to the chosen case. This case study research focuses on one academic technical division, Advanced Manufacturing Technologies (AMT), at a community and technical college.

Although case studies are not thought to be generalizable, Stake (1978) posited that the case study often lends itself toward generalizability for readers with similar experiences. Stake also stated that the expectation of research is to benefit the reader by increasing people's understanding and not only for the sake of adding more to the archives. Because the purpose of the research was to study one unique academic technical division at one community college, a case study design was selected as the research paradigm. This case study could benefit other colleges with similar experiences interested in the SCTCFLEX model of instruction.

Qualitative research, as described by Slavin (2007), is intended to explore a phenomenon in rich detail by engaging the researcher in the environment. Qualitative studides are closely tied to the perceptions of the researcher and seeks to explain issues through the observations of the researcher and other participants. Because the purpose of this research was to gain insight into the perceptions of administrators, faculty, and

students relating to the SKYFLEX model, the study was conducted through the collection of qualitative data.

This qualitative case study used grounded theory methodology. Grounded theory researchers develop theory as they progress through analyzing the data. The researcher is not seeking to prove or disprove a theory before beginning the study and is open to where the research leads, therefore the findings are "grounded" in the data. The grounded theory methodology is a way of looking at the data moving from individual thought and concepts toward collective knowledge or themes (Slavin, 2007). This research study sought to understand each person's perceptions of their experience as related to the SKYFLEX model by coding the transcribed interviews to see if common themes emerged.

The Researcher

The researcher worked at State Community and Technical College for twenty years in various roles and holds a Bachelor of Science in Family and Consumer Science and a Master of Science in Health and Human Performance. The SCTCFLEX model is not a part of the researcher's responsibilities. The student and faculty participants had no relationship with the researcher that could have represented a conflict of interest. Of the three administrators interviewed, two had a direct supervisory relationship with the researcher, and one was a colleague in the same role as the researcher in another area.

The researcher has professional experience in the skills necessary to conduct the research design. In addition to pursuing a Doctorate in Educational Leadership with courses focusing on qualitative research methodology, the researcher has been involved with interviewing students for various reasons as part of the researcher's administrative role.

STUDY PARTICIPANTS

The Students

The sample was drawn from a population of students enrolled in at least one course utilizing the SKYFLEX model in the AMT division. All of the above students were eligible to participate with no restrictions on full or part-time enrollment, enrollment location, employment status, gender, marital or parental status, or grade point average. Students were required to be eighteen years of age or older to participate. The students' email addresses were provided by the College's institutional research department. The survey was sent to 289 students enrolled in a course using the SCTCFLEX model. An implied consent form, as seen in Appendix A, was included in each survey.

The students were asked to respond to a brief survey, as shown in Appendix B, by email. Students were selected for focus group interviews from a pool of survey respondents who indicated they were willing to be contacted and interviewed as part of a focus group. Sixty-eight (23.5%) students responded to the survey. From the students willing to be interviewed, seven were selected for participation in two focus groups with three or four individuals in each focus group. An informed consent form, as seen in Appendix C, was required for each participant in this study.

The Faculty

The sample was drawn from the faculty in the AMT division with teaching experience before the introduction of the SCTCFLEX model and using the SCTCFLEX model. Faculty hired after the introduction of the SCTCFLEX model were excluded from the study. All faculty participants were recruited for individual interviews through email, as shown in Appendix D. Six faculty participated in the study. An informed consent form, as seen in Appendix C, was required for each participant.

The Administrators

The administrators were selected based on their involvement with the development and implementation of the SCTCFLEX model. Three administrators were selected to be interviewed: the college President, the Provost, and the Dean of the AMT division. An informed consent form, as seen in Appendix C, was required for each administrator.

DATA COLLECTION

This study utilized three types of data collection. For students, a brief survey, found in Appendix B, was used to capture their initial perceptions and comments. The survey was developed using Qualtrics survey software and deployed via email. Qualtrics created an individual link to the survey for each email address. After the initial deployment of the survey, the researcher set up automatic reminders for students who had not completed the survey. These email reminders were sent about every two weeks. The survey was open until June 2019. All survey data were stored in Qualtrics.

All interviews took place in person and were recorded electronically using a digital voice recorder. Individual interviews took place with only the researcher and the participant(s) present in a single interview session. The focus group interviews were conducted in a small conference room with three or four participants for each session. Each interview was transcribed by a professional online transcription service, Rev ™.

The interview questions were open-ended and began with questions asking participants to describe to the researcher how the SCTCLEX model worked and what types of assignments were included in the model. As the interviews progressed, questions were more focused on the participants' perception of the effectiveness of the model. The researcher had a scripted set of interview questions, as seen in Appendix E,

but allowed participants to discuss the SCTCFLEX model freely. The researcher asked follow-up questions to help clarify responses or if a participant introduced a new topic.

The interviews were sent once to the faculty and administrator participants once for review. Each was asked if the transcription accurately portrayed their interview responses. The student participants were not sent a copy of the transcription for review because the semester had ended and most students were unavailable. None of the participants who were asked made any edits to their transcribed interview.

According to Mertins and Wilson (2012) there is no set formula for calculating the appropriate sample size for qualitative research. The appropriate sample size depends on many factors that are often unique to each case. Researchers ultimately strive for data saturation or the point at which no new information is being gleaned from additional participants. Fusch & Ness (2015) state that saturation may not as be as much quantity as quality or depth and richness of the data. Two ways Mertins and Wilson (2012) suggest reaching saturation is through interviews and focus groups.

While the sample size for this study was numerically small, the size was appropriate for the case and the resources available to the researcher. This study employed a survey, individual interviews, and student focus groups. Student focus groups were selected as a method of data collections to allow the researcher to collect multiple perceptions from one interview.

For this case study, the sample size began with 289 students, 16 faculty members, and 3 administrators. Sixty-eight students responded to the survey or more than 23% of the total sample. Of the responding students, the researcher interviewed 11.7% of the students as part of a focus group. The researcher interviewed all faculty who fit the

criteria of teaching before and after the introduction of the SCTCFLEX model. The researcher interviewed all of the administrators involved in the SCTCFLEX model development and implementation.

PROCEDURES

The researcher sought and obtained approval from the Institutional Review Board (IRB) from Western Kentucky University (WKU). A letter of support for the research was obtained from SCTC and was included in the IRB submitted to WKU (see Appendix F). The original IRB was approved for individual interviews and focus groups with study participants. Upon reflection of the sample size, an amended IRB was submitted and approved that included the survey protocol for students.

Once the amended IRB was approved, the researcher deployed the survey to the students. The researcher contacted the AMT faculty requesting volunteers to participate in the interviews. The researcher scheduled interviews with the administrators. Once faculty responded with their willingness to participate in the study, interviews were scheduled at their convenience. The interviews for administrators took place in their respective offices. Due to convenience for the faculty, the faculty interviews were conducted at the researcher's office. Student focus groups were conducted in a small private conference room on the same campus as the students' courses, but outside of their program location. The interviews and focus groups were scheduled for one hour and with most lasting between 40-50 minutes.

DATA ANALYSIS

Data analysis was completed using codes. The researcher used the coding methodology outlined by Vaughn and Turner (2016) which organizes coding into three

strategies: the identification of categories, mapping relationships, and setting exclusion criteria. The identification of categories included creating the overall themes found in the data. For example, while some responses found in the data were useful, they did not appear to directly address the research question. Mapping these responses to larger themes helped to connect the responses to the appropriate themes. The researcher set exclusion data for responses that were off topic or outside of the scope of the interview question. These responses were valuable to the overall data; however, the researcher excluded them from coding.

The data analysis began with open coding the transcripts in groups in the order in which the interviews were conducted. For example, the researcher coded all faculty interviews first, then administrators, and then the student focus groups. The student survey was coded last due to some students continuing to complete the survey throughout the research period. The researcher allowed for time for reflection between coding to consider the emergence of themes, as well as to understand the data. Open coding is the initial step in coding and assigns each line of the transcription a code. Once open coding was completed, the researcher used axial coding which is when the open codes are grouped according to categories (Mertens & Wilson, 2012). Categories of codes were developed as the transcripts were reviewed. As the data analysis continued some codes were edited or combined as different themes were noted.

Grounded theory requires the researcher to continue to interact with the data as themes emerge. Corbin and Strauss (2008) noted this continued interaction requires the researcher to go back to data already analyzed and make changes as the researcher understands the data better through additional data and reflection. As the data were

coded the researcher made notes and often went back to prior transcripts to review codes and ideas.

NVivo ™, a qualitative data analysis software, was used to organize and store the data during the data analysis period. The software was used to highlight codes, make notes, pull together codes from different data pieces, and to look for keywords in the data for associations to codes. The analysis was led by the researcher. The researcher did not use the NVivo™ software to automatically code the data. The researcher manually coded all of the data.

TRUSTWORTHINESS

The trustworthiness of qualitative research relies on the ability of the researcher to convince the audience the research is an accurate representation of the phenomenon studied and that the researcher is qualified to assess the data. Shenton (2004) stated four criteria for ensuring trustworthiness: credibility, transferability, dependability, and confirmability, with several ways to assess each of the criteria. First, credibility is established by the researcher following established qualitative study design and participant protocol such as random sampling, triangulation of the data, and ensuring study participants are willing and prepared to offer honest data. This qualitative case study followed established research design and ensured participants were willingly participating. The use of survey data and interviews helped to triangulate the data along with institutional information. The interviews were transcribed and faculty and administrators were given the opportunity to member check their interviews. The survey instrument was checked for content validity by a third party who is familiar with qualitative research and with the subject matter.

The researcher was qualified to conduct the study and assess the data. She possesses 20 years of experience working with technical education and with students enrolled in technical programs. The researcher is immersed in the field and familiar with the organization's culture and the program setting. Her educational background provided a foundation through multiple courses to conduct an effective qualitative research design.

This qualitative case study was not designed to be transferable. Like most case study research, this study was concerned with one specific phenomenon or example. However, according to Stake (1978), audiences can make up their own mind regarding how the case may relate to their own situation or experiences.

The researcher followed a set interview protocol which lends toward dependability and confirmability. All groups of participants were addressed in the same manner and asked the same set of questions. The transcribing and coding of the data lends credibility to the themes that the researcher highlighted in the data. Additionally, the transcribed interviews and survey data will be available for five years following the study.

The researcher established a clear set of guidelines for the study in order to reduce the potential of researcher bias. Due to having a long history with SCTC, the researcher made it clear to the administrators prior to their support of the study that the research sought the perceptions of administrators, faculty, and students regarding the SCTCFLEX model and the data would be truthfully reported. The triangulation of the data through surveys, interviews, and institutional information helps to limit potential researcher bias.

An area of concern for this study was the low response rate on the student survey. Sixty-eight out of 289 students responded or 23.5%. This low rate may have indicated a

response bias. Students who responded may have felt stronger about the subject either positively or negatively and, therefore, could have impacted the results more strongly than if more students had participated. In retrospect, more efforts to encourage the students to participate such as incentives and instructor encouragement could have yielded a better participation rate and improved trustworthiness and validity of the study.

ETHICAL CONCERNS

The ethical treatment of participants was a top priority for the researcher throughout the study. All names of the participants were held confidential outside of the published identities of the college President, Provost, and the Dean of the AMT division. All participants gave implied consent (by continuing with the survey) or informed consent. Each interview participant received a copy of the informed consent. The study followed the approved IRB protocol.

SUMMARY

The purpose of this chapter was to outline the methods used in the study. The procedure, study participants, data collection, and interview protocol described the methods used and how the researcher ensured the trustworthiness of the study. A qualitative case study using the grounded theory approach was used to evaluate the effectiveness of the SKYFLEX model in meeting its stated objectives through the perceptions of the administrator, faculty, and student participants. The goal of Chapter IV is to provide the results obtained through the methodology described in Chapter III.

CHAPTER IV

RESULTS

This chapter describes the results of the qualitative case study using grounded theory methodology to answer the research questions. The chapter also details the data analysis process and how the analysis is consistent with grounded theory research and relates to the research questions. The chapter includes a description of the student sample demographics. Open coding and axial coding were used to analyze the data and assign categories and themes as the researcher reviewed and processed the survey and interviews. As the analysis progressed, different themes emerged from the data that tied back to the research questions that follow:

1. What types of barriers, challenges, and successes did administration experience when implementing an alternative program delivery model in a lab-based technical program? (Administration perspective)
2. How do faculty perceive the program's impact on student's learning outcomes and lab performance? (Faculty perspective)
3. How do students perceive the impact of this program on their access to courses/training and their success in the program? (Student perspective)

SAMPLE

Sixty-eight students participated in the online survey. Seven participated in the focus group interviews. Six faculty members and three administrators were interviewed individually. Chapter III described the specific participant parameters for each of the three groups: students, faculty, and staff. The student demographics for eligible student participants for gender were 4% female, 93% male, and 3% unreported. The

demographics for race were 2% Asian, 5% African-American, 6% Hispanic/Latino, 3% non-specified, 2% two or more races, and 82% White. Seventy-five percent of females were White. The average student age was 28 years, with a median age of 24 years and a mode of 20 years. In an internal survey conducted by the AMT division during Spring 2019, 69% of students responded they were receiving financial aid, 8% plan to transfer to a four-year college after graduation, and 54% were employed in their program field. All of the six faculty participants were male. Two of the administrator participants were male, and one was female. No demographics on age or race were obtained for either faculty or administrators.

DATA COLLECTION

This study utilized three types of data collection: a brief student survey, focus groups, and individual interviews. For students, a survey was sent to 289 potential participants, with 68 responding or 23.5% of the sample. The online student survey open response questions were coded separately due to the difference in the questions on the survey compared to those in the interviews. From an inquiry question in the survey, 11 students volunteered to participate in focus group interviews, and seven were interviewed based on convenience. All individual interviews took place with only the researcher and the participant present in a single interview session. The focus group interviews were conducted in a small conference room with three or four participants for each session. The faculty and student interview questions were open-ended and began with questions asking participants to describe to the researcher how the SCTCFLEX model worked and what types of assignments were included in the model. As the interviews progressed, questions were more focused on the participants' perception of the effectiveness of the

model. The researcher had a scripted set of interview questions but allowed participants to discuss the SCTCFLEX model freely. The researcher asked follow-up questions to help clarify responses or if a participant introduced a new topic. Following grounded theory, themes began to emerge while conducting faculty interviews. While the researcher did not change the interview questions as a result of emerging themes, she asked more guided follow-up questions in later faculty interviews.

The interviews were recorded using a small digital voice recorder. The recorder was placed on the table, and interview participants were shown the device and asked whether they were ready to begin recording prior to the interview. The interview files were downloaded to the researcher's computer following the interviews. The researcher conducted member checks for faculty and administrator interviews. The interviews were sent to the faculty and administrator participants for review. The participants were asked whether the transcription accurately portrayed their interview responses. The student participants were not sent a copy of the transcription for review because the semester had ended and most students were unavailable. None of the participants returned any edits to their transcribed interview.

DATA ANALYSIS

Data analysis was completed using codes. The researcher used the coding methodology outlined by Vaughn and Turner (2016) which organizes coding into three strategies: the identification of categories, mapping relationships, and setting exclusion criteria. The identification of categories included creating the overall themes found in the data. Mapping relationships connects difficult to code items to categories. For example, while some responses found in the data were useful, they did not appear to directly

address the research questions. Mapping these responses to larger categories helped connect the responses to the appropriate themes. The researcher set exclusion data for responses that were off topic or outside the scope of the interview question. These responses were valuable to the overall data; however, the researcher excluded them from coding.

The data analysis began with open coding the open answer survey responses and the transcripts in groups in the order in which the interviews were conducted. The researcher coded all faculty interviews first, then administrators, and then the student focus groups. The survey responses were coded last due to some students continuing to complete the survey throughout the research period. The researcher allowed for time for reflection between coding to consider the emergence of themes and to understand the data. Mertens and Wilson (2012) describe open coding as the initial step in coding where the researcher assigns each line of the transcription a code. Once open coding was completed, the researcher used axial coding, which is when the open codes are grouped into categories. Categories of codes were developed as the transcripts were reviewed. From the categorized data, different themes began to emerge.

Grounded theory requires the researcher to continue to interact with the data as themes emerge. Corbin and Strauss (2008) noted this continued interaction requires the researcher to go back to data already analyzed and make changes as the researcher understands the data better through additional data and reflection. As the data were coded, the researcher made notes and often went back to prior transcripts to review the relationships between codes, categories, and themes. The interviews with students, faculty, and administrators were coded using existing codes and adding new codes as the

data revealed them. Flick (1998) posited that at first, the coding process is very closely tied to the actual text. However, as the coding process moves on, the codes are analyzed in a more abstract way leading to combining and recategorizing the codes as the researcher sees themes develop.

NVivo™, a qualitative data analysis software, was used to organize and store the data during the data analysis period. The software was used to highlight codes, make notes, develop relationships between codes, and to look for keywords in the data for associations to codes. The researcher led the analysis but did not use the NVivo™ software to code the data automatically.

Results of Student Online Survey

The online student survey consisted of six questions using a Likert scale and three open-response questions. The survey was distributed to 289 students, with 68 completing for a participation rate of 23.5%. Table 1 includes the survey questions and the analysis of the responses for the six questions using the Likert scale of strongly agree, agree, neither agree nor disagree, disagree, and strongly disagree. The three open-response questions in the student online survey were:

Q1 What is your favorite thing about the SCTCFLEX model?

Q2 What is your least favorite thing about the SCTCFLEX model?

Q3 If you could change one thing about the SCTCLEX model what would it be?

The researcher open coded all responses to the questions and then assigned the codes to categories. The codes for the first two open-response questions were often polarized because of the nature of the questions, such as, What is your favorite thing or what is your least favorite thing about SCTCFLEX?

Table 1

Online Student Survey Results

Survey Questions	Strongly Agree (%)	Agree (%)	Neither Agree nor Disagree (%)	Disagree (%)	Strongly Disagree (%)
Q1 Completing my program with an associates degree is important for me to reach my career goals.	68.12	21.74	5.80	2.9	1.45
Q2 The SCTCFLEX model of completing online modules with one lab meeting each week per class allows me more flexibility to manage my school, work, and family obligations.	57.98	31.88	8.7	1.45	0
Q3 After completing the online modules I feel well prepared for lab.	30.43	43.48	14.49	11.59	0
Q4 The SCTCFLEX model allows me to take more classes each semester.	34.78	36.23	21.74	7.25	0
Q5 My instructor is available to me for questions and to explain concepts I do not understand.	55.07	39.13	4.35	1.45	0
Q6 I learn more by completing the online modules than a lecture in a classroom.	28.99	13.04	24.64	15.94	17.39

Note. N=68

From the categorized responses, several themes began to emerge. These themes were related to work-life balance issues, flexibility with completing assignments and coming to school, course structure, impact of the reduced time in the instructional setting, course demand on students' time and effort, and educational quality of the SCTCFLEX program. The following paragraphs discuss the themes that emerged from the responses.

Work-Life Balance. Work-life balance was the most prevalent positive theme in the students' responses when asked, What is your favorite thing about the SCTCFLEX model? Twenty-six open codes were assigned to categories in which the students responded that the SCTCFLEX model allowed them to have more time to work; more time with family; or the ability to manage the time demands for work, family, and school.

Each SCTCFLEX course only meets once per week for the lab, with a significant portion of the work done online. Eleven students indicated they were able to work more each week. One student wrote being able to manage school and work as their favorite thing about the SCTCFLEX model, "balance school and a full six day a week job." From the students' responses, working and going to school appeared to be a top priority for them and something that they may struggled with balancing. Many of the students surveyed, as indicated by this response, seemed to believe the SCTCFLEX model helped them manage the demands of family, work, and school; "I can manage my work and school time at the same time."

Flexibility. Flexibility was a theme assigned to categories used to describe responses in which the student indicated the SCTCFLEX model allowed them to do their work on their schedule. While flexibility could be viewed as similar to the theme of work-life balance, the researcher made a distinction to assign codes to categories related to flexibility when the student response indicated independence of when they performed the work or when they attended class as a positive attribute of SCTCFLEX. Sixteen open codes mentioned flexibility as a positive aspect of SCTCFLEX. As with the theme of work-life balance, several students suggested that the flexibility of the SCTCFLEX model allowed them to do the online portion of the coursework around their work schedule. A student discussed the SCTCFLEX model providing flexibility around work as "It is easy to work around my work."

Course Structure. Course structure was a theme that emerged from student responses related to how the SCTCFLEX model was delivered with both online and face-to-face lab portions of each course. Twenty-seven open codes were assigned to

categories related to the course structure. The researcher categorized 12 of the 27 responses as positive toward course structure and 15 responses of the 27 as negative toward the course structure. Some student responses seemed to indicate an issue with a particular course, while other students referred to the overall structure of the SCTCFLEX model. One student response was very favorable toward the SCTCFLEX model, "I love it!" However, several students indicated they had issues with understanding the material outside of class. One student described the issue: "I sometimes don't have the time or brainpower to properly understand and comprehend the lab qualifiers." Additionally, while some students found the flexibility of the model as one of their favorite things about SCTCFLEX, others found learning the material on their own more challenging.

Reduced Time in Instructional Setting. This theme emerged from responses by students who indicated the SCTCFLEX model gave them too little time with their instructor or not enough time working hands-on in the laboratory setting. Twelve responses were open coded, categorized, and included in this theme. The student responses in this theme appear in contrast to those included in the work-life balance theme. However, the same students who indicated their favorite thing about SCTCFLEX was the ability to work more hours and be on campus less may also have stated their least favorite thing about SCTCFLEX was not enough time with their instructor or hands-on work. The responses ranged from not having enough instruction time to specific statements about online learning. One student commented, "The lecture is online. I am a more hands-on person. I learn a lot better when there is someone to explain to me when something is wrong." Several student responses indicated that online learning was not as effective as face-to-face instruction. This student discussed the AMT program as a type

of program that needs more hands-on instruction, "It can be difficult to comprehend a hands-on field online." These responses indicate that students value face-to-face time with their instructors and hands-on learning.

Course Demands. This theme came from student responses referring to the amount of time or work the SKYFLEX model required. Seven students out of 68 participants indicated course demands as their least favorite thing about the SCTCFLEX model. Student responses included in this theme range from the amount of homework in the course being excessive to the length of the class being too long.

Educational Quality. This theme emerged from categories of open codes in which the student response indicated a problem or issue with the delivery, content, or material in the SCTCFLEX model. Five open codes were assigned to the educational quality theme. While this theme was not representative of many categories of open codes or student responses, the researcher felt it was important to include in the themes as the responses were related to how students perceived the quality of the SCTCFLEX model and what types of educational issues were essential to the students surveyed. One student stated that the online portion did not prepare them for what they should know for the lab. Other students had issues with the material not being released to students on time and the simulators being used in the online environment were slow and out-of-date.

SCTCFLEX Improvements. The third survey question asked the students if they could change one thing about SCTCFLEX, what would it be. SCTCFLEX Improvements was the theme that resulted from the students' responses when they stated an improvement to the way the SCTCFLEX model was delivered or when the classes were offered. Twenty-five open codes were assigned to categories leading to the course

structure theme. Five students' responses indicated a desire for more flexibility in the online environment, such as having longer due dates and allowing students to work ahead. Two students expressed a need for more active online content instead of long videos and ensuring material was easily accessible by phone when computer access was limited. Additionally, students suggested increasing the amount of lab time, and class time to two days per week, and adding more class time to review the online material.

No Changes Indicated. Twenty students out of 68 or 29.4%, participants responded that they would not change anything about the SCTCFLEX model, or they responded to the question with non-applicable (NA). Some student responses fell outside the chosen categories for this question, such as a change in the location of the course or a difference in the price of tuition. Additionally, one student responded to remove the unnecessary content from the courses.

Results of Administrator Interviews

The administrator interviews consisted of eight open-response questions (Appendix E). Interviews were conducted with all three SCTC administrators with direct involvement in the development and implementation of the SCTCFLEX model. The interviews were conducted and recorded by the researcher and transcribed by Rev™, a professional transcription company. The interview responses were open coded and categorized to develop themes as related to the research question:

1. What types of barriers, challenges, and successes did administration experience when implementing an alternative program delivery model in a lab-based technical program? (Administration perspective)

The question was analyzed looking for emerging themes that applied to three key words in the research question: barriers, challenges, and successes. The following is a description of each theme that related to the research question.

Barriers and Challenges

Community/Government Influence. The manufacturing industry, community, and government/legislative factors were discussed by the administrators in depth as a significant factor that challenged them to look critically at their current methods of delivering technical education and creating the SCTCFLEX model. Two of the administrators discussed the outside pressure to increase the number of students entering into the workforce in the manufacturing sector. The emphasis was not only on getting more students through SCTC's AMT program but also on getting them through quicker. One administrator discussed the pressure coming from the legislature and industry.

> Legislators that were being fueled by comments from industry or industry who was just giving comments directly to us, that as the economy got better, then they needed people more quickly trained in a shorter timeframe and just more volumes of them. (Administrator 1)

The pressure to provide more employees in a shorter amount of time was not new to SCTC. However, SCTC had been reluctant to change its delivery model of technical education, which focused on face-to-face instruction. "Actually, over a period of a few years we've been asked to change the schedules like this, and our response always was that we didn't know how we would do it, and through demand we decided to do it" (Administrator 3). Realizing SCTC's model of providing technical education was no longer working for the community and industry, SCTC also realized it also was no longer

working for students who were working, going to school, and caring for their families.

> We were in a standard collegiate model that didn't really fit the work schedule of working adults, so the whole idea here is to create an inclusive program that will allow people basically to maintain a regular schedule, a student's collegiate schedule, as well as having the versatility of working around a work schedule, or a personal life schedule. (Administrator 3)

The pressure from the community, compounded by the knowledge that SCTC's model of technical education was no longer meeting the needs of students, created the incentive for SCTC to create the SCTCFLEX model.

Faculty Technology Usage. The SCTCFLEX model integrates varied types of instructional media and technology in the online portion of courses. Faculty were required to learn new techniques in a short time period. Before SCTCFLEX, many of the faculty in the AMT division taught face to face without the use of very much digital media. For these faculty, this created a challenge and a barrier to the implementation of the SCTCFLEX model. Two of the administrators discussed that they perceived faculty technology usage impacted the implementation of the SCTCFLEX model Administrator 2 voiced that technology was the biggest challenge in implementing SCTCFLEX.

> The biggest challenge? Well, I think Administrator 3 dealt with a lot of the biggest challenge and I think he did a great job with this, was that it's very different than the way people taught before. Especially in technology. (Administrator 2)

Since the SCTCFLEX program relies heavily on digital content, both Administrator 2 and 3 discussed the issue of technical faculty with little or no experience

with digital content struggling to create and deliver quality online content. The need to learn new ways of teaching and modern technology increased the faculty workload significantly as they worked to develop the courses. Administrators looked for ways to decrease the workload and support faculty through the challenges.

> Administrator 3 really worked with them, and we gave them time over the summer to prepare for them. Because we knew it would be very labor-intensive to change a class that was in person and hands-on, to look at really what can they learn on their own on the computers. (Administrator 2)

Another challenge the administrators expressed related to technology was its changing nature. Administrator 3 expressed frustration with technology when one software system was phased out and replaced with something new, "A couple things, one thing is being relied ... rely upon external technology. For instance, the semester after we were using Microsoft Mixed™, within a year, that technology went away." When the technology changes, faculty must search for a new product that is compatible with the software products in use, so they do not have to recreate digital content.

Student Recruitment. All three administrators discussed the challenge of recruiting students into manufacturing-related fields. Two administrators discussed how the current educational climate toward some manufacturing-related fields discouraged students from considering them as viable career options preferring to push students toward four-year degrees.

> Some programs, because of the way we're raising the millennials and then whatever the next generation is, we've not put much value on certain career fields. We have, for 20 years, by and large, encouraged kids towards four-year degrees probably more than any generation before us. (Administrator 1)

Administrator 2 expressed a barrier to recruitment as the lack of understanding of manufacturing jobs by parents and high schools. To change this lack of knowledge, SCTC has been working with middle schools and high schools through several events and grants to raise the awareness of manufacturing-related fields.

Additionally, two of the administrators discussed how the low unemployment rate impacted student recruitment in a negative way. Potential students who might have come to school were participating in the workforce, often in jobs that do not require a college education. According to Administrator 3, the SCTCFlex model helped to address that barrier because of the flexible scheduling in which students can work and attend school.

SCTCFLEX Successes

Increased Enrollment. One of the stated goals of the SCTCFLEX model was to increase enrollment in AMT, especially for the nontraditional student. Two of the administrators discussed how they felt SCTCFLEX was growing enrollment for this demographic.

> …I think our recent study shows that our demographic of 25 years and older in our technical programs ...SCTCFLEX is the only program that have an increase in them. Increase in that demographic…We did know the demographic of 25-year-olds were going down. But now we have 25 and up, more as a rule, than we did in the past. (Administrator 3)

Before SCTCFLEX, it was hard to recruit students who were working and taking care of a family. One administrator defined the problem this way.

> And how could we reach them? Adult students who were already working at other jobs. And then I always throw in too, parents, who have kids, if the kid gets sick or something. But what was a way to make things more available to them? (Administrator 2)

However, the SCTCFLEX model removed some of the barriers that students face, such as inflexible scheduling and long hours spent on campus. These barriers were particularly high for students who worked many hours per week and had the responsibility of caring for family members. According to the administrators, the SCTCFLEX model made coming back to school an option for those students.

Use of Physical Resources. The SCTCFLEX model promoted the efficient use of physical resources. The online environment could enroll more students and flexible lab times allowed SCTCFLEX to increase its capacity to teach students in the lab setting. One administrator discussed evenings as an option that would increase the efficient use of resources.

> Evenings ... we are discussing evening schedules. Maybe even weekends. Evenings the biggest gap. In all of our resources, we have fifty percent of resources not being used, if we don't do that. So this new program has expanded our resource availability. (Administrator 3)

Another administrator discussed the SCTCFLEX model freed up available space for labs, which in turn benefited the students. Administrator 2 noted, "I know, again, the space issue that this could really open up space if we went to this kind of a model. So it could ensure the learning, open the space, make it more flexible for the adults."

Faculty Efficacy. As previously noted, the faculty use of technology was a challenge to the implementation of the SCTCFLEX model. One administrator acknowledged the challenge the faculty faced and discussed how as the model has progressed, they have grown their technology skills as they embraced the SCTCFLEX model. Two administrators discussed that the faculty worked hard to implement the SCTCFLEX model without the assistance of instructional designers or additional time to work on learning the technology.

> And (they) really went out on a limb with this and put a lot of time and effort. Lots of time and effort. And now actually are reaping the rewards. And say how much they love it and that it really ensures their students are learning. It's been going all through the advanced manufacturing technology program and that's just something I love saying when people say, "How did you get that to happen?" It's the faculty took it by the horns and helped make it happen. (Administrator 2)

As faculty confidence grew, Administrator 3 discussed how the quality of the media the faculty were using also had improved. Each semester the faculty worked toward making the online content more interactive.

Results of Faculty Interviews

Six SCTC faculty members in the AMT division using the SCTCFLEX model were interviewed. There were eight open-response interview questions (see Appendix E). The interviews were conducted and recorded by the researcher and transcribed by

Rev™, a professional transcription company. Their interview responses were open coded and axial coded. The faculty interviews were focused on answering the following research question:

2. How do faculty perceive the program's impact on students' learning outcomes and lab performance? (Faculty perspective)

Several themes developed related to student learning outcomes and lab performance.

Student Learning Outcomes

Student Knowledge and Skill Attainment. Faculty were asked to describe how the SKYFLEX model impacts student knowledge and skill attainment. Five faculty members stated they saw no change in the student's knowledge of the material or skill attainment using the SCTCFLEX model. One instructor indicated that their students seemed more knowledgeable of the material when attending lab than before the SCTCFLEX model.

Of the five faculty members who perceived no change in the student's knowledge or skill attainment, four expressed a lack of confidence in their ability to provide quality instruction in the SCTCFLEX model. As the interviews progressed, several faculty members reflected that even if the student learning outcomes had not increased, they also had not decreased with the SCTCFLEX model instead of the traditional face-to-face method: "…I kinda been beating myself up thinking they weren't getting it. But now that I think about it, before, they didn't know any of it. So I guess in a way, it is helping." One faculty member who did not feel the overall student learning outcomes or skill attainment had improved also perceived the SCTCFLEX model to have polarized the students' knowledge level.

> I think the blended learning format kind of polarizes their performance on the lab. In other words, before, in a traditional class, there was a spectrum, or a range, and you had everybody, you know, from this side to this side, and they were evenly distributed. Whereas, with the blended learning format, you're either ready or you're not. (Faculty 2)

Another faculty member discussed a reason why students may haved improved student learning outcomes and skill attainment as a result of the SCTCFLEX model: being able to learn more because they have more time to work in the field.

> The biggest way that it's beneficial is it frees up time for them to work and that's something I think that might be lost in this. I've always said…they will learn more in the field then they will from me anyway and so if they have more time in the field, it's hard to calculate how this course affects that. (Faculty 3)

The faculty member did not indicate if all of the students were working in the training field of study or if some students were working outside the training field of study and how that could impact those students.

Another faculty member who did not perceive the SCTCFLEX model to be impacting student learning outcomes and skill attainment stated that the program is still helping a lot of students by allowing them to keep working and come to school. Before SCTCFLEX, according to this faculty member, these students would not have been able to work and attend school.

> I think it's helped more with the, maybe not their performance. It hasn't went down. And it hasn't been a negative thing. It's increased accessibility, I guess, is the best thing…So overall it's helped a lot of those people. So being able to go to get school and do something. (Faculty 4)

All six of the faculty interviewed taught in the SCTCFLEX model, with the focus on technical education and employment. Each faculty member had a role in ensuring graduates were employed in the field of training after graduation. Therefore, the faculty placed a strong emphasis on working while attending school.

Student to Student Engagement. Faculty voiced that in a traditional technical program format, students spend a considerable amount of time working together and often develop close relationships. In the SCTCFLEX model, students may have been on campus only one day per week per class. One faculty member expressed a concern that in their classes, they felt the SCTCFLEX model increased the amount of time for students to feel comfortable with each other, and this could have impacted their success in the course.

> It just takes longer to get going. And that bothers me because there's some students that kind of get lost in that period of time and they end up withdrawing from class. And so it's not a big number of students, but I'm just saying, you know, maybe 5% get caught in something like that. (Faculty 5)

Lab Performance

Lab Preparedness. All six faculty members agreed that when the students complete the online assignments as assigned before a lab day, they were more prepared for the lab than they were in the traditional face-to-face model. In the face-to-face model, faculty would spend time before starting lab lecturing on the course content because some

students had not read the material. The SCTCFLEX model required students to access the material online and take a lab qualifier or quiz to participate in the lab. One faculty stated, "...I honestly feel like they're definitely equal, if not a little bit more prepared, because they're having to do a lot of this on their own and they know they have to be prepared to participate in that lab."

Improved Lab Efficiency. Five of the six faculty members discussed how the SCTCFLEX model improved the efficiency of the time spent in the laboratory. The traditional model had two shorter lab days. With the SCTCFLEX model, the lab was only one day, but it was twice as long. The faculty indicated students got more time hands-on time in the lab because the lab only had to be opened and closed one time (one lab day) instead of twice (two lab days).

> …the biggest change as far as the lab performance would be the time… Because what you had before, we basically did 8:00 to 9:15 lectures…Then I gave them a break. And I say every day, sometimes we were done at 8:45, sometimes we went over. But then they take a break, by the time you get out, get all your tools out, it's close to 10:00. You get 45 minutes or so before a lunch break. You go back. You clean up. Throughout a week of getting tools out and cleaning up, by taking that day out, that's 45 minutes… I feel like it's more efficient. Especially in what we do, because now we have time in the mornings where if we're doing a painting job, we can do the base coat and everything in the morning and still finish in the afternoon. And a lot of times they would have to stay over til 4:00 and 5:00. So efficiency wise, I think the lab's better…(Faculty 1)

Faculty also voiced those techniques that required more time benefit from the SCTCFLEX model's extended lab times. Faculty stated their classes could begin their labs on-time and get more done with the SCTCFLEX model. One faculty member discussed how long projects often went over the scheduled lab time.

> I don't know that the performance has been different but one thing that I have noticed is where sometimes in lab the thing that you're doing you can barely get started because your lab is an hour and a half is a fair amount of time but there's a lot of processes that we teach and these processes take. If you're going to recover a refrigerant you, can't always recover a refrigerant in an hour and a half. If I'm going to demonstrate how to do it and then get them started they're going to be leaving before it gets done or around the time it gets done. Then we can't move it back or we can't do anything like that there's some processes, I think it works out better to have more time to do that. (Faculty 3)

Results of Student Focus Group Interviews

SCTC students participating in the SCTCFLEX model were interviewed in two focus groups. All seven students stated they were currently employed. There were eight open-response interview questions (see Appendix E). The interviews were conducted and recorded by the researcher and transcribed by Rev™, a professional transcription company. The interview responses were open and axial coded. The codes were categorized and themes developed related to access, learning outcomes, laboratory performance, and online delivery issues. The student focus group interviews focused on answering the following research question:

3. How do students perceive the impact of this program on their access to courses/training and their success in the program? (Student perspective)

Increased Access. All seven students interviewed expressed that they were employed and held several other commitments such as working in a family business, serving in the military, farming, and raising children. While some students found the flexibility to work on the SCTCFLEX modules on their own time beneficial, others voiced it was challenging to find the time to work on their assignments at home with their other obligations. The flexibility to change a lab day or to make up a lab day was essential to several students. While many students have significant time commitments outside of class, one student, a veteran with a family, summed up how the flexibility of SCTCFLEX helped him with his many personal obligations and allowed him to continue toward earning his degree.

> I work two different part-time jobs. I have my two kids, my wife, and I have my four adopted nieces and nephews who live with me so... this is pretty much my down time. Sitting here in a quiet booth (welding), is the best part of my day. I'm also in the National Guard, so I do miss class periodically. So I try to weasel in classes whenever I can to do whatever I can to get ahead …I've missed one class because my wife had to go get rushed to surgery, but she was fine, and I only missed half a class that day. Being able to miss three classes and still graduate is great. It gives you the flexibility to like, "hey, I can't do this one day". But you do miss a lot when you miss that one class. (Student 1)

Two other students expressed similar experiences with multiple responsibilities outside of the classroom and how the flexibility of the instructors and online content of the SCTCFLEX model helped balance their school, work, and personal life.

Achievement of Program Outcomes. While students expressed how the flexibility of the SCTCFLEX model helped them handle their work-life responsibilities, several students indicated the online content of the class presented some challenges to them meeting their desired program outcomes. When asked whether completing the online modules before lab made them feel more prepared or less prepared for lab, the students in Focus Group 1 had very different opinions about the effectiveness of the online modules than students in Focus Group 2. The students in Focus Group 1 were in a different program within the AMT division with a different instructor than students in Focus Group 2. Those in Focus Group 1 stated they often felt disconnected from the information they needed to know to be successful in the lab. When they got the correct information, several weeks had gone by and their lab products were not meeting the course standards.

> We welded for, what, four or five weeks, probably? And then he taught us, "hey, on the lesson, if you switch the polarity, which is you switch the positive and negative, it welds better." Well, that would have been great to know four weeks ago...We've just been wasting metal. Our welds were crap. You could not... they were terrible. (Student 2)

Additionally, the students in Focus Group 1 did not interact with their instructor outside of the lab time. When asked if they would contact the instructor to get clarification on information, the students felt that by the time their question was answered, the information was no longer relevant, so they did not try to contact the instructor.

The students in Focus Group 2 voiced satisfaction as a group with the online learning modules for their program. They said the modules were well planned and

delivered, and their instructor was available by phone during certain times of the day to answer student questions. One student referenced that the program they were in (electrical technology) was easier to understand through online modules than other programs might have been. Another student indicated that while the online model was useful in the course he was taking, the effectiveness depended on the type of course and was no replacement for student-faculty interaction.

> This hybrid class, this material is well-suited for the hybrid class, which is very unique. In my experience, all the other online classes or hybrid classes I've either failed or dropped…The time that's spent in class in front of a teacher is invaluable and I just want to make that clear. (Student 3)

However, one student felt the online model helped him understand the concepts better because he had the opportunity to learn and research the topics ahead of the lab. He utilized outside resources to help answer questions with which he was confused by the online content.

Issues with Online Delivery. All three students in Focus Group 1 indicated significant barriers caused by the quality of the online modules in the SCTCFLEX model. While students expressed positive comments about their instructors, they emphasized there were significant audio/visual barriers to their ability to listen and understand the presented information. Student Focus Group 1 discussed obstacles to understanding the audio recordings of their instructor due to the instructor's dialect, the recording equipment used, and their physical surroundings when they wanted to listen to the material. Additionally, two of the students in Focus Group 1 struggled to hear the recording because of the low volume. The students stated they could not hear some words.

Additionally, the videos were incorrectly captioned, and therefore, were not helpful. All of the students in Focus Group 1 said the perceived poor quality audio recordings had negatively impacted their ability to answer questions correctly and had lowered their grades on assignments and exams.

The students in Focus Group 2 reported no issues with the online delivery of the modules. These two groups of students had different instructors and were in different programs. The two student focus groups had very different experiences with the SCTCFLEX model. These experiences appeared to be directly related to the type of program in which the students were enrolled and the perceived quality of the online material per instructor.

CONCLUSIONS

This chapter contained the results of the analysis of the data and related the data to the research questions. Sixty-eight students were surveyed; three administrators, six faculty members, and seven students were interviewed for this grounded theory study. Interview questions were designed to understand the perspectives of the administrators, faculty, and students of the success of the SCTCFLEX model in meeting its stated goals of increasing access and improving student learning outcomes.

Through grounded theory research and coding, several themes were identified which emerged from different codes that were specific to each of the research groups. By continuing to compare the data among the three groups of research participants to discover relationships between the data, four theories emerged. The four theories resulting from this study summarize the effectiveness of the SCTCFLEX model: (a) The SCTCFLEX model increases access particularly to nontraditional working-age students,

(b) The SCTCFLEX model increases lab efficiency and effectiveness, (c) Quality instructional design and technical proficiency is key to the success of the SCTCFLEX model, and (d) faculty need continuing professional development support to ensure SCTCFLEX online learning modules are accessible and of high quality.

The factors that contributed to the success of the SCTCFLEX model, in spite of the barriers the data revealed, were evident in both the faculty and student interviews. The data revealed the SCTCFLEX model increased access due to the flexible scheduling model and reduction in the time spent on campus. Students were able to work more in their field of study while progressing toward their educational goals. The faculty concerns regarding their ability to produce a quality online module were validated in the outcomes of the student focus group interviews. Chapter V includes the summary of the analysis and discussion on the four theories.

CHAPTER V

DISCUSSION AND CONCLUSIONS

The purpose of this qualitative case study was to explore the effectiveness the SCTCFLEX model implemented in SCTC AMT division was at meeting its stated outcomes through the perspective of the following stakeholders: administrators, faculty, and students. Additionally, the study sought to discover the barriers and challenges experienced in implementing the SCTCFLEX model.

The SCTCFLEX model combined online digital learning with laboratory-based experiences in which the primary emphasis was on mastering the course competencies needed in the workforce. The SCTCFLEX model was a significant departure from the way technical education programs were offered in the AMT division. Traditionally, each course within the AMT division met two days each week, with a portion of the class time spent in the classroom with the instructor providing course content related to the subject and a portion of the class time spent in the laboratory setting to demonstrate the course competencies. The SCTCFLEX model took advantage of computer-mediated content delivery technologies to replace the traditional faculty-centered lecture with a modular web-based delivery system that included virtual lab simulations, audio/video-recorded lectures, as well as other relevant multimedia interactive activities that should include substantive faculty interaction.

This chapter contains discussion and analysis related to the following research questions:

1. What types of barriers, challenges, and successes did administrators experience when implementing an alternative program delivery model in a

lab-based technical program? (Administration perspective)

2. How do faculty perceive the program's impact on students' learning outcomes and lab performance? (Faculty perspective)
3. How do students perceive the impact of this program on their access to courses/training and their success in the program? (Student perspective)

This chapter also contains a summary of the findings, implications for practice, recommendations for future research, and a brief conclusion.

Through grounded theory research and coding, four theories were identified from the research and were specific to each of the research groups. The four theories uncovered some strengths in the SCTCFLEX model and revealed areas of concern for all stakeholders: (a) the SCTCFLEX model increases access particularly to nontraditional working-aged students, (b) the SCTCFLEX model increases lab efficiency and effectiveness, (c) quality instructional design and technical proficiency is key to the success of the SCTCFLEX model, (d) and faculty need continuing professional development support to ensure SCTCFLEX online learning modules are accessible and of high-quality.

The factors that contributed to the effectiveness of the SCTCFLEX model at increasing access to students despite the barriers were evident in both the faculty and student interviews. Additionally, the contribution of the administrators to this study was necessary as they detailed the factors influencing their support of the SCTCFLEX model, in part, to satisfy the state legislature's and community's demand for SCTC to produce more skilled workers. Given limited existing physical and human resources, the administrators viewed the SCTFLEX model as a way to increase the number of students

in the AMT division and make efficient use of existing resources. In a time of record low local unemployment rates, the administrators believed the SCTCFLEX model would be attractive to adult age working students because of the decrease in the time required on campus. SCTCFLEX would allow students to work, supporting SCTC's relationships with employers, and continue making progress toward their educational goals.

SUMMARY OF FINDINGS

SCTCFLEX Increases Access to Nontraditional Working-Age Students

This study's conclusion that the flexible delivery model, SCTCFLEX, increases access to nontraditional working-age students agrees with the literature that online and blended learning increases access and convenience for students, especially for working and single parents as compared to face-to-face courses (Benson et al., 2008). Much like Mitchell (2017), who found that online learning increases access to nontraditional students through reducing time constraints for courses, this study found students perceive that SCTCFLEX allows them to manage the demands of their family, work, and school better than a traditional face-to-face technical program. The majority of students who responded to the online survey, 89%, agreed or highly agreed the SCTCFLEX model of completing online modules with one lab meeting each week per class allows them more flexibility to manage their school, work, and family obligations. Also, 71% of students agreed or strongly agreed that SCTCFLEX allows them to take more classes each semester.

The existing literature shows a significant number of manufacturing jobs that go unfilled due to the lack of skilled employees (Giffi et al., 2018). Females are underrepresented in technical programs and manufacturing jobs. Flexible delivery

models, like SCTCFLEX, can increase access to new populations of students to help fill those jobs. Traditionally, students in manufacturing technical programs are male. SCTCFLEX, can increase access to females and other underrepresented minority students to help fill future manufacturing jobs.

SCTCFLEX Model Increases Lab Efficiency and Effectiveness

This study found that faculty perceive the SCTCFLEX model increases lab efficiency and effectiveness. Before the model, technical courses at SCTC met two days per week. The lecture portion of the course took place before each lab. The amount of time students were in the lab varied for different courses, according to the assigned credit hours, from two to four hours. Within the scheduled lab time, faculty included time for students to set up labs and gather their tools, time for occasional short breaks, and a lunch break for all-day classes, and time for students to put their tools away and perform any lab clean up or maintenance. Often, these required activities left the faculty and students feeling rushed to complete longer or more complex lab activities. Faculty reported students staying late to finish projects or finishing projects themselves after students left.

With the SCTCFLEX model, labs meet only one time per week, and the former lecture portion of the course is online. The lab meets for the required hours all on one day. The faculty reported this format allows the students to set up and clean up the lab only one time, saving lab time to complete more course objectives. Additionally, the extended lab times allowed for longer or more complex lab activities to be completed within the time frame of the lab. These longer or more complex lab activities were not possible before the implementation of the SCTCFLEX model.

The current literature on blended learning focuses on program and learning outcomes. However, for this research, no studies were found that included an assessment of the efficiency and effectiveness of the lab portion for the courses in blended programs. Horvitz (2016) noted the need for more research in the area of scheduling flexible lab times in order to accommodate changes in work shifts within the semester, but that recommendation for future research does not refer to the efficiency or effectiveness of labs in blended learning technical programs.

Quality Instructional Design and Technical Proficiency is Key to the Success of the SCTCFLEX Model

The majority of students who participated in this study perceived the SCTCFLEX model increases their access to come to class and to take more classes each semester. However, the students who participated in the two focus groups had very different experiences when speaking about the quality of the online components for their courses. Some students voiced that some components of their online modules were creating barriers for them due to the low quality of the voice recordings and incorrect captioning of the videos.

This study found the quality of the instructional design and the technical proficiency of the faculty was key to the success of the SCTCFLEX model. Administrators and faculty should design blended learning programs with the needs of the audience in mind paying particular attention to creating online components that are accessible to students with disabilities, to those who may possess inadequate technology, and for those who may be using their mobile phones to do their coursework. This study reinforces Mitchell (2017), who found that some of the most common reasons that community colleges were not offering more online and blended learning classes were

related to the disinterest of faculty and to a lack of skill in developing online courses.

As part of quality instructional design, high faculty-student interaction increases the students' acceptance of blended and online learning, according to Tran (2016). The students in Focus Group 1 who reported dissatisfaction with the online components of SCTCFLEX reported little contact with their faculty member outside of the lab and a delayed response time to get questions answered or to receive clarification on course information. The students in Focus Group 2 who reported frequent communication with their faculty member expressed positive views toward their SCTCFLEX class. This study appears to reinforce Dang et al. (2016), whose study found that students respond better when they perceive their faculty enjoys teaching the course and is approachable.

Faculty Need Continuing Professional Development

This study found that faculty need continuing professional development to ensure that SCTCFLEX is accessible and high quality. The faculty interviewed in this study expressed concern over their ability to teach online effectively. A study by Vogt (2014) reported similar findings in technical faculty who went through training to teach online. Professional development for technical faculty often focuses on skill development and rarely includes pedagogy related subjects. This study agrees with Lester et al. (2017) who notes that for technical faculty, pedagogical-related professional development should be inclusive to all genders and focused on student engagement and knowledge retention, not skill development alone.

Faculty employed at SCTC in the AMT division received extensive professional development before implementing the SCTCFLEX model in their courses. The professional development included how to use the technology needed to create online

modules to replace their current lectures. This study found that although faculty had received professional development, they need continuing professional development and support in related pedagogical topics to ensure their online content was accessible and engaging to students.

IMPLICATIONS FOR PRACTICE

The four main findings from this study and the literature imply that flexible schedules with a blended learning format, like the SCTCFLEX model, have positive implications for increased access for students, especially nontraditional age working adults, as well as increased lab efficiency and effectiveness. Tasked with the need to increase enrollments and to produce more graduates to fill jobs in manufacturing, leaders in technical education seeking to improve and innovate should consider incorporating a flexible delivery model, like SCTCFLEX (Viviano, 2012).

Technical programs with labs are time-intensive, with some labs ranging from 90-120 contact hours per semester. Colleges spend considerable resources on lab spaces and faculty to teach technical education. A flexible delivery model, like SCTCFLEX, appears to make efficient use of faculty and physical resources. Students are in the lab one time per week per course, and because students are required to prepare for the lab by completing assignments and assessments before lab, faculty can spend valuable lab time focused on students completing course competencies. By minimizing the time needed for the lecture, two lab set ups, and clean ups, and break periods, the labs are a more efficient use of time for faculty and students. This increased efficiency frees up physical resources, which could present an opportunity to teach more lab courses in the space.

Moving from a face-to-face delivery model to a blended learning model requires a commitment by the institution to train faculty properly and to provide ongoing support and course review to ensure online material is high quality and accessible. Many faculty teaching in technical programs may not be proficient in the technology needed to create and facilitate material needed in an online environment. Furthermore, technical faculty may be reluctant and resist moving their traditional lectures online.

Even though moving content online is time-consuming and often difficult for the faculty, it does not justify merely putting the material online if the quality is not being continually reviewed and held to a high standard. Some of the students in the focus groups indicated they were making progress *despite* the barriers in the online portion of their class due to the poor quality of the course material. Expectations for the quality of online portions of the classes should be made clear to faculty.

Fletcher & Gordon (2017) encouraged administrators and faculty to view online and blended learning formats as a way to maximize student learning and to increase access for nontraditional students. The researchers encouraged institutions to fully support technical faculty by providing incentives relative to pursuing professional development opportunities in order to develop online or blended learning formats. Institutions should view professional development in this area as an ongoing need for faculty and include the associate costs for training or stipends in their budgeting process.

The quality of the online materials should be a priority for administrators and faculty. Providing material online that is not accessible or of high quality does not help the student meet their education goals. If students are struggling to understand the recordings and transcripts, this places an unnecessary burden on those who may already

be managing the demands of work, family, and school. Administrators should be proactive and involved to ensure faculty have the skills and tools they need to succeed.

LIMITATIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

While the researcher still believes qualitative research was appropriate for this study, the number of qualitative interviews was limited due to the time constraints of the researcher and participants. More exhaustive and in-depth interviews, along with observations of the learning environment, would give this study more credibility. Additionally, as the SCTCFLEX model is ongoing, a more extended study could strengthen the data.

This study relied heavily on the input of the students who participated in the online student survey and the student focus groups. The participation rate for the online student survey was 23.5%. I acknowledge that much of the weight of the data is from a small portion of the students. In retrospect, more energy should have been given to encouraging students to complete the survey. I was concerned that if the faculty encouraged the students to respond to the survey, it would place an undue influence on the students to respond in a positive manner. The findings of this study would be more reliable if the participation rate was higher. However, even though the participation rate was low, clear themes emerged from the data.

Flexible scheduling, blended, and online learning in technical settings such as manufacturing is a growing trend in higher education. Very little research exists that addressed these modalities for technical programs such as those in the AMT division in higher education. There is a need for more research on blended and online learning models and the way in which each component separately, online material and the lab

experience, impact student learning and success. Because of the minimal flexible scheduling models that include flexible lab times, more research on the existing programs is vital for future research to influence practice.

CONCLUSION

Community colleges in the U.S. play a critical role in preparing students for employment in the workforce. In Kentucky, a particular priority has been placed on increasing jobs related to engineering and manufacturing due to a shortage of skilled employees to fill those jobs. This study found that blended learning formats with flexible lab times, like the SCTCFLEX model, increase access for nontraditional working-age students and increase lab efficiency and effectiveness.

Technical education in manufacturing has historically focused on face-to-face training dedicated to mastering skills in a laboratory setting. Traditional technical education is time-intensive. Technical courses often have a 1:2 ratio of classroom hours to laboratory hours with some courses meeting for 90-120 hours per semester. A full-time student may be enrolled in as many as five courses per semester. Moreover, in the community college setting where most technical programs exist, the majority of students are employed at least part time. Often the student is employed in a related field with working hours that may fluctuate, putting a further burden on students to attend classes consistently and to be prepared for their courses.

The traditional model of delivery limits access to nontraditional working-age adults, especially women and minorities. Currently, women and minorities are underrepresented in manufacturing technical programs and in manufacturing, in which jobs are often considered high-wage and high-demand. A dilemma exists between the

need to fill more manufacturing jobs and a model of delivering technical education that limits access to sizeable potential student populations.

To increase the numbers of nontraditional working-age adults in manufacturing programs at SCTC, the SCTCFLEX model was a significant departure from the way technical education programs were being offered in the division. In contrast to the traditional format, the SCTCFLEX model takes advantage of computer-mediated content delivery technologies to replace the traditional faculty-centered lecture with a modular web-based delivery system that includes virtual lab simulations, audio/video-recorded lectures, along with other relevant multimedia interactive activities that include substantive faculty interaction.

The results of this study uncovered some strengths in the SCTCFLEX model and revealed areas of concern for all stakeholders: (a) the SCTCFLEX model increases access particularly to nontraditional working-aged students, (b) the SCTCFLEX model increases lab efficiency and effectiveness, (c) quality instructional design and technical proficiency is key to the success of the SCTCFLEX model, (d) and faculty need continuing professional development support to ensure SCTCFLEX online learning modules are accessible and of high quality.

This study found the SCTCFLEX model to increase access to nontraditional working-aged students. While increased access was seen by all stakeholders in this study as a positive thing, it may only be a reflection of the student spending less time on campus and, therefore, having more time to balance their obligations. This study found possible quality issues with some of the instructors and the online content in the SCTCFLEX model. An environment of ongoing improvement will make SCTCFLEX

more effective at meeting its goals of increased student access while maintaining student success.

I believe administrators should engage and support faculty in continuous quality review and ongoing professional development activities In doing so, it would ensure the online learning modules meet quality standards and are accessible to all students not just when beginning a new program but as an ongoing part of the normal faculty review process.

Efforts to increase the number of women and underrepresented minority students into SCTCFLEX model programs can open doors to high-wage and high-demand jobs to new populations of students who will help manufacturers bridge the skills gap and fill their jobs to keep the industry moving forward. However, efforts must be made to recruit this population, such as marketing that includes appropriate representation, the inclusion of minorities from industry in program advisory committees, and training faculty to avoid gender-biased instructional practices.

For technical leaders who are interested in starting a program like SCTCFLEX there are some important things to consider. Changing from the traditional model of technical education to a model like SCTCFLEX requires a substantial commitment of time and resources from administration and faculty in getting the program started. First, the college should envision how their program should be delivered. Would it be a model like SCTCFLEX or another version of a blended learning delivery model? Second, there must be faculty buy-in and participation in order for the program to be successful. SCTC provided faculty with stipends and course load reductions while they were working on developing their courses. Faculty also need support with professional development and

instructional design. Many technical faculty are experts in their technical fields but have no formal training in instruction. Faculty need ongoing support, training, and course review.

Finally, a program like SCTCFLEX should seek continuous improvement using nationally accepted quality online course standards. Several organizations provide quality assurance guidelines for online courses that could be used to set standards. The standards for online technical courses should be the same as for any other course on campus.

Based on the findings of this study, a blended learning model like SCTCFLEX can be a tremendous asset to the institution by increasing access for students enrolling in technical education programs. Technical programs utilizing a blended learning format may see increased enrollments and more students completing the program. However, developing a blended learning technical program requires the commitment of additional resources and the support of the administration. A particular emphasis should be placed on quality instructional design and high online teaching standards. Ongoing program review, which includes the evaluation of online offerings should be routine in all blended technical programs.

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APPENDIX A: IMPLIED CONSENT FORM

IMPLIED CONSENT DOCUMENT

Project Title: The implementation of an innovative technical education program designed to increase student access and success; a case study

Investigator: Lisa Hunt, Department of Educational Leadership: lisaa.hunt@kctcs.edu

You are being asked to participate in a project conducted through Western Kentucky University. The University requires that you give your agreement to participate in this project.

You must be 18 years old or older to participate in this research study.

The investigator will explain to you in detail the purpose of the project, the procedures to be used, and the potential benefits and possible risks of participation. You may ask any questions you have to help you understand the project. A basic explanation of the project is written below. Please read this explanation and discuss with the researcher any questions you may have. You should keep a copy of this form for your records.

1. **Nature and Purpose of the Project:** The purpose of this case study is to determine if the Competency-Based Education Blended Learning model (CBEBL) is effective in meeting specific components of its stated goals from three different perspectives: the administration, the faculty, and the students.

2. **Explanation of Procedures:** Participants will be asked to provide their opinions and a description of their experiences as related to the CBEBL model outcomes. The time involved for students who participate in the survey will be ten minutes.

3. **Discomfort and Risks:** The potential risks of participating in this research is limited. All information obtained from the surveys is confidential and no identifying information will be provided in the final report. Some participants may be concerned negative opinions could impact the program.

4. **Benefits:** All information obtained relating to this research may be used by the institution or others to improve outcomes for technical programs. Research on CBEBL model programs is limited. Therefore, this research will add to the knowledge base regarding this method of instruction.

5. **Confidentiality:** All information regarding participants will be kept confidential. No names of students, faculty, or administrators will ever be disclosed to anyone or included in the data or released.

6. **Refusal/Withdrawal:**

Refusal to participate in this study will have no effect on any future services you may be entitled to from the University. Anyone who agrees to participate in this study is free to withdraw from the study at any time with no penalty.

You understand also that it is not possible to identify all potential risks in an experimental procedure, and you believe that reasonable safeguards have been taken to minimize both the known and potential but unknown risks.

Your continued cooperation with the following research implies your consent.

THE DATED APPROVAL ON THIS CONSENT FORM INDICATES THAT
THIS PROJECT HAS BEEN REVIEWED AND APPROVED BY
THE WESTERN KENTUCKY UNIVERSITY INSTITUTIONAL REVIEW BOARD
Robin Pyles, Human Protections Administrator
TELEPHONE: (270) 745-3360

WKU IRB# 19-256
Approved: 3/15/2019
End Date: 8/30/2019
EXPEDITED
Original: 2/18/2019

APPENDIX B: STUDENT SURVEY

Student Survey

Q1 Completing my program with an associates degree is important for me to reach my career goals.

- ○ Strongly agree (1)
- ○ Somewhat agree (2)
- ○ Neither agree nor disagree (3)
- ○ Somewhat disagree (4)
- ○ Strongly disagree (5)

Q2 The SKYFLEX model of completing online modules with one lab meeting each week per class allows me more flexibility to manage my school, work, and family obligations.

- ○ Strongly agree (1)
- ○ Somewhat agree (2)
- ○ Neither agree nor disagree (3)
- ○ Somewhat disagree (4)
- ○ Strongly disagree (5)

Q3 After completing the online modules I feel well prepared for lab.

- ○ Strongly agree (1)
- ○ Somewhat agree (2)
- ○ Neither agree nor disagree (3)
- ○ Somewhat disagree (4)
- ○ Strongly disagree (5)

Q5 The SKYFLEX model allows me to take more classes each semester.

- ○ Strongly agree (1)
- ○ Somewhat agree (2)
- ○ Neither agree nor disagree (3)
- ○ Somewhat disagree (4)
- ○ Strongly disagree (5)

Q6 My instructor is available to me for questions and to explain concepts I do not understand.

- ○ Strongly Agree (1)
- ○ Agree (2)

○ Somewhat agree (3)

○ Neither agree nor disagree (4)

○ Somewhat disagree (5)

Q7 I learn more by completing the online modules than a lecture in a classroom.

○ Strongly Agree (1)

○ Agree (2)

○ Somewhat agree (3)

○ Neither agree nor disagree (4)

○ Somewhat disagree (5)

Q8 What is your favorite thing about the SKYFLEX model?

_____

_____

_____

_____

Q9 What is your least favorite thing about the SKYFLEX model?

_____

_____

_____

_____

_____

Q10 If you could change one thing about the SKYFLEX model what would it be?

_____

_____

_____

_____

_____

Q11 If you are interested in being interviewed as part of a group of students please leave your name and contact information.

_____

_____

_____

_____

_____

APPENDIX C: INFORMED CONSENT FORM

INFORMED CONSENT DOCUMENT

Project Title: The implementation of an innovative technical education program designed to increase student access and success; a case study

Investigator: Lisa Hunt, Department of Educational Leadership; lisaa.hunt@kctcs.edu

You are being asked to participate in a project conducted through Western Kentucky University. The University requires that you give your signed agreement to participate in this project.

You must be 18 years old or older to participate in this research study.

The investigator will explain to you in detail the purpose of the project, the procedures to be used, and the potential benefits and possible risks of participation. You may ask any questions you have to help you understand the project. A basic explanation of the project is written below. Please read this explanation and discuss with the researcher any questions you may have. If you then decide to participate in the project, please sign this form in the presence of the person who explained the project to you. You should be given a copy of this form to keep.

1. **Nature and Purpose of the Project:** The purpose of this case study is to determine if the Competency-Based Education Blended Learning model (CBEBL) is effective in meeting specific components of its stated goals from three different perspectives: the administration, the faculty, and the students.

2. **Explanation of Procedures:** Participants will be asked to provide their opinions and a description of their experiences as related to the CBEBL model outcomes. The time involved for students who participate in the focus group interview will be thirty minutes. The time involved for students, faculty, and administration who participate in the individual interviews will be thirty minutes.

3. **Discomfort and Risks:** The potential risks of participating in this research is limited. However, some participants may be uncomfortable discussing their opinions of the program or its outcomes. Some participants may be concerned negative opinions could impact the program.

4. **Benefits:** All information obtained relating to this research may be used by the institution or others to improve outcomes for technical programs. Research on CBEBL model programs is limited. Therefore, this research will add to the knowledge base regarding this method of instruction.

5. **Confidentiality:** All information regarding participants will be kept confidential. No names of students, faculty, or administrators will ever be disclosed to anyone or included in the data or released.

WKU IRB# 19-256
Approved: 2/18/2019
End Date: 8/30/2019
EXPEDITED
Original: 2/18/2019

6. **Refusal/Withdrawal:** Refusal to participate in this study will have no effect on any future services you may be entitled to from the University. Anyone who agrees to participate in this study is free to withdraw from the study at any time with no penalty.

You understand also that it is not possible to identify all potential risks in an experimental procedure, and you believe that reasonable safeguards have been taken to minimize both the known and potential but unknown risks.

_____ _____
Signature of Participant Date

_____ _____
Witness Date

THE DATED APPROVAL ON THIS CONSENT FORM INDICATES THAT
THIS PROJECT HAS BEEN REVIEWED AND APPROVED BY
THE WESTERN KENTUCKY UNIVERSITY INSTITUTIONAL REVIEW BOARD
Robin Pyles, Human Protections Administrator
TELEPHONE: (270) 745-3360

WKU IRB# 19-256
Approved: 2/18/2019
End Date: 8/30/2019
EXPEDITED
Original: 2/18/2019

APPENDIX D: EMAIL TO FACULTY PARTICIPANTS

Hello (faculty name),

I am conducting a research study on the effectiveness of Southcentral Kentucky Community and Technical College's (SKYCTC) competency-based education blended learning model used in the **Applied Manufacturing Technology** program. I am looking for several faculty members to participate in an interview to discuss the impact of the program on student learning outcomes and lab performance. Your experiences and opinions regarding the program are important to this research and improving the future of technical programs.

Some important things to know about participating;

- Must be 18 or older.
- Participation is completely voluntary.
- All identities will be kept confidential, and no real names will be included in responses.
- Participation will take approximately 30 minutes of your time.
- Refreshments will be provided.
- All participants will be placed in a drawing for a $25 Logan's Roadhouse gift card.

If you are interested in participating, please let me know by March 15, 2019, by responding to this email. Your help is very important, and I look forward to hearing from you.

Sincerely,

Lisa Hunt

APPENDIX E: INTERVIEW QUESTIONS

Student Focus Group Interview Questions

1. Can you tell me a little about your career goals once you complete your program?
2. Can you describe for me some of the demands on your time outside of class (work, family, hobbies, etc.)?
3. Can you walk me through how your program (competency-based education with blended learning) works for completing a weekly assignment and lab?
    a. How much time do you spend on completing each module?
4. How does the way this program is structured compare to other courses you may have had outside of this program?
5. If you work or have family commitments, how do you fit studying and completing your assignments and attending lab into your life?
6. Going back to completing the modules before attending and participating in lab, describe how you feel about your level of knowledge of the material before you attend lab?
    a. Do you feel more or less prepared for class or lab using this model than in other courses you have taken?
    b. Describe what it is like to complete the written portion online instead of having your teacher give you the information in class?
7. Have you needed to miss class/lab because of a work or family obligation?
    a. How does completing the modules online impact your ability to complete your coursework and take care of your other obligations?
    b. How does being able to switch a lab day impact your ability to attend

labs?

8. What, if anything, would you change about the way your program (competency based educations with blended learning) is offered?

Faculty Individual Interview Questions

1. Can you walk me through how your program (competency-based education with blended learning) works for students to complete a weekly assignment and lab?
    a. Describe how much time you think students spend completing each module?
2. Going back to completing the modules before attending and participating in lab, describe how you feel about your students' level of knowledge of the material before they attend lab?
3. Can you describe if students seem more or less prepared using this model than with other courses you may have taught with a different format?
4. How do your students feel about the independent learning portion of completing the written portion online instead of having you give them the information in class?
5. Can you describe how students' lab performances have changed, if any change has been noted, since the program began using this model?
6. Can you describe how this model impacts student knowledge and skill attainment?
    a. Which piece of the model, if any, has had the greatest impact?
7. Can you describe if, in your opinion, this model has improved the students'

overall success in the program?

8. What, if anything, would you recommend changing about this model to improve student learning outcomes and lab performance?

Administration Questions

1. Can you describe for me the influence that the community (employers, legislatures, and others) had on the college's decision to implement a competency-based education with blended learning model (CBEBL) in the Applied Manufacturing Program?
2. As we know, there is estimated to be a significant gap in the number of jobs projected and the number of employees who will be ready to fill those jobs. In your opinion, can you describe to me what are some of the greatest challenges the college faces in getting enough students to complete programs in technical education?
3. What was the most influential factor for you that gained your support for the implementation of the CBEBL model?
4. What was the biggest challenge you saw when the college began implementing CBEBL?
    a. How has that challenge changed or been addressed as the model was implemented?
5. Can you describe any barriers that the college experienced that may have impacted the implementation of CBEBL?
6. Can you describe for me any successes that the college has experienced since

implementing the CBEBL?

7. What, if anything, would you change about implementing the CBEBL in Applied Manufacturing Technology?
8. How would the CBEBL model work in other technical programs?
    a. If it could be successful in other programs, does the college have any plans to increase the number of programs offering CBEBL?

Individual Student Interview Questions

1. Can you describe to me the importance of completing this program in obtaining your career goals?
2. How does the CBEBL model impact your ability to finish your courses and complete your program?
3. Has the program allowed you more flexibility to manage your school work and the other parts of your life?
4. How does it feel to be studying and working independently on the material instead of having a faculty member covering the material in class?
5. What, if anything, would you change about the way your program is offered?

APPENDIX F: LETTER OF SUPPORT

January 8, 2019

Office of Research Integrity
Western Kentucky University
Bowling Green, KY 42101

Dear Members of the IRB Committee:

As President and CEO of Southcentral Kentucky Community and Technical College (SKYCTC), I am aware of the research proposed by Lisa Hunt, doctoral student at Western Kentucky University. It is my understanding that the research will include interviewing SKYCTC students, faculty and administrators.

I grant Lisa Hunt permission to engage our students, faculty and administrators, per research methods outlined in her dissertation study documentation. If I can be of further assistance, please contact my office at (270) 901-1111.

Sincerely,

Phillip. W. Neal
President/CEO

Dr. Phillip Neal
President/CEO
1845 Loop Drive • Bowling Green, KY 42101
P: (270) 901-1111
southcentral.kctcs.edu