THE MENTORSHIP OF INSTRUCTORS AND ITS IMPACT ON COMPUTER SCIENCE INTEREST AMONG MIDDLE SCHOOL GIRLS: AN EVALUATION STUDY

by

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DEDICATION

To every little girl dreaming of a life as a scientist; fear nothing. Find your inspiration, harness your determination, and live your life as a scientific adventure.

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As a child who was filled with wonderment and avid curiosity, I struggled in the traditional classroom setting. I learned what it took to push past obstacles, create goals, and cross the finish line. One of my favorite stories as a child was *The Tortoise and Hare*. As a fable centered around perseverance, this type of mantra has stayed with me throughout my education and professional experience. I have had the opportunity to be surrounded by family and friends who were steadfast in their belief of my success, allowing me to sacrifice time and prior commitments to succeed. I have taken chances and risen to the occasion by the encouragement of leaving my comfort zone.

This dissertation was written while traveling to four continents and numerous plane rides crisscrossing the United States. While I was tempted to sequester myself at home and not travel so much for the sake of focusing on my writing, I consciously chose to make it a part of the journey. This is what this process is all about: learning about the challenge, finding focus, and achievement among the chaos. What better way to learn more about ones' perseverance than to take risks, leave ones' comfort zone, make progress, and then offer a heartfelt acknowledgment to those who gave guidance along the way? This process became part of my voyage in learning how to complete a task similar to the tortoise; no matter the speed, you will still win. To those who helped in the creation of this dissertation:

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ABSTRACT

The purpose of this study was to evaluate the effectiveness of STEMaven mentors motivating and retaining middle school girls' interest in computer science viewed through the lens of knowledge, motivation, and organizational influences. To better understand the effectiveness of mentors, I conducted a mixed-methods case study involving mentors at a coding and technology after-school program. Eighteen participants completed a simple survey that consisted of thirteen questions. Eight survey participants that met additional criteria were interviewed using open-ended questions lasting approximately 40-60 minutes in length. Findings indicate that effective mentor instruction involves the development of evidence-based practices fostered through professional development centered around opportunities of self-awareness, evaluation methods, and reflection occurring during and directly after the facilitation of a workshop. In addition, effective instruction involves the ability to teach at any knowledge level, using hands-on lessons that are creative, relevant, and engaging. Furthermore, effective mentor instruction described in this study is based on mentors working to increase their effective and evidence-based teaching skills that will increase interest of computer science in middle school-aged girls. The findings of the study aid in developing instructional approaches that enhance instruction in after-school programs of any discipline.

Keywords: Motivation, effective and evidence-based teaching strategies, mentors, middle school girls, STEM

CHAPTER ONE: INTRODUCTION

Introduction to the Problem of Practice

Women have made gains in many professional fields, but they remain underrepresented in computer science. This trend of inequality raised awareness of gender disparity in computing occupations and increased interest and retention strategies for young girls. A quick perusal of a children's toy store reveals a movement toward increasing girls' interest in technology fields. As cognizance changes, along with increased funding and availability, boys are no longer the majority of students attending informal learning opportunities involving exposure to and mentoring in technology outside of school hours (McNally, 2012). However, it is not enough to teach technology during school hours, and it is essential to promote collaboration, cooperation, and acceptance through effective teaching and mentoring.

Technology, defined by Lan and Young (1996), is always connected with obtaining a certain result, resolving certain problems, completing certain tasks using particular skills, employing knowledge, and exploiting assets. It is comprised of both products and techniques. Even as technology is more accessible and affordable, the U.S. Department of Education (2016) stated the K-12 school system was not equipped to prepare students, particularly girls, for collegiate-level work in computer science. Computer science, as of March 2020, is comprised of eight disciplines: computer engineering, computer forensics, computer software engineering, electrical engineering, game and interactive media design, information science, mathematics teacher education, and neuroscience. With only 18% of computer science degrees being earned by women, it is imperative to create interest among girls and expose them to computers and technology at an early age (Sassler, Michelmore, & Smith, 2017). Unfortunately, schools have barriers that limit efforts to interest girls in computer science, such as funding, partnerships, expertise, and instructional interventions (Williams, 2011). Furthermore, Vekiri (2010) found girls' self-efficacy and interest in computer science declined without instructional interventions to directly target stereotypes and misconceptions.

Tan, Barton, Kang, and O'Neill (2013) found a pattern of reoccurring thoughts in the girls they studied, suggesting the reason they choose not to pursue a science, technology, engineering, or mathematics (STEM) career was due to the idea that these fields were too masculine and did not personify soft, feminine characteristics. For this reason, feelings of not belonging in the STEM classroom or community or of not being smart enough ultimately disrupted their interest to pursue STEM, not low-test scores (Campbell, 2011). Similarly, Outlay, Platt, and Conroy (2017) found instructional interventions designed to promote computer science were strongly related to student attitudes on technology, and those with a goal of fostering retention of middle school girls had a retention success rate of over 85%. Likewise, Bystydzienski, Eisenhart, and Bruning (2015) found efforts to increase interest and proficiency in STEM among high school girls had promising results, as tools to build confidence in computer science correlate to graduation rates. In addition, workshop participants have strengths in different areas, which is more aligned to Gardner's Theory (1983), and different approaches to teaching would better align or appeal to the students' multiple intelligences. When lessons can be created to differentiate to the senses, there is an increase in proficiency and interest. Further evidence of the need to address this issue is the increasing number of middle school girls who desire to obtain a career in computer science but ultimately choose a non-STEM career (Hardin & Longhurst, 2016). The retention of young girls and women's interest in computer science must be addressed to preserve a balanced and adequate talent pool to meet the country's workforce needs (Liben & Coyle, 2014).

Organizational Context and Mission

STEMaven (pseudonym) is a 501(c)(3) nonprofit corporation founded in January 2017 to offer a variety of workshops for middle school-aged girls to explore technology, coding, and science. The mission of STEMaven is to inspire middle school girls in East Tennessee to actively explore the fields of technology, to close the gender gap in the technology profession, and to foster participants' future careers. They provided free coding and technology-related workshops through hands-on workshops. The workshops were facilitated by volunteers that STEMaven called "instructional mentors." These volunteers had degrees ranging from undergraduates to Ph.D. research scientists in the field of STEM. STEMaven hosted 3-hour workshops at either a local college campus, a local library, or middle school computer lab every other week throughout the year.

STEMaven has a framework where each workshop is facilitated by mentors who have the background knowledge of each lesson, and each is developed and taught through evidence-based practices. Through this effective set of norms, STEMaven has grown in the number of participants each year, and, in just two years, hosted 500 to 600 participants. Focusing primarily on the fifth- through eighth-grade girls, participants come from a range of local area schools, with coding as the preferred workshop.

The programs' goals are to provide increased opportunities through effective and evidence-based instruction and mentorship for middle school girls to engage in workshops that motivate and retain their interest in computer science. The program hosts between 20 and 30 events annually that offer female students unique opportunities to explore their interests in various areas of technology and computer science. Similar to other successful intervention programs that have effective teaching and mentoring, documented attendance rate shows that there has been a steady increase in the number of program participants each year. This evidence demonstrates the program is reaching a large number of middle school girls interested in learning more about computer science and other STEM fields.

Organizational Goal

STEMaven provides local middle school girls free hands-on coding, otherwise called computer programming, and technology-related workshops to inspire and encourage them to pursue careers related to computer science. Along with computer science, there is an emphasis on computational thinking skills. Computational thinking is normally associated with computer science when a student is learning how to code. Computational thinking skills, often referred to as "21st century skills," assist in effective problem solving (Shute, Sun, & Asbell-Clarke, 2017). Computational thinking skills include algorithmic thinking, debugging, iteration, and pattern recognition. By December 2020, mentors at STEMaven will demonstrate improved effective, and evidence-based instruction proficiencies. The improvement of effective and evidence-based instruction proficiencies will increase confidence in facilitating workshops and encourage the interest of computer science and aid in closing the gender gap in the technology profession. The director outlined the need for mentors to understand effective and evidence-based teaching strategies that aid in interest in computer science. STEMaven's goal was assessed through mentor surveys as well as interviews collected through January 2020.

Related Literature

The broadening gender gap has a negative impact on the future of diversity, creativity, and innovation within the STEM workforce. First, stereotype threat directly influences middle school-aged females' attrition from STEM fields. Secondly, a lack of professional role confidence is a direct cause of low graduation rates among college-aged women. Lastly, the lack of interventions and female role models ultimately deters young girls from pursuing a STEM career.

As early as middle school, the gender gap affects females who aspire to achieve a career in STEM due to low self-efficacy and stereotype threat. A majority of middle and high school girls are deterred from pursuing a STEM career due to outdated stereotypes still present in society (Hughes, Nzekwe, & Molyneaux, 2013). From STEM-related posters in the classroom depicting mostly male scientists to aisles of toys targeted at boys, girls are silently guided to believe there is little to no room for them in STEM (Tan et al., 2013). Furthermore, Tan et al. (2013) conducted a study with middle school and first-year college students and identified three ways in which a sense of belonging can be found within a classroom: earning good grades, being surrounded by classmates who share the same interests, and sustaining a high level of effort (Tan et al., 2013). Lastly, stereotyped beliefs of STEM classes as male-dominated can begin as early as the primary grades (Blažev, Karabegović, Burušić, & Selimbegović, 2017). Blažev et al. (2017) conducted a study of 883 primary-aged Croatian students and found that, regardless of prior school achievement, students with stereotype-consistent interests in school subjects tend to show stronger stereotype endorsement than others. The long-term effect of stereotype threat in STEM disciplines adds to the layer of difficulty in preserving women in STEM careers. The added layer of complexity extends to a lack of professional role confidence in college-aged women.

Lack of professional role confidence among college-aged women is directly linked to their ability to see themselves as successful STEM professionals. This lack of confidence in pursuing STEM disciplines affects the already low rate of women earning STEM degrees (Hardin & Longhurst, 2016). Litzler, Samuelson, and Lorah (2014) discovered, from a large-scale 2008 online survey of over 10,000 undergraduate students, that encouraging professors and student community, comparison to peers, major desirability, and GPA have a significant, positive relationship with professional STEM confidence. Furthermore, the study showed family members, teachers, peers, and supervisors who encourage college-aged women to create a strong sense of STEM self-confidence are critical for establishing resiliency. The benefit of an active community of peers and family from an early age through the completion of a STEM degree decreases stereotype threat.

Women who earned a STEM degree persevered in a habitually male-dominated arena by believing they belonged and deserved to be there (Zeldin, Britner, & Pajares, 2006). Over the last three decades, the number of women who earned these degrees has increased while their number in STEM careers consistently remains about 15% (Ceci, Williams, & Barnett, 2009). Women who graduate and pursue these careers may still lack professional STEM confidence. Cech, Rubineau, Silbey, and Seron (2011) argue this lack of professional STEM confidence is the primary reason women leave these careers. STEM confidence affects the retention of young girls and college-aged women within these careers, and the gender gap is linked to the decline in retention rates of this population, driving the need for intervention programs to foster STEM interest and self-esteem.

Recognizing the need for interventions, many elementary, middle, and high schools created after-school programs to engage young girls in STEM activities. Studies show programs aimed at increasing girls' interest and self-esteem in STEM are successful at motivating them to pursue STEM careers. Hyllegard, Rambo-Hernandez, and Ogle (2017) conducted a study of 72 middle school girls and found those with the lowest self-esteem in STEM expressed the highest interest in mathematics and science, followed closely by girls with the highest self-esteem in

STEM sharing the same interest. Furthermore, formal semester-long after-school programs may result in stronger long-term outcomes (Hyllegard et al., 2017). Research consistently finds more schoolboys than girls are likely to have a positive perception of STEM subjects (Liben & Coyle, 2014), so there is a need to increase middle school girls' interest in computer science. According to a study by Shuen et al. (2011) of 319 female students, hands-on semester- and year-long workshops have a positive, long-lasting effect on STEM self-esteem and interest.

Long-term mentorship from female faculty, as well as female graduate and undergraduate students, has been proven to inspire young girls to pursue STEM fields and improve their attitudes toward these subjects (Shuen et al., 2011). In another study by Halim, Soh, and Arsad (2018), descriptive analysis revealed a high interest in science among both genders, while inferential investigation indicated a significant difference in interest in mathematics among girls.

Importance of the Evaluation

Providing increased opportunities through effective and evidence-based instruction and mentorship for middle school girls that motivate and retain an interest in computer science is vital for a variety of reasons. STEM helps bridge the gender and ethnicity gap in science and mathematics (Werner & Denning, 2009). It facilitates economic development, thereby enhancing job creation. Additionally, a growing body of evidence suggests effective after-school programs can have positive outcomes for girls in middle school (Campbell, 2011). Thus, the organization needs to increase retention and cultivation rates to continue bridging this gender gap. Evaluating the organization's performance and how it provides increased opportunities through effective and evidence-based instruction and mentorship for middle school girls provided formative data to assess the organization's programming decisions.

Description of Stakeholder Groups

Three stakeholder groups play a role in the goal of this study. The STEMaven program director selects the workshops, recruits the mentors, and manages the program's overall performance. The mentors help facilitate the learning of the curriculum, revise workshops to adapt to the students' learning level and encourage the development of interest in computer science to ensure progress and growth of attendance rates. The student participants partake in the workshops designed to encourage and retain an interest in computer science (Table 1).

Stakeholders Groups' Performance Goals

Table 1

Organizational Mission, Global Goal and Stakeholder Performance Goals

Organizational Mission		
The mission of the STEMaven is to inspire middle school girls in East Tennessee to actively explore the fields of technology, to close the gender gap in the technology profession, and to foster participants' future careers.		
Organizational Performance Goal		
By December 2020, mentors at STEMaven will demonstrate improved knowledge and use of effective and evidence-based instruction proficiencies.		
STEMaven Program Director	STEMaven mentors	Participants
By August 2019, the program director conducted an analysis of the FY17-FY18 framework used to determine content for workshops and strategies that encompassed effective and evidence-based strategies.	By November 2019, the mentors contributed to the achievement of the organization's performance goal by facilitating coding and technology-related workshops that encourage development of interest in computer science.	By December 2020, middle school girl participants will have increased engagement in workshops due to use of effective and evidence-based teaching strategies used by the mentors.

Stakeholder Group for the Study

While the joint efforts of all stakeholders contributed to the achievement of the overall organizational goal, it was essential to evaluate why the majority of mentors had a lack of knowledge in effective and evidence-based teaching skills. Therefore, the stakeholders of focus for this study were the mentors at STEMaven.

The mentors contributed to the achievement of the organization's performance goal by facilitating workshops that increase interest, confidence, and perceptions of computer science. The program plays a significant role in bridging the gender gap in science, technology, engineering, and mathematics and improves the students' problem-solving skills.

Purpose of the Project and Questions

The purpose of this study was to evaluate the effectiveness of STEMaven mentors necessary to achieve the goal of instruction that motivates and retains middle school girls' interest in computer science. Employing the Clark and Estes (2008) gap analysis model, the analysis focused on knowledge, motivation, and organizational influences related to achieving this organizational goal. While a complete needs analysis would focus on all STEMaven stakeholders, for practical purposes, the stakeholders in this analysis were all STEMaven mentors. Four questions guided this study:

1. To what extent is STEMaven contributing to the development of effective and evidence-based teaching skills in the mentors?
2. What are the STEMaven mentors' knowledge and motivation related to improving their effective and evidence-based teaching skills?

3. What is the interaction between STEMaven's organizational culture and context and the mentors' knowledge and motivation to improving effective and evidence-based teaching skills?
4. What are the recommendations for STEMaven's practice in the areas of knowledge, motivation, and organizational resources?

Methodological Framework

A mixed-methods approach to this study allowed for the quantitative and qualitative assessment of survey and interview results. Information gathered provided insight into the knowledge, motivation, and organizational factors necessary for STEMaven to inspire middle school girls in East Tennessee to actively explore the possibilities of technology, to empower their future careers, and to help close the gender gap in the technology profession. Data were gathered using a screening survey and semi-structured interviews. A survey was used to validate the assumed influences outlined in the knowledge, motivation, and organizational factors tables, and in-person interviews explored the assumed knowledge, motivation, and organizational causes of effective and evidence-based instruction and mentorship. The survey utilized a combination of Likert scale and multiple choice. Descriptive analysis was conducted upon completion of the simple survey results, and both the mean and standard deviation were identified to find the averages in responses. Interviewees were purposefully recruited for participation after the screening surveys were submitted.

Definition of Terms

The following terms and acronyms are used for this study:

After-school program: Any organized activity youth can participate in outside of the traditional school day or classroom.

Coding: The process of using a programming language to get a computer.

Computer science: The study of computers and computational systems, mostly related to software and software systems.

Gender gap: The unequal balance of opportunity or status through social, intellectual, or economic attainment.

Hands-on: relating to, being, or providing direct practical experience in operation or functioning of something.

Instructional interventions: Specific program or set of steps to aid in the development of learning.

Mentor: An experienced advisor who shares information about his or her own career path, as well as guidance, motivation, emotional support, and role modeling.

Retention: The ability to keep or the continuation of holding an interest in the subject.

Self-efficacy: belief in one's own power to do things successfully.

STEM: Pertaining to the culture and integration of curriculum on science, technology, engineering, and mathematics.

Stereotype threat: When someone feels themselves to be at risk of conforming to stereotypes within their social context.

Technology: The application of scientific knowledge for practical purposes, especially in industry.

Organization of the Project

Five chapters were used to organize this study. This chapter provided the key concepts and terminology commonly found in a discussion about the gender gap in STEM-related to computer science. In addition, STEMaven's mission, goals, stakeholders, and the framework for the project were introduced. Chapter Two provides a review of current literature on after-school programs. Topics such as the history, impact, and structure of after-school programs were addressed. Chapter Three details the knowledge, motivation, and organizational elements of STEMaven that were examined, as well as methodology related to achieving the organizational goal. In Chapter Four, the data and results were assessed and analyzed. Finally, Chapter Five provides solutions, based on data and literature, for closing the perceived gaps as well as recommendations for an implementation and evaluation plan for the solutions.

CHAPTER TWO: REVIEW OF THE LITERATURE

This literature review examined the problem of cultivating and retaining middle school girls' interest in computer science. The chapter begins with the definition and history of after-school programs. It discusses general research on the different types of in-school and after-school computer science instructional interventions available to middle school girls around the United States. To understand the benefits of after-school computer-based programs in middle schools, elements of computer science after-school programs need to be defined. The review presents an in-depth discussion on the characteristics of successful programs in relation to evaluation, professional development, sense of community, and rigor of instruction. The relationship between school programs and gender disparity and self-efficacy, school retention rate, and inequality in opportunities for employment and education are also examined. Following the general research literature, this chapter provides an overview of the Clark and Estes' (2008) knowledge, motivation, and organizational influences framework used in this study. This section defines the types of knowledge, motivation, and organizational influences to increase mentors' ability to meet the organizational goal. The chapter ends with a presentation of the conceptual framework guiding this study.

An Overview of After-School Programs

After-school programs, sometimes referred to as instructional interventions, have increased in popularity over the past 15 years (Durlak, Mahoney, Bohnert, & Parente, 2010). The majority of these programs provide elementary and middle school students an opportunity to socialize with peers, interact with positive role models, and receive assistance in completing a task, such as homework or a project. A high-quality program allows students to construct relationships with peers and mentors in an informal setting, increasing motivation, and connecting with their interests (Nugent, Barker, Grandgenett, & Adamchuk, 2010). In this context, students benefit academically and forge new social networks while learning the tools needed to be a STEM professional.

After-school programs are created for a variety of disciplines and structured to support different ability levels. These programs allow exposure to unique opportunities not typically found in the classroom, which enriches and foster interest in STEM (Hollister, 2003). Naizer, Hawthorne, and Henley (2014) developed a theoretical framework for building after-school programs to retain middle school girls' interest in computer science. This model permitted for participants to build self-efficacy through gender-specific workshops offered within a well-designed after-school program. Other studies have shown positive affective outcomes from similar interventions. For example, Grolnick, Farkas, Sohmer, Michaels, and Valsiner (2007) found a supportive and engaging after-school program can cultivate interest, motivation, and competence in middle school-aged girls. The quality of these workshops depends on the level of support, the knowledge and motivation of the facilitators, and the capabilities and proficiency of the coordinator (Lundh, House, Means, & Harris, 2013).

History and Growth of After-School Programs

The growth of after-school programs has provided an avenue for expanded enrichment and learning opportunities for all ages and genders, with more recent programs designed specifically for middle school girls (Mouza, Marzocchi, Pan, & Pollock, 2016). This has allowed for the cultivation of girls' interest in computer science and the reduction of the gender gap in computer science. After-school programs primarily began due to historical changes in the labor force and the formal school setting (Halpern, 2002). During the late nineteenth century, the need for children in the labor force dropped dramatically (Schuman, 2017). During this time, expectations of students' academic success increased and were expedited by the creation of universal, compulsory education (Halpern, 2002). The first type of after-school club was for males only, called "boy's clubs," and took place after school hours. By the early twentieth century, researchers noted after-school programs could aid in student's growth and development (Mahoney, Lord, & Carryl, 2005).

Current computer science-based after-school programs have grown in both depth and funding over the last 30 years. Before the 1970s, after-school programs were rare, and, often, students did not have an outlet to boost interests in areas outside of school (Afterschool Alliance, 2017). Most care was provided at home by parents or family members, and, when family members were not available, children were cared for by neighbors or family friends. At home, children typically had an outlet in a nurturing setting and an opportunity to work on homework, play, have snacks and participate in extracurricular activities (Mahoney et al., 2005). With the change in American economics and dual-income households, supporting at-home after-school care is increasingly difficult. After-school care provides the support students need in a well-organized atmosphere (Junge, 2003). Considerable growth of after-school programs is evident by an increase in media coverage and funding by government and private organizations (Wade-Jaimes, Cohen, & Calandra, 2019).

In 1994, Congress established the 21st Century Community Learning Center program (Zhang & Byrd, 2006), which allowed local schools to open up for broader use by the community. In 1998, the programs refocused on providing the same type of enrichment during summer break. Programs ran between three and five years with funding to support a new program. Three-year programs are fully supported each year, while 5-year programs are supported in decreasing amounts each year.

In the last decade, Congress appropriated over a billion dollars a year to maintain or establish after-school programs across the country (Zhang & Byrd, 2006). Since 2000, federal, state, and city governments, as well as communities, have pushed initiatives to create or expand after-school enrichment programs. An estimated 23% to 30% of American students, from both public and private schools, attend an after-school program a minimum of three days a week (Zhang & Byrd, 2006).

Link to Education Reform

After-school programs have seen a jump in attendance due to the increase in divorces, single-parent homes, and families in which both parents are employed (Mahoney et al., 2005). After-school programs reduce peer pressure and outside negative influences for those who attend (Afterschool Alliance, 2017). According to the American Institute for Research (2008), the goals of after-school programs are to be well-organized and provide quality curriculum, implementation, supervision, facilities, and evaluation procedures. The most significant influence on achievement is the quality of the program (U.S. Department of Education, 2016). Since the inception of No Child Left Behind (NCLB), state and federal accountability requirements increased expectations for student achievement and engagement in English language arts, science, and mathematics. NCLB legislation mandated each state set a starting point for yearly progress and raise this bar annually through 2014 (Seaton & Carr, 2005). In turn, the school increased and promoted innovative teaching and higher levels of engagement to raise student interest and achievement. The number of after-school programs increased to meet district goals. After-school interventions have grown throughout the years by focusing on the different types of learning formats and support from the community. The history and growth of after-school interventions led to the development and utilization of multiple models (Afterschool Alliance, 2017).

After-School Computer Science Instructional Interventions

Arizona State University started the Center for Science and Imagination in 1992 to bring together scientists and artists and combine the two disciplines (Perera et al., 2017). Scientists reported the kind of teaching involved in the sciences was also part of the arts curriculum (Perera et al., 2017). Curiosity is fundamental, regardless of whether one is an engineer or artist (Payton, White, & Mullins, 2017). Combining the disciplines improves understanding of how a set of research questions can influence research questions asked elsewhere. The National Science Foundation (NSF) supports blending movement and computer programming, as this supports building the computation thinking skills of young girls. Also, the Education Testing Services found hands-on project-based lessons improve retention, augment design thinking, and offer a different approach to learning computer science (Mesiti, Parkes, Paneto, & Cahill, 2019). Therefore, hands-on learning is likely to improve retention (Mesiti et al., 2019).

Universities are collaborating with local industry and school systems to improve students' preparation through innovative experiences wherein students can network with professionals and expand on their identities as achievers (Verma, Dickerson, & McKinney, 2011). These after-school programs provide students hands-on learning and are funded over multiple years (Migus, 2014). Typically, these programs are structured to take place on weekends with an additional two-week academy in the summer and focus on middle school-aged students. The curriculum encompasses field trips to museums and career day events. Teachers in these programs are generally middle school teachers who receive 40 hours of professional development and 40 more hours of follow-up training and support. Teachers are trained in curriculum implementation and also receive free materials and resources to teach the same lessons in their classrooms (Migus, 2014).

Nonetheless, middle school after-school programs should be more than an extension of the classroom or preparation for high school learning. To have an effective impactful and challenging after-school program, the staff needs to be well-trained and dedicated. There should be a set of norms, values, and expectations, and asset-based standards to make the teachers more facilitators than managers (Morehouse, 2009). Morehouse (2009) adds that lessons need to have meaningful projects to allow students to contribute to a greater good and solve a problem. They should have a reinforcing structure consistent with supporting youth as they develop emotionally, socially, and morally. Lastly, all lessons need to have a hands-on approach to learning with group projects with real-world implications. Making a program challenging provides individual instruction, learning experiences, and expectations. As such, the program benefits students by improving retention, creating more interest, and allowing them to establish connections with peers (Morehouse, 2009). Moreover, in partnership with community organizations, after-school programs can create challenging and high-quality curriculum (Nugent et al., 2010).

After-school programs can only be effective if they are funded. Rorie, Gottfredson, Cross, Wilson, and Connell (2011) found 65% of registered voters believe after-school programs were necessary for their communities (Afterschool Alliance, 2017). Since 2006, Congress has invested over $1 billion in these programs. Effective after-school programs include constructive activities, socialization skills, and promote positive goals. In addition, they encourage positive self-efficacy in the discipline. According to Girod, Martineau, and Zhao (2004), after-school programs in rural and inner cities have been funded $250 million from the U.S. Department of

Education over the past decade. For instance, KLICK! (Kids Learning In Computer Clubhouses!) is a federally funded after-school computer program based in Michigan, developed by local teachers and funded by the Department of Education and the Kellogg Foundation. The program supports 200 students at 10 schools (Girod et al., 2004). Students build webpages, surf the internet, chat online, film and edit movies, and play computer games. Students develop a newsletter and compete in video games and robotics. The program has allowed teens who are less successful in traditional school classrooms to thrive and become empowered as they learn new skills and apply them without being judged by their peers. Research shows participation is active for teens who typically do not value school, have a low GPA, and have little knowledge of technology.

Characteristics of Successful After-School Programs

Effectiveness of after-school program achievement is assessed based on four categories: identification of theoretical framework, formulation of initial scale, a test of content validity, and confirmatory factor analyses. The structure of these programs commonly has four key objectives; academic development, social behavior, caring environment, and personal inspiration (Afterschool Alliance, 2017; Fashola, 1998; Little, Wilmer, & Weiss, 2008). Quality programs usually combine academic, recreational, physical, and artistic elements throughout the curriculum to engage students (Grogan, Henrich, & Malikina, 2014). In addition, evaluations are essential in establishing a process to monitor the progress of achievement and allow for curriculum adjustment, reallocation of funding, improvement of facilities, staff development, decision making, and accountability (American Institute for Research, 2008). A school's after-school program is only useful when administrators support it. Establishing an effective after-school program requires thinking strategically about the future of the program and collaboratively sharing ideas, missions, and resources in developing the program (McElvain & Caplan, 2001).

For instance, Omaha, Nebraska, is expected to become a "tech hub" by 2020. Moreover, it will become a national "STEM Ecosystem" with help from community organizations and by being part of the STEM pipeline (Leas, Nelson, Grandgenett, Tapprich, & Cutucache, 2017). Becoming a STEM Ecosystem requires community organizations committed to providing high-quality STEM training and increasing the workforce for long-term economic stability. To create the STEM Ecosystem, the city created after-school activities called NE STEM 4U centered on problem-based learning, which has increased content knowledge (Leas et al., 2017). Furthermore, it is designed for youth who are forming their opinion about STEM areas and careers. This program's model can be duplicated in other cities to increase STEM awareness and curiosity.

Environment

An environment that promotes a positive learning experience for middle school girls is one that employs culturally responsive teaching strategies. These strategies center the lessons around the cultural knowledge, prior experiences, the frame of reference, and performance styles of how middle school girls learn to make the lessons more relevant and useful for them (Gay, 2000). Positive relationships occur between mentor and participant when culturally responsive teaching is utilized as it builds interaction between academic and socio-cultural realities (Ladson-Billings, 1992). Programs that promote mentors to be culturally sensitive create a framework where a wide variety of instructional strategies build upon multiple intelligences that teach participants how to incorporate a combination of information from various disciplines in one lesson (Gay, 2000; Ladson-Billings, 1992).

Mentors can be organized into three categories: cultural organizers, cultural mediators, and orchestrators of social contexts for learning (Diamond & Moore, 1995). When a mentor understands the vital role culture plays during a lesson and thus provides opportunities for students with different levels of intelligence to freely express themselves, they are considered cultural organizers. Cultural mediators are those who offer opportunities for participants to engage in critical dialogue centered around cultural conflicts and then analyze variances between reality and those that are from a different cultural mindset. Mentors must recognize the importance of how culture can influence learning to make their facilitation of lessons compatible with the social, cultural contexts of middle school girls (Diamond & Moore, 1995).

Cooper, He, and Levin (2011) explained the Critical Cultural Competence or CCC, as a process that extends beyond basic knowledge of diversity, culture and climate, confidence and self-efficacy and toward a self-reflection on the biases that can occur in an educational setting. Ladson-Billings (2001) viewed CCC as the responsibility and action of mentors to learn about the background of their students and the reasons why they are participating in the program. This thought process transpired the necessity for educators to participate in quality professional development opportunities regarding educating diverse learners. Without professional development, Cooper et al. (2011) proposed, concepts of difference are likely to be left unattended, while students are left isolated from their diverse thinking while their mentors abandon the instructional learning process.

Program Approaches and Professional Development

Professional development focused on standards that define computer science is necessary for better implementation of after-school programs. Effective after-school programs are designed to meet local needs and combine elements beyond state standards. Fashola (1998) stated after-school programs are successful when they provide structure, a link to the school curriculum, and employ well-qualified and well-trained staff. Consistent and fluid training for all staff contributes to programs' giving engaging experiences for students. An example is the effective research-based professional development characteristics of the NSF GK-12 Program, which partners universities with local school districts and places university STEM graduates in the classroom with teachers and which uses an inter- and intra-reliability testing concept. The NSF supports teacher professional development, and approximately 20% of all federally supported research at U.S. higher education institutions (Cormas & Barufaldi, 2011). The objective of the GK-12 professional development program is to increase communication and teaching skills, best practices for teaching, additional professional development, and improved partnership with local school districts and higher education institutions. Participants have a shared vision, and, within these programs, there are key stakeholders, plenty of resources and time for planning, time for collaboration and support from outside professions, and proximity to universities.

The partnership between the Department of Teacher Education and School of Engineering at the University of Dayton and a Dayton Regional STEM center created the STEM Education Quality Framework (SQF). SQF is a tool to guide STEM teachers. The program includes curriculum development in a 6-week NSF program. Its objective is to increase the knowledge of teachers, empower teachers to provide an innovative experience to their students, as well as be informed to give students potential careers and societal needs (Pinnell et al., 2013).

The program is structured with an introductory innovation and design project, followed by a more in-depth design project provided by an industrial mentor. It includes industry tours and training related to curriculum design and pedagogy. There are also brainstorming sessions, a five-step process for curriculum development, including midterm edits and assessment, culminating with a web-based publication of the curriculum.

Teacher Preparation and Engagement

Out-of-school programs also benefit teachers through additional preparation. Teachers in after-school programs develop a similar language, network, and attitude conducive to the program (Ulvik & Sunde, 2013). Since teachers need a conceptual understanding of their role in after-school programs as well as practical skills, these programs equip them with skills to help them in guiding and teaching.

Moreover, Wahl-Alexander, Schwamberger, and Neels (2017) observed teachers who participate in after-school clubs are more likely to enrich communication with community members. They also incorporate new methods of organization and scheduling. Teachers feel a sense of community with their peers and ownership in designing program lessons. They feel a sense of affirmation at the close of the program and a deeper understanding of student affiliation. Teachers increase their collaboration with parents and develop effective communication strategies to enhance the parent-teacher connection.

Teachers in after-school programs gain knowledge through teaching lessons (Hynes, 2012). They enhance their teaching strategies and content knowledge by using examples or analogies students understand. After-school programs provide an opportunity for teachers and mentors to improve their professional skills, content knowledge, and community outreach. These programs benefit not only students and teachers but help to close the gender gap by increasing interest in computer science in middle school girls.

Rigor of Instruction

Rigor is widely used in the education system to describe instruction, learning experiences, and academically challenging educational expectations. The rigorous and motivating curriculum can be successfully infused within high-quality after-school computer science programs. The Education Trust conducted a study in 2015 and found computer science was viewed as frustrating and often resulted in modest learning gains and interest. Results showed after-school programs have the flexibility to reduce this stress through cooperative learning and meaning as well as through individualized relationships between students and educators.

Impact of After-School Programs

There are two main types of after-school programs throughout the country: camps that occur during the summer months and after-school programs that occur during the school year. Both types of after-school programs allow students to learn and develop interests to increase their engagement in everyday and academic life. Most of these programs are supported by school districts and include a range of activities as well as play, snacks, homework, and enrichment.

Most experiences take place during the school year, but outside of the classroom, and lessons align more closely with the school curriculum. They are driven by students' authentic interests, are flexible in time and space, credit-bearing, and aligned with school and community collaboration. Programs that support computer programs address subject matter, practices, terms, and instruments not included in the average school day or even covered in advanced grade levels. Examples of these programs are learning at a local research agency and participating in a youth research team associated with a local organization. Both policymakers and funders view after-school programs as a viable way of engaging students in a high-quality program to build interest and commitment to a discipline (Bevan & Michalchik, 2013).

Real-Life Skills

After-school programs permit school districts to add new classes to the traditional school curriculum. These programs allow students to experience "real-life" skills and develop knowledge, which can lead to a life-long interest. Patriots Technology Center Training Center at Kettering Middle School has been offering after-school programs for 15 years (Gay, 2012). The center hosts exhibit on cybersecurity, video gaming, robotics, flight simulation, and computer building for students and parents to view. Each team develops a video game which is judged by gaming professionals. The center provides students exposure to computer science professionals, and a local video gaming conference continually recruits its students due to the program's success. The project manager states the success of the program occurs when former club members go to college, get jobs in the areas of computer science, and return to share their experiences with current students. Although there is a wide range of instructional interventions, there is a common theme of success. Along with describing examples of after-school programs, crucial elements are highlighting current computer science instructional interventions.

Female Student Self-Efficacy

Current research on characteristics of exceptional after-school programs is abundant and highlights the qualities, goals, and evaluations used to sustain these programs. Research shows after-school computer programs have a positive impact on attitude, self-efficacy, and knowledge for middle school girls. After-school programs present a unique opportunity for middle school girls academically, socially, and emotionally (Naizer et al., 2014). Naizer et al. (2014) explained after-school programs have a positive impact on student attitudes toward mathematics and science, with even short bursts of intervention showing immediate benefits. The authors found consistent exposure in an after-school program resulted in increased interest in STEM subjects. Exposure to role models has a positive impact on middle school girls by improving attitudes toward the discipline (Weber, 2011). Middle school girls who begin to think about a career in computer science and find a role model in the field are more likely to pursue a computer science degree.

After-school programs allow students to understand concepts, processes, and procedures better. These activities enhance achievement and interest in computer science and lead to an increase in inquiry and reasoning skills (Sahin, 2013). After-school programs also motivate students to work together, share ideas and have a sense of belonging. Studies show students' participation in a computer science after-school program in their early years enhances and retains their interest (VanMeter-Adams, Frankenfeld, Bases, Espina, & Liotta, 2014).

Students report a more positive experience in after-school programs when they are structured, including positive emotions (Shernoff, 2010). Studies also show an increase in social competence. Students learn how to better work with others through cooperation and teamwork. They have an increase in empathy and understanding, which is critical to understanding different perspectives of thought. They have an increase in psychosocial adjustment and social skills and also learn how to develop relationships with their peers and adults.

After-school programs foster problem-solving skills that transfer to learning in a typical classroom environment. According to Mayer, Quilici, and Moreno (1999), students learn content-specific skills taught via educational games, general cognitive abilities, including learning strategies in an informal setting; and gain exposure to educational computing environments, which can transfer to improved cognitive processing in a variety of situations. As such, the programs prepare students with the skills to be change agents in the field, and retention of interest continues to solidify.

Female Student Retention

After-school programs are increasingly recognized as aiding in the retention of girls' interest in STEM. Schools, both public and private, seek outreach opportunities to prompt STEM and attract more girls to the field (Ma & Schapira, 2017). Workshops are created in a collaborative effort to make equipment readily available, train teachers, provide step-by-step instructions, and design individual tasks to help students more easily understand concepts and want to practice more. Visits to museums and natural settings, entering science fairs, and joining STEM-related clubs at their school also help to make a lasting impression on female students' interest (Cech et al., 2011).

Reducing Stereotyping

There has been a history in the United States of stereotyping women as unable to succeed in STEM (Campbell, 2011). Werner and Denning (2009) noted the attitude that the field is competitive and masculine causes the low number of women in computer science. The rate of female undergraduates in computer science declined from 37% in 1984 to 27% in 1997 (Denner, Werner, Bean, & Campe, 2005). The decrease may be caused by a lack of confidence and stereotyping. Furthermore, Denner et al. (2005) found a high need for interventions to increase the interest and ability of female students in computer science and related careers. Similarly, the NSF completed a study on the learning environment's effect on students' perspective of stereotyping and found a combination of a sense of belonging or how they were valued played a role in eliminating this factor.

Girls Creating Games is a current example of an after-school and summer program for sixth- through eighth-grade girls aimed at reducing stereotype threat and activating interest in information technology. The program centers around girls in the role of a designer of interactive computer games. A second example is pair programming, which helps to improve women's representation in computer science as well as increase practical problem solving in computer science coursework (Werner & Denning, 2009). Pair programming involves two students sharing one computer and each having a clear role. One is the driver who manages the keyboard and mouse while the other navigates, requiring collaboration. Working with a partner in such a format is appealing to girls because it aligns with their social interests (Werner & Denning, 2009). Computer games are considered an essential component in building children's problem-solving skills (Curtis & Lawson, 2002). Notably, they drive girls toward the role of tech leaders, which helps to break down stereotypes and discrimination.

Closing the Gender Gap

Computer science programs provide unique hands-on learning experiences to middle school girls. Girls are typically not attracted to computers and computer programming, and a way to curb this thought process is to introduce young girls to computers and how they work (Shortt, 1998). Through after-school computer clubs, computer camps, or enrichment programs aimed at girls, girls will become familiar in a non-stressful environment, allowing for them to be encouraged to use a variety of technologies. These after-school programs should include the history of computers and the contributions of this technology from the women who created them.

Mayer-Smith, Pedretti, and Woodrow (2000) stated gender stereotypes are decreasing with computer science instruction. This is due to the increase in after-school programs, which boost attitudes on the subject and experience at a younger age. Modern culture has added to the rise in computer science interest through social media and video gaming. In addition, the increase in computer usage in all classrooms starting in the elementary years increased self-efficacy and pushed technology as a norm.

Girls who participated in a computer-game construction experiment were just as successful as their male counterparts. Computer-game construction enhances essential discipline-related high-order thinking skills, teaches valuable computing science abstraction skills, and is not male-dominated. Computer science is the fastest-growing economic sector, with a 68% increase in output growth rate projected for the next decade (U.S. Bureau of Labor Statistics, 2017). With computational science is a critical factor in solving current real-world issues, such as space travel, environmental modeling, cell phones, online social media, and even the development of medicine, local schools are starting to support out-of-school programs to boost the retention of interest (Carbonaro, Szafron, Cutumisu, & Schaeffer, 2010). Middle school girls who participate in after-school computer science programs tend to have a higher self-concept but also experience gender bias more than their male peers. Gender bias can come from male peers, teachers, mentors, and even female peers. There is evidence of misappropriation in computer science and ongoing gender segregation. Having the outlet of the computer science after-school program allows middle school girls to obtain positive peer connections and promote retention of interest (Robnett, 2016).

Knowledge, Motivation and Organizational Influences Framework

The Clark and Estes (2008) gap analysis framework was designed to evaluate problems within an organization through a review of knowledge and skills, motivation, and organization. When a gap exists within any of these categories, performance goals become unattainable. The framework allowed for an examination of the root cause of gaps to improve individual and organizational performance (Clark & Estes, 2008). Krathwohl (2002) stated there are four types of knowledge types needed for employees to solve performance issues and achieve stakeholder goals: factual, conceptual, procedural, and metacognitive. Clark and Estes explained motivation is centered on an employee's personal beliefs about themselves and their coworkers. The authors emphasized motivation requires three process areas: active choice, when people act upon their decision to work toward a goal; persistence, when people continue working toward their goal despite barriers and distractions; and mental effort when people decide the amount of energy to put into working toward their goal and do so. Additionally, motivation is a critical factor in achieving the success of a target due to beliefs one develops for one's self as a learner and achiever (Rueda, 2011). Finally, organizational influences on stakeholder performance may include organizational culture, processes, and resources (Clark & Estes, 2008).

The Clark and Estes (2008) gap analysis framework was applied to the STEMaven computer science instructional intervention in terms of teacher knowledge, motivation, and organizational needs to meet performance goals. The following sections discuss assumed influences on the stakeholder performance goal in the context of knowledge and skills. Secondly, assumed influences from the motivational perspective are described. Finally, assumed organizational influences are studied. Each of the assumed stakeholder knowledge, motivation, organizational influences on performance were examined through the methodology discussed in Chapter Three.

Stakeholder Knowledge, Motivation and Organizational Influences

Based on a review of current research, two knowledge influences on STEMaven's mentors are discussed in the next section, followed by the types of knowledge, which helped to determine the methodology to assess mentors' knowledge gaps.

Knowledge and Skills

Clark and Estes (2008) affirm that, when an organization invests in resources to increase employees' knowledge and skills, there is a positive long-term impact on the organization's productivity. The authors suggested reinforcing knowledge and skills pertinent to the mission and vision improved the employees' aptitude in closing performance gaps related to their profession. Clark and Estes's reasoning was based on an assumption of performance being enriched when employees use the new knowledge and skills to solve performance problems and close the gaps between their current performance levels and performance goals. When employee performance gaps are closed, the organization strengthens its ability to achieve its organizational goals (Clark & Estes, 2008).

To solve performance issues and achieve their goals, employees need four types of knowledge. Factual knowledge consists of the essential facts and definitions an employee must know to understand their discipline or solve their performance problem. The second type is conceptual and includes the categories, principles, models, theories, and structures which allow employees to differentiate information and analyze correlations to the performance problems. The third type of knowledge is procedural, which is directly applied to a task to solve a performance problem. It consists of knowing how to do something, the methods of inquiry, and the criteria for using those skills, techniques, and methods. The fourth type is metacognitive. This type of knowledge allows for awareness and knowledge of one's cognition. The employee knows how they learn, about the task, and about strategies needed to carry out the task.

The first dimension is the knowledge influences required for mentors to achieve their goals. To help STEMaven mentor's close performance gaps, it is necessary to assess their knowledge influences and corresponding knowledge types. Based on a review of the current research, a procedural and a metacognitive knowledge influence on STEMaven's mentors are discussed in the next section. This categorization into the types of knowledge helped to determine the methodology to assess the STEMaven mentor's knowledge gaps.

Knowledge Influence 1 (Procedural). STEMaven mentors need to understand effective and evidence-based strategies in teaching middle school students in computer science (Allison & Rehm, 2007). Allison and Rehm's (2007) action plan highlighted the importance of effective strategies related to increasing middle school girls' interest in computer science. The first step is to review the descriptions and selection criteria in each lesson and scanning for verbiage students may not understand. The second step is for mentors to understand the importance of culture and climate within the program. The third step is to ensure facilitators have a strong background in their subject and have knowledge of best practices. The last step is to audit the lesson plans and check if they are organized explicitly around middle school standards and promote a vested interest in computer science.

Knowledge Influence 2 (Metacognitive). Mentors need to need knowledge of deficit thinking so they can promote a positive learning experience for middle school girls and employ culturally responsive teaching strategies. Mentors must know effective teaching strategies, apply the knowledge, and subsequently reflect on their effectiveness in teaching. Self-monitoring effectiveness in education is essential to retaining the girls' interest in computer science. Akl, Keathly, and Garlick (2007) found that actively reflecting on an organizations' effectiveness ensures ongoing success. The authors used a two-step evaluation plan with both formative and summative measures. The formative measure provided feedback regarding the development and implementation of the lesson plans, and the summative assessment addressed the quality and effectiveness of the activities. Di Stefano, Gino, Pisano, and Staats (2014) reported one becomes more effective at a task after reflecting on the way one has performed it before. The team conducted three studies based on the dual-process theory of thought. The results showed that, when a group used reflection and sharing through group talk, they performed an average of 18% or better. When employees meet to reflect on the who, what, when, where, and why, they can review previous learning and give learning a new meaning, these meetings have a positive impact on group morale. Table 2 illustrates an overview of the knowledge influences on STEMaven's mentors, corresponding knowledge types, and methods to assess knowledge gaps about the stakeholder and organizational goals and the mission of the organization.

Table 2

Knowledge Influences, Types, and Assessments for Knowledge Gap Analysis

Organizational Mission		
The mission of the STEMaven is to inspire middle school girls in East Tennessee to actively explore the fields of technology, to close the gender gap in the technology profession, and to foster participants' future careers.		
Organizational Global Goal		
By December 2020, mentors at STEMaven will demonstrate improved knowledge and use of effective and evidence-based instruction proficiencies.		
Stakeholder Goal		
The mentor goal, supported by the program director, is to facilitate workshops that increase interest, confidence, and perceptions of computer science.		
Knowledge Influence	Knowledge Type	Knowledge Influence Assessment
Mentors need to know how to incorporate effective and evidence-based strategies of teaching middle school girl's computer science.	Procedural	Survey items to assess his/her knowledge. For example, "I understand what skills are needed to have a culturally responsive lesson." (strongly agree, agree, disagree, strongly disagree) During my lesson(s) at STEMaven, I employ culturally responsive learning techniques." (strongly agree, agree, disagree, strongly disagree) "I take the time to learn about the background of my students and reasons to why they are participating in the program." (strongly agree, agree, disagree, strongly disagree)

Table 2, continued

Knowledge Influence	Knowledge Type	Knowledge Influence Assessment
Mentors need to know what deficit thinking is so they can promote a positive learning experience for middle school girls and employ culturally responsive teaching strategies.	Metacognitive	Interview questions for mentors to collect information on their reflective teaching strategies. For example, "Explain the importance of how cultural can influence learning." "How do you include this in your lesson(s) to make them compatible with the social cultural contexts of middle school girls?" "What strategies do you employ to address deficit thinking with other mentors and/or the director?" "Are students included in these strategies?"

Motivation

Motivation is the second dimension required for STEMaven's mentors to achieve their stakeholder goals. Clark and Estes (2008) explained motivation is centered on an employee's personal beliefs about themselves and their coworkers. As previously mentioned, the authors state motivation encompasses active choice, persistence, and mental effort. The authors cautioned employee performance challenges could hinder these three motivational process areas. By assessing and addressing motivational challenges, organizations can aid employees in closing the gaps between their current performance levels and their performance goals. When employee performance gaps are closed, the organization is closer to achieving its organizational goals. STEMaven can achieve its organizational goal by supporting mentors so that they can confidently teach computer science to middle school girls. Multiple factors can affect motivation and goal orientation (Rueda, 2011).

For STEMaven, two specific considerations are critical to success. First, mentors need to see how effective their teaching is in increasing retention of an interest in computer science. Second, mentors need increased confidence that they can teach computer science to middle school girls. For STEMaven to assess motivational challenges, understanding the motivational influences related to mentors' achieving their stakeholder goal is critical. This literature review focused on the effect of goal orientation and self-efficacy on mentors' motivation to effectively teach middle school girls in computer science. The application of these theories to assess the STEMaven's mentors' motivational levels are discussed. The type of motivation influence determined the methodology to evaluate mentors' motivational gaps.

Goal orientation. Goal commitment and implementation objectives are fundamental to achieving goal-directed behavior. Goal orientation is the degree to which an employee focuses on a task and the task's results. As Bandura (2000) wrote, unless people believe they can produce desired results and omit the lack of motivation, they have little incentive to get things done. With a strong goal orientation, employees will focus on the whole goal and how it will affect the organization. At STEMaven, for each new workshop, the educational project manager needs to describe in detail what the project is, the expectations, and a clear vision of how it is related to the objective of the program. When managers employ strategies based on strong goal orientation, productivity will increase with teachers reaching the goal along with utilizing current resources and skills. Also, a definite goal orientation allows teachers to see their contribution to the overall goal.

Self-efficacy. As Borgogni, Dello Russo, and Latham (2011) stated, to strengthen ones' self-confidence, one must work on self-efficacy and perception. Motivation needs to be supported by competent evidence in line with ones' conceptual reasoning (Pintrich, 2003). When an organization focuses on enhancing its collective efficacy, it increases employee self-efficacy, which leads to an increase in organizational productivity. When managers can recognize the needs and expectations of the employees, they will be at relating to others in a particular context or role efficacy (Borgogni et al., 2011). In addition, the researchers stated role efficacy is the potential value of a person in personal and interpersonal effectiveness while occupying a particular role. Understanding the role of efficacy and its relationship between role uncertainty and conflict helps to improve an organization's climate and employees' self-efficacy. The roles of employees must be clear, as they are considered an essential component of the group performing functions and aids in self-efficacy (Pintrich, 2003).

Richter, Hirst, van Knippenberg, and Baer (2012) found creative self-efficacy and individual creativity increases a team's resources. When there is shared knowledge and diversity within groups in an organization, there is an increase in both creativity and self-efficacy. When an employee harnesses their creative self-efficacy, they will have the knowledge and skills to produce creative outcomes and realize more creative benefits from team resources.
They will proactively access resources such as team members' knowledge, expertise, and insights. When employees have the belief in themselves to be successful in their tasks, their performance increases, and the organization's goal is accomplished.

Goal orientation and self-efficacy are the key motivational factors that influence teachers and mentors in successfully teaching in an after-school program. In addition to motivational factors, organizational factors need to be addressed when assessing the influence of these factors on an after-school program. Table 3 below identifies two motivational influences focused on goal orientation and self-efficacy. These influences were used to more fully understand how motivation affects the mentors' engagement in increasing the number of middle school girls' interest in computer science.

Table 3

Motivational Influences and Assessments for Motivation Gap Analysis

<table>
<tr><td colspan="2"><u>Organizational Mission</u>
The mission of the STEMaven is to inspire middle school girls in East Tennessee to actively explore the fields of technology, to close the gender gap in the technology profession, and to foster participants' future careers.</td></tr>
<tr><td colspan="2"><u>Organizational Global Goal</u>
By December 2020, mentors at STEMaven will demonstrate improved knowledge and use of effective and evidence-based instruction proficiencies.</td></tr>
<tr><td colspan="2"><u>Stakeholder Goal</u>
The mentor goal, supported by the program director, is to facilitate workshops that increase interest, confidence, and perceptions of computer science.</td></tr>
<tr><td><u>Assumed Motivation Influences</u></td><td><u>Motivational Influence Assessment</u></td></tr>
<tr><td>Goal Orientation: Intrinsic: Mentors need to see how effective their teaching is in increasing retention of interest in computer science.</td><td>Survey item, "Overall how satisfied are you with facilitating a STEMaven lesson(s)?" (very satisfied, satisfied, neutral, dissatisfied, very dissatisfied). "How motivated are you to see students succeed?" (very motivated, somewhat motivated, not very motivated, not at all motivated, not sure).</td></tr>
<tr><td>Self-Efficacy: Individual self-efficacy: Mentors need increased confidence that they can teach computer science to middle school girls.</td><td>Interview item "Tell me how confident you about my ability to teach middle school girls in computer science." (strongly disagree-strongly agree) Interview item: "</td></tr>
</table>

Organization

This section examined the possible organizational barriers or influences (Clark & Estes, 2008) affecting STEMaven mentors' ability to increase middle school girls' interest and retention of computer science.

Both organizational barriers and social barriers need to be discussed as interrelated constructs affecting the increase in the number of middle school girls' completion of the computer science program. Along with the knowledge and motivational gaps, organizational factors such as organizational identity and continuity, trust, and access to best practices modeling are linked to having the elements to accomplishing the performance goal.

Organizational culture theory. Schein (2017) defined culture as basic conventions learned by a group as they solve a problem. These conventions can then be transferred to new group members as the appropriate way to recognize, reason, and feel when the same problem arises. There is a benefit in the cognizance of these cultural forces.

Therefore, the culture affects this change process and, thus, the ability to maintain the desired change (Kezar, 2001).

Schein (2017) described culture as an influential construct consisting of three levels: artifacts, beliefs and values, and basic underlying assumptions. According to Clark and Estes (2008), culture is multi-dimensional and serves as a channel for describing the goals, beliefs, and processes gained by employees over a period of time. These basic underlying assumptions are the most defiant aspects of culture to adopt in the change process, especially in organizations with a perceived resilient culture (Schein, 2017).

Organizational culture can be deep-seated and lend to stability, as some theorists suggest flexible and adaptive learning has a more promising position to prepare employees for the complex and changing world (Senge, 1990). This type of thought can be matured through the obligation to the inquiry, communication, diversity of thought, and a commitment to acknowledging that problems are complex and interconnected (Schein, 2004). Change to the cultural environment cannot improve on its own and must be shared by all employees within an organization (Senge, 1990). Gallimore and Goldenberg (2001), as described in this paper, divided culture into two categories: cultural models and cultural settings. There are two cultural models and two cultural settings influencing mentors to facilitate workshops that increase interest, confidence, and perceptions of computer science.

Cultural models. Cultural models are an organization's internal beliefs and values. The socio-culture framework suggests these models are often seen as barriers, but, if addressed along with knowledge and motivation, they can then become opportunities for growth. The two cultural models are organizational identity and continuity, along with trust, and the specific cultural setting is the STEMaven organization.

Organizational identity and continuity. When an organization understands the element of its own identity, it can then begin to grow (Schein, 2004). Organizations with a collective identity encompassing the entire workforce create bonds in the employee community and improve perceptions of effort (Bolman & Deal, 2008). A set mission and vision allow employees common purpose structured across the organization. Without a clear and shared message, issues such as retention and continuity will emerge (Bolman & Deal, 2008). Collaboration, development of shared values and goals, and articulated norms support continuity (Bolman & Deal, 2008; Krosgaard, Brodt, & Whitener, 2002; Schneider, Brief, & Guzzo, 1996).

Culture of trust and collaboration. Teaching can be inherently stressful, especially under the pressure of creating individual lessons to retain the interest of middle school girls. This takes a profound knowledge base of pedagogy and a system of support, including trust and collaboration with all employees. Schneider et al. (1996) suggest the nature of interpersonal relationships, hierarchy in decision making, the focus and use of goals, support, rewards, and recognition all manifest honest and open interactions. Teachers must feel safe to take risks and be encouraged to be collaborative, as organizations with these practices have more significant growth (Garmston & Wellman, 1999; Senge, 1990).

Cultural settings. Cultural settings are the cultural models' indicators. The parameters within an organization can be studied and observed.

This section reviews specific cultural settings at STEMaven, which may be barriers or assets to stakeholder goal achievement, including mentor support systems, mentors and models, and communication of instructional values.

Teacher support systems. A learning organization is capable of encouraging employees to acquire and transfer knowledge (Huffman, Thomas, & Lawrenz, 2003). Teachers are more useful when they have accessible support systems (Huffman et al., 2003). Examining practice, curriculum implementation and development, and collaborative work can be challenging to implement and sustain. Productive support systems targeting the specific levels of individual teachers increase peer support, roles, and job satisfaction (Kipps-Vaughan, 2013). Along with emphasizing long-term active support through engagement, connections between teachers' work and their students will improve professional practice (Huffman et al., 2003).

Mentors and models. A key support system for improving the depth of knowledge for new and established teachers are mentors and models. In educational environments, a mentor is a more experienced coworker who supports teachers in the development and execution of the instruction (Ulvik & Sunde, 2013). Utilizing mentors is an intuitive practice that provides teachers the support to solve problems and develop trustful relationships (Fresko & Alhija, 2012). Therefore, providing teachers with opportunities for mentoring supports the conceptual understanding of their role and helps to develop their practical skills as well as job satisfaction.

Table 4 below identifies the organizational influences. These influences were used to more fully understand how motivation affects the mentor's engagement in increasing middle school girls' interest in computer science.

Table 4

Organizational Influences

Organizational Mission	
The mission of the STEMaven is to inspire middle school girls in East Tennessee to actively explore the fields of technology, to close the gender gap in the technology profession, and to foster participants' future careers.	
Organizational Global Goal	
By December 2020, mentors at STEMaven will demonstrate improved knowledge and use of effective and evidence-based instruction proficiencies.	
Stakeholder Goal	
The mentor goal, supported by the program director, is to facilitate workshops that increase interest, confidence, and perceptions of computer science.	
Assumed Organizational Influences	Organization Influence Assessment
Cultural Model Influence 1: Organizational identity and continuity: The organization needs a culture that supports change in existing teaching strategies founded on collective engagement, shared purpose, and collaboration to aid in motivating and retaining interest of the participants.	Survey questions about the value of new teaching strategies. For example, "The organization provides professional development that is centered around new teaching strategies." (A great deal, somewhat, a little, not at all) "PD is offered that is centered around new teaching strategies." (A great deal, somewhat, a little, not at all). "The PD is beneficial to both yourself and the organization." (very helpful, somewhat helpful, somewhat unhelpful, not helpful at all).
Cultural Model Influence 2: Cultural Trust: There needs to be a culture of trust in the organization between leadership and mentors.	Interview questions would surround concepts of transparency and accountability. For example, "How does the program director hold you accountable for success or failure of your workshop(s)?" "Explain how leadership exemplifies ideal accountability behaviors and transparency for all mentors." "The program director is proactive in identifying internal and external factors that may derail a workshop before it facilitated."
Cultural Setting Influence 1: Support systems: Mentors need a culture that supports change in existing teaching strategies founded on collective engagement, shared purpose, and collaboration.	Interview questions asked whether the mentors feel they are in a culture that supports change in existing teaching strategies founded on collective engagement, shared purpose, and collaboration. For example, "What barriers may exist that hinder mentors from creating a new engaging lesson(s)." "What supports systems would you like to see STEMaven put in place that could further support the goal of increasing interest, confidence, and perceptions of computer science?"

Table 4,continued

Assumed Organizational Influences	Organization Influence Assessment
Cultural Settings Influence 2: Mentors and models: Mentors need effective role models who have succeeded in increasing interest, confidence, and perceptions of computer science.	Interview questions that ask whether mentors have access to a mentor that has facilitated a successful after-school program. For example, "Tell me about when you were able to meet with an effective mentor(s) that succeeded in increasing interest, confidence, and perceptions of computer science."

Conceptual Framework: The Interaction of Stakeholders' Knowledge and Motivation and the Organizational Context

The conceptual framework is a critical component of the research process, as it is the causal structure guiding the study and includes the system of concepts, beliefs, and theories to support the research (Maxwell, 2013). Its purpose is to assist the researcher with a visual model of the essential ideas, the scope, the concepts being investigated, and of gaps in the literature, which are key to answering research questions (Maxwell, 2013). The conceptual framework presented below, in both graphical and narrative form, defends the research and aid in identifying the appropriate methods for investigating the research questions (Maxwell, 2013). Therefore, the conceptual framework presented in this written work considers previous research on best practices and methods on how to facilitate workshops that increase interest, confidence, and perceptions of computer science.

This study employed the knowledge, motivation, and organizational factors gap analysis model developed by Clark and Estes (2008). The variables are interrelated, work as part of a system, and align to achieve the organizational goal (Clark & Estes, 2008). The framework utilized the knowledge, motivation, and organization variables for this study. It emphasized previous research in context with the ability of after-school programs to increase interest and retention of middle school girls in computer science. There was also the consideration of previous research in a context that contributed to identifying the methods most applicable to the organizational needs at STEMaven. This study aimed to find a medium to best support the organizational goal of providing increased opportunities through effective and evidence-based instruction and mentorship for middle school girls to engage in workshops that motivate and retain their interest in computer science by December 2020 (Figure 1).

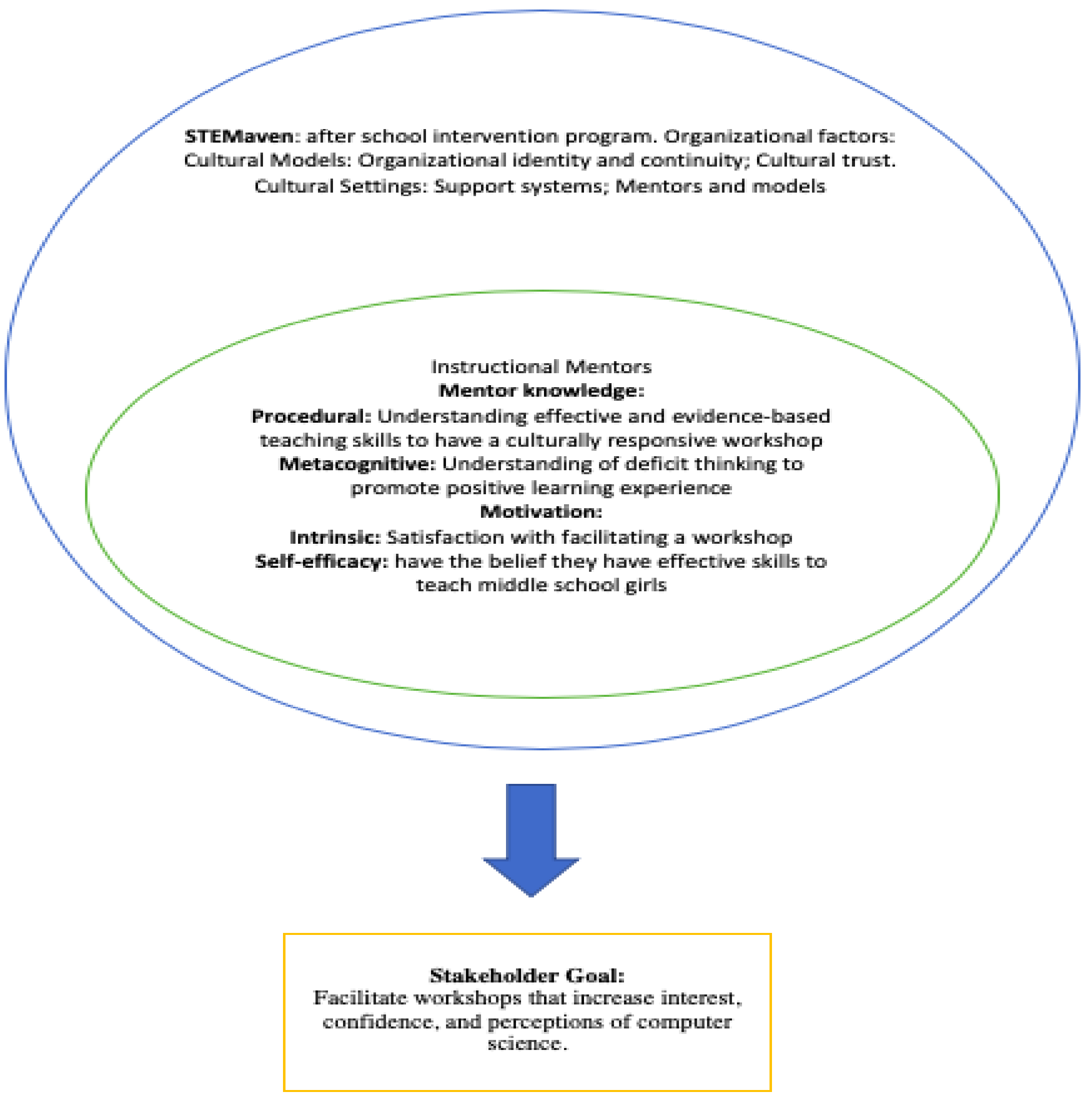

Figure 1. Conceptual framework: Interaction of stakeholder knowledge and motivation within organizational cultural models and settings.

While this study presented and organized the knowledge, motivation, and organization factors independent of each other, it was necessary to understand the intersecting relationships among variables. According to Maxwell (2013), a concept map is a visual representation of the conceptual framework for the design of a study, and an explanation of the symbols and their interaction is depicted in Figure 1, the map for this study. This figure outlined the relationships among the factors influencing best practices and methods with the STEMaven program, both with each other and within the broader organizational context, leading to the effectiveness of self-reflection in teaching and the stakeholder goal. In the figure, the more substantial blue circle represents STEMaven as the organization of the study and cultural settings and models within it. These cultural influences include organizational culture around issues such as organizational identity and continuity and supports and structures that affect teacher effectiveness (Schein, 2004, Schneider et al., 1996; Senge, 1990).

Within the organization, the global goal of mentors at STEMaven, demonstrating improved knowledge and use of effective and evidence-based instruction proficiencies grounds the subject of the study. They are illustrated in the figure as a green circle. Within the global goal are the knowledge and motivation influences on teacher effectiveness. The knowledge influences are declarative and factual in relation to best practices and methods and metacognitive regarding the instruction to increase retention of an interest in computer science (Akl et al., 2007; Alvarado & Judson, 2014; Di Stefano et al., 2014). The motivational influences include intrinsic value to motivation and engagement in the professional development process and individual and collective self-efficacy with creating an interest in computer science (Bandura, 2000; Borgogni et al., 2011; Clark & Estes, 2008; Priyadarshini, 2009; Richter et al., 2012; Rueda, 2011). These influences must also interact with one another for the achievement of the goal (Clark & Estes, 2008). Interacting with one another and within the broader organizational context, these influences are represented to best support growth towards the stakeholder goal (Clark & Estes, 2008).

Conclusion

This evaluation study sought to identify the resources necessary to reach the goal of mentors at STEMaven demonstrating improved knowledge and the use of effective and evidence-based instruction proficiencies. To inform this study, this chapter reviewed literature related to increasing the effectiveness of teaching strategies and reflection. This literature reviewed the identification of the assumed knowledge, motivation, and organizational influences specifically related to the achievement of the stakeholder goal and experience at STEMaven. The knowledge influences included procedural concepts about best practices and methods, along with effective teaching strategies and metacognitive concerning self-reflection. The motivation influences included intrinsic value about engagement in the professional development process and the individual and collective self-efficacy in believing they have practical teaching skills. Finally, the organizational influences included program culture around issues of identity and continuity, teacher support systems, and structures to influence teacher effectiveness and communication of knowledge. Chapter Three describes the process of validating these influences.

CHAPTER THREE: METHODOLOGY

The purpose of this study was to evaluate the effectiveness of STEMaven mentors necessary to achieve the goal of demonstrating improved knowledge and the use of effective and evidence-based instruction strategies. This was achieved by employing the Clark and Estes (2008) gap analysis model with a mixed-methods design. Both were used when the researcher conducted quantitative research, analyzed the data, and then explained the results along with the qualitative results (Creswell & Creswell, 2018). While a complete needs analysis would focus on all STEMaven stakeholders, for practical purposes, the stakeholders to be focused on in this analysis were the STEMaven mentors. Four questions guide this study:

1. To what extent is STEMaven contributing to the development of effective and evidence-based teaching skills in the mentors?
2. What are the STEMaven mentors' knowledge and motivation related to improving their effective and evidence-based teaching skills?
3. What is the interaction between STEMaven's organizational culture and context and the mentors' knowledge and motivation to improving effective and evidence-based teaching skills?
4. What are the recommendations for STEMaven's practice in the areas of knowledge, motivation, and organizational resources?

The remainder of the chapter outlines a description of the participating stakeholders, data collection and instrumentation, data analysis, credibility and trustworthiness, ethics, and limitations and delimitations of this study.

Participating Stakeholders

The stakeholder group of focus for this study were 34 STEMaven volunteers and mentors, some of whom hold terminal degrees in STEM. Mentors at STEMaven are not required to be of a particular gender, nor to facilitate a workshop, is a mentor required to have a terminal degree in a STEM field, or currently hold a position in that field. The quantitative portion of this study involved a screening survey sent to all volunteers and mentors, allowing for purposive sampling to find out which mentors facilitated a workshop. One of the reasons for quantitative sampling in this study was to provide descriptive statistics regarding the mentors who have facilitated workshops and have background knowledge of the organization (Creswell & Creswell, 2018). To gather as much data as possible, an interview was requested. Ideally, seven to 10 mentors were needed to be identified for a 45 to 60-minute interview (Johnson & Christensen, 2015). The interview request was sent by email to all mentors who had facilitated at least two workshops and held a terminal degree in a STEM field. The interview questions aimed to describe the attributes and thoughts of the participants as they related to the research questions and conceptual framework (Robinson & Firth Leonard, 2019).

Survey Sampling Criteria and Rationale

Criterion 1. Approved volunteers and mentors at STEMaven. The study was interested in those who have been approved to mentor a workshop.

Criterion 2. Mentors who have facilitated a workshop. The emphasis of the mentorship is a significant part of the study and could provide insight into the research questions and related influences. There are approximately 75 workshops each fiscal year on eight different topics of computer science. Each workshop is available to students at three levels based on their prior knowledge: basic, intermediate, or advanced.

Survey Sampling Strategy and Rationale

I surveyed all STEMaven mentors who had facilitated at least one workshop since January 2018 to get as much data as possible. The survey was administered after the summer workshops to gauge the participants' perceptions and feelings of STEMaven workshops related to the increase in interest of computer science for middle school girls. This was administered through a link sent via email from Qualtrics to reach the whole audience.

Interview Sampling Criteria and Rationale

Criterion 1. Mentors who have terminal STEM degrees and had or currently have a career in STEM. These mentors have obtained a degree based on computer science or technology. They are in a position to recall aspects of the program related to obtaining an interest in computer science and or technology.

Criterion 2. Mentors who have facilitated at least two workshops since January 2018. This was to ensure mentors understood the program and what students needed to capture their interest in STEM.

Criterion 3. The mentors must have completed the survey.

Interview Sampling Strategy and Rationale

Participant selection for the qualitative portion of this study was purposeful, so the researcher could better understand the problem and answer the research questions (Creswell & Creswell, 2018). For this reason, purposeful sampling was used to identify participants who met specific needs for the study (Johnson & Christensen, 2015). In addition to surveys, I interviewed mentors to gain more depth and understanding of the results. Merriam and Tisdell (2016) stated interviews as a source of data, allow the researcher to obtain rich information as well as to find out participants' perspectives.

Eight participants who previously completed the questionnaire were selected and contacted based on the purposeful criteria related to identifying the extent to which mentors at STEMaven are demonstrating improved knowledge and the use of effective and evidence-based instruction proficiencies. This sampling allowed for an adequate representation of diverse thought, opinion, and belief in addition to insight learned from semi-structured open-ended questions to aid in the validation of survey data addressing questions on knowledge, motivation, and organizational influences related to increasing interest in computer science.

Table 5

Sampling Strategy and Timeline

	Sampling Strategy (e.g., census, purposeful with max. variation)	**Number in Stakeholder population (e.g., There are 50 mentors)**	**Number of Proposed participants from stakeholder population (e.g., of the 50, I will sample 10 mentors, 2 from each of 5 departments)**	**Start and End Date for Data Collection**
Surveys:	Screening for interviews, purposeful Likert scale questions to triangulate with interviews	Total 34 part-time mentors.	I sent the survey to all mentors and hope for a 70% participation rate.	August – September 2019
Interviews:	Screened participants to be representative of the population demographics	Total 7 part-time mentors.	A minimum of 7 survey participants representative of the stakeholder demographics.	October-November 2019

Data Collection and Instrumentation

This study used quantitative sample surveys and qualitative interviews to explore the interaction of knowledge, motivation, and organizational influences on STEMaven mentors' performance. The study relied on surveys to collect data and provide simple summaries about the samples as well as the measures obtained. Furthermore, a descriptive analysis of the samples was formed based on quantitative data analysis. Qualitative methods aided in answering the research questions in a manner that was meaningful to STEMaven and similar programs.

Survey

Survey instrument. The researcher administered the surveys via an online link distributed through email. The instrument was created in English. The quantitative survey consisted of demographic questions and 13 survey items. The survey took approximately 10 to 15 minutes for participants to complete. The last survey question asked if they were willing to participate in an interview. If they were, they were asked to provide their email or phone number. The survey protocol can be found in Appendix A.

Survey procedures. Johnson and Christensen (2015) stated quantitative research is essential to make accurate generalizations about a population using sample data. The survey used in this study was quantitative to provide for generalization about STEMaven mentors concerning the knowledge, motivation, and organizational influences related to the mentors at STEMaven, demonstrating improved knowledge and the use of effective and evidence-based instruction proficiencies. To gain the most significant sample possible, the survey was sent to all mentors at STEMaven that fit the survey criteria protocol.

Interviews

The study collected data through interviews. This method provided a qualitative understanding and insight into how knowledge, motivation, and organizational influences at STEMaven affected the consistent implementation of mentors at STEMaven, demonstrating improved knowledge and the use of effective and evidence-based instruction proficiencies. Face-to-face techniques helped to generate interpretations and theory.

Interview protocol. Merriam and Tisdell (2016) stated that interviews are primary sources of data that allow the researcher to gain rich information as well as the opportunity to find out the participants' perspectives. The interviewees were mentors who voluntarily agree to participate and who have taught at least two workshops in the past year. For convenience, all interviews took place via phone or video conference, allowing for the comfort of the mentor due to heavy work schedules. No participant preferred a more private location, so additional locations were not considered. The interview protocol can be found in Appendix B.

Interview procedures. The interviews were semi-structured and in-depth and occurred after the survey had been closed. Semi-structured interviews have a higher likelihood of yielding comparable data. Interviews were planned to occur during October and November 2019, but additional interviews were held in January 2020 to gain additional data. Each participant was interviewed individually only once for no more than 60 minutes. Interviews occurred over the phone or via video conferencing using software of the participants' choice. The researcher used a notepad for notetaking. The interview consisted of open-ended questions that allowed participants to respond in their context and express themselves comfortably (Patton, 2002). The semi-structured, open-ended questions permitted the interviewer opportunities to explore and probe (Merriam & Tisdell, 2016). The interview questions addressed knowledge, motivation, and organizational influences related to mentors at STEMaven, demonstrating improved knowledge and the use of effective and evidence-based instruction proficiencies. The interview guide provided the interviewer a consistent set of questions to ask of each interviewee (Patton, 2002).

Data Analysis

Making meaning from data is the process of analysis (Merriam & Tisdell, 2016). Data analysis included several strategies and tools and started with the sequential analysis of survey questions and one-on-one interviews. The researcher reviewed the quantitative survey data along with the qualitative transcriptions of the interviews through sequential design. This section describes the approach of analyzing one phase of data and then looking at another method of collection (Creswell & Creswell, 2018).

Qualitative Analysis

The qualitative transcriptions of the one-on-one interviews through sequential design involved an analysis of a single case that helped formulate a theory, after which the rest were examined for their contribution to the theory. The process involved narrative analysis where the stories presented by the participants were reformulated based on the contexts and different experiences of the individuals to inform the study and analyzed for STEMaven perceptions and descriptions.

Quantitative Analysis

The survey was conducted using the software Qualtrics, and the tool also supported analysis for triangulation among data points to aid in disaggregation. In analyzing quantitative data, the researcher calculated the mean, percentages, medians, and modes. The majority of comparisons were made using multiple item themes. Demographic information was contained in the survey instrument. These measurements provided a further quantitative understanding of the participants (Johnson & Christensen, 2015) and were analyzed using descriptive statistics and frequency tables for the level of education and gender. Tables and figures were analyzed for participants' characteristics and perceptions of STEMaven. Survey items are presented in a narrative setting as well as with visualization and table in Chapter Four.

Credibility and Trustworthiness

The researcher is the instrument in the qualitative phase of the research. The qualitative phase may carry inherent bias (Merriam & Tisdell, 2016) due to the researcher's serving as a volunteer mentor in the program. Therefore, this section describes the steps the researcher took to minimize inherent bias and increase credibility and trustworthiness through all phases of the research. The researcher spent an adequate amount of time collecting the data until the findings seemed comprehensive, and no discoveries or themes emerged (Merriam & Tisdell, 2016). To test the credibility of the results, the researcher keenly pursued both ideas and examples, which may counter the emerging theme(s), both within each of the qualitative methods and any needed follow-up.

As mentioned in the ethics section, the researcher was neither an evaluator nor a direct supervisor of mentors in the program. Therefore, participants were reassured of the confidentiality of their engagement was vital for credibility. During data collection, the researcher provided written and verbal statements that solidified the confidentiality of the data. This confidentiality provided increased credibility and trustworthiness that made mentors feel comfortable in responding to the survey and interview questions honestly and openly (Creswell & Creswell, 2018). Additionally, the participants could have opted out of the study at any time. This explanation and open understanding of data collection increased credibility and trustworthiness (Rubin & Rubin, 2012).

Throughout the computation of the analysis and during the reporting, the researcher self-reflected regarding bias, assumptions, and perspective. The researcher kept a digital journal related to each of the data collection methods to document questions, reactions, and areas that could have required further clarification. The digital journal allowed the researcher to reflect on the bias. As Merriam and Tisdell (2016) stated, power dynamics will always be present while gathering data. The researcher paid close attention to the power dynamics throughout the collection of data and any subsequent reflections.

Finally, the reporting phase included detailed descriptions of all findings. The researcher included descriptions, quotations, and any other comprehensive information gathered from the participants as they connected to the research. This detailed description and increased transparency of the data collection process increased credibility. The reporting includes a discussion of the findings and recommendations reflective of the literature. This referencing solidifies the reporting in formerly conducted research and increase reliability in the recommendations (Merriam & Tisdell, 2016).

In summary, there are multiple ways human beings experience phenomena, and this study's resulting narrative related solely to participants' experience. Research can remind us of the fundamental unlikelihood of netting absolute truth (Merriam & Tisdell, 2016). Like the instrument in qualitative research, the researcher ensured trust and conducted the study ethically. The validity of the findings relied solely on the trustworthiness of the researcher.

Validity and Reliability

The interview and survey questions added to both validity and reliability. The participants were selected both randomly and purposively, which reduced selection bias and increase reliability (Krueger & Casey, 2009). The researcher aimed to have 90% of the population take part in the study. This number of participants was to contribute to the greater validity of the study and provide sufficient data to create generalization regarding the population (Johnson & Christensen, 2015).

Threats to the validity of this study included historical threat due to the newness of the program, having a range of creation of fewer than three years, and possible dispersal of treatment, primarily due to a variety of data collection of over three months. While this period is relatively short, reducing any threat of development, reversion, or impermanence, it could have also lead to participants' cross-contaminating. Nonetheless, an essential reason for using interviews was that they allowed for ideas to be shared one-on-one (Merriam & Tisdell, 2016).

Therefore, contamination as a threat to validity applied to the quantitative and qualitative phases of the study. To evade this threat, the researcher provided a statement in the interview and survey emails requesting participants not discuss the interview or survey questions with colleagues. Ultimately, reliability depended on participants' answering honestly and openly according to interview and survey instructions.

Ethics

This study was substantiated in operating ethically before, during, and following the study. Therefore, to conduct the research ethically, the researcher considered several accountability measures. Glesne (2011) stated the overall goal of obtaining new knowledge might take a subservient role to researcher responsibilities, such as respect for persons, beneficence, and justice. These expectations included gaining informed consent to participate, voluntary participation, right to withdraw without penalty, separate permission to record, and confidentiality.

Informed consent is an essential element of the institutional review board and the study (Rubin & Rubin, 2012). There is an obligation of all researchers not to harm their participants (Glesne, 2011). The researcher had the duty to obtain informed consent. Therefore, all participants were informed of their protection through the University of Southern California's

Human Subjects Protection Program. Additionally, the researcher provided those surveyed an information fact sheet for exempt non-medical research. The participants gained knowledge that their participation was voluntary and possible risks related to participating in the study (Glesne, 2011). The researcher declared all participation would remain confidential, nor would names or answers be shared. Interviewees were also reminded of the confidentiality of all conversations. All participants were reminded they could cease involvement in the study at any time. The researcher provided, in writing at the beginning of the survey and verbally before the interviews, a notice of the option to not participate without an effect on their professional opportunity within the program. In addition, at the start of the interviews, the researcher requested permission to record all audio manually. Following the interviews, the researcher utilized software to transcribe interviews verbatim. The transcripts were coded with pseudonyms for confidentiality. The researcher destroyed all files following transcription and stored all data temporarily during the analysis phase.

Finally, while conducting the study, the researcher assumed the mentors at STEMaven wanted the program to succeed and answered questions in both surveys and interviews honestly and accurately. There was an inherent bias for which the researcher needed to account. This bias included the researcher's role of over 12 years of STEM teaching experience as a middle school teacher.

Limitations and Delimitations

There were both limitations and delimitations the researcher was aware of as this study began. Limitations could vary throughout the study and be out of the researcher's control. The design of this evaluation study, including instrumentation and sampling methods, constrained the analysis and interpretation of the data. For instance, the interview questions were not validated prior to the study for clarity or understanding in a similar sample group. Therefore, mentors may have interpreted the questions differently from the researcher's intent. In addition, the study was conducted during a brief period during the fall workshop series, making it dependent on the respondents' mindset during this limited and exhaustive time of year for the organization. Delimitations are the researcher's choices, which may have had repercussions for the study. The limitations of this study incorporated data collection from mentors at STEMaven who have facilitated at least one workshop since January 2018. The study did not include the students. A sample of this size limited the external validity and called into question the applicability of study findings to other settings (Creswell & Creswell, 2018).

Further research is needed to determine whether the findings apply at other after-school programs of mentors demonstrating improved knowledge and the use of effective and evidence-based instruction proficiencies that, in turn, cultivate girls' interest in computer science. Research should examine whether quality programs are more likely to utilize partnerships within the local community as a non-negotiable element to support learning and foster interest in the discipline. Lastly, additional research is needed to learn whether after-school programs are successful when access, sustained participation, program quality, and strong community relationships are evaluated.

CHAPTER FOUR: FINDINGS

The purpose of this study was to evaluate the effectiveness of STEMaven mentors necessary to achieve the goal of demonstrating improved knowledge and the use of effective and evidence-based instruction strategies. This study employed the Clark and Estes (2008) gap analysis model, with an analysis focused on knowledge, motivation, and organizational influences related to achieving the organizational goal. This chapter first reviews the stakeholder participants in the study, then outlines the findings and results from the survey and interviews in relation to the research questions:

1. To what extent is STEMaven contributing to the development of effective and evidence-based teaching skills in the mentors?
2. What are the STEMaven mentors' knowledge and motivation related to improving their effective and evidence-based teaching skills?
3. What is the interaction between STEMaven's organizational culture and context and the mentors' knowledge and motivation to improving effective and evidence-based teaching skills?

To address these research questions, the researcher developed a 13-item online survey and conducted eight interviews. The data collection for this study took place over a 3-month period. The Director of STEMaven supplied the email contacts of all mentors who had facilitated a workshop since January 2018. A total of 34 emails were supplied. The list of emails was current at the time of the study and contained both employment and personal addresses. For that reason, the director sent the first email containing a short explanation of the study to all 34 contacts prior to the release of the survey. An email containing a link to complete the survey was sent one day later and sent via Qualtrics. Over a 2-week period, surveys were collected via

Qualtrics. Upon the closing of the survey, mentors who had provided contact information agreeing to participate in an interview were sent an email requesting participation. Only four responded. Not having enough data through interviews, a second email was sent requesting interviews. This resulted in five additional mentors, with four being interviewed. All interviews took place using video conferencing.

Participating Stakeholders

The stakeholders of focus for this study were mentors at STEMaven. This population consisted of 34 mentors, aged 18 and older, with experiences that ranged from current undergraduate students to working professionals who hold terminal degrees in a STEM field. This study sought to develop a sample of mentors who represent the entire mentor population at STEMaven, yet excluded mentors with only a high school degree due to the desire to study those with a professional STEM background. Therefore, this study, conducted in the fall of 2019, quantitatively and qualitatively explored the research questions with mentors who had a minimum of an undergraduate degree. In addition, each had facilitated at least one workshop since January 2018. Mentors were surveyed confidentially and asked to provide an email address if they agreed to participate in an individual, semi-structured interview. To qualify for the semi-structured interview, they needed the additional requirements of a terminal degree in a STEM discipline, had or currently have a career in a STEM field, and facilitated at least two workshops since January 2018. This section offers an overview of the mentors who participated in the survey, followed by a description of the interview participants.

Survey Participants

The quantitative survey, created in Qualtrics, was sent by email to the 34 participants who held at least an undergraduate degree and facilitated at least one workshop since January

2018, followed up by two reminders. Figure 2 shows the highest level of education, followed by the number of workshops each respondent has facilitated (Figure 3). The final data set included 18 mentors who completed the survey, representing a 53% response rate.

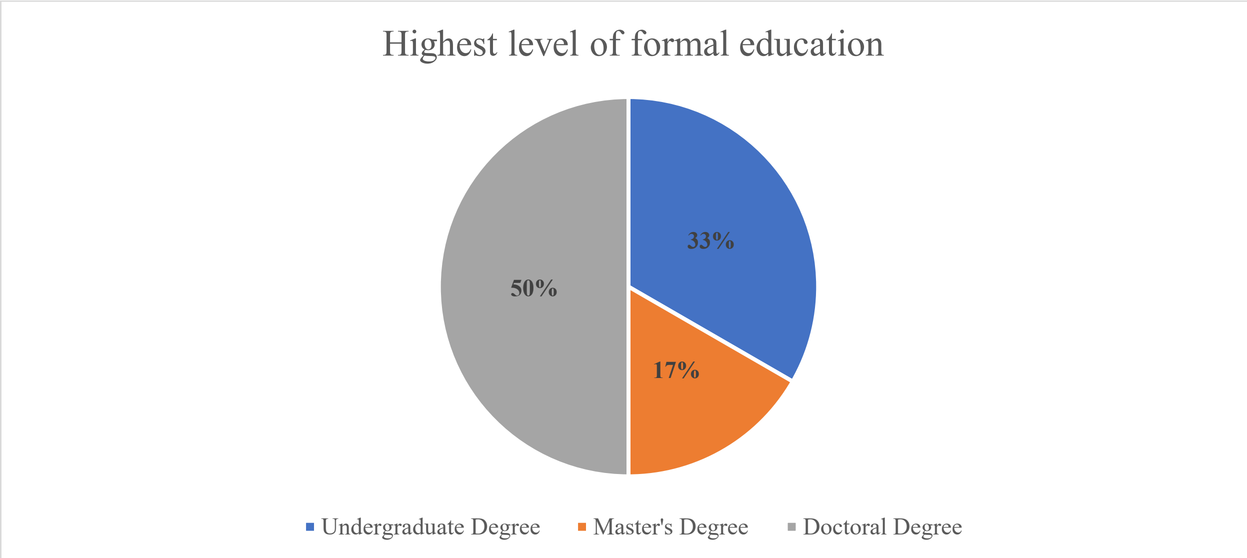

Figure 2: Survey participants' highest level of formal education.

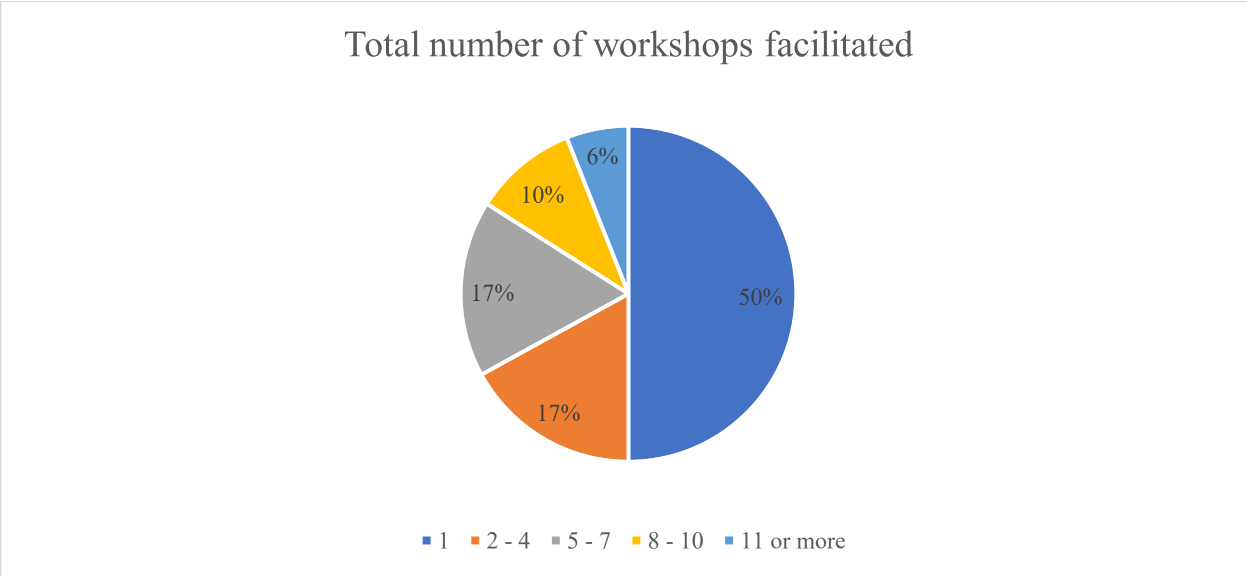

Figure 3: Total number of workshops facilitated since January 2018.

Among survey participants, 33% were undergraduates, 17% had earned a master's degree, and 50% had earned a doctoral degree. Disciplines were represented across survey participants and consisted of metallurgy and materials engineering at 25%, Physics 25%, computer science 25%, nuclear engineering 13% and mathematics 12%. In addition, seven of the 18 survey participants, or 39%, responded they had volunteered as a mentor at one or more after-school programs outside of STEMaven prior to January 2018. The survey did not allow for an open-ended field to respond regarding the specific type or location where they mentored. Of the 18 participants who completed the survey, 83% were female, while 17% were male.

Interview Participants

As stated in Chapter Three, a total of eight mentors participated in interviews. After the completion of the survey, participants had the option to offer their email address if they wanted to be interviewed. The researcher contacted each participant based on the interview sampling criteria and rationale, contacting those who completed the survey, held a terminal degree in STEM discipline, had or currently held a position in a STEM field, and facilitated at least two workshops since January 2018. Nine mentors responded, supplied their email address, and were emailed requesting a day and time to be interviewed. In total, eight mentors responded and held an interview, totaling 44% of the survey population. Of the eight participants, seven were female and one male. In addition, two had employment history as a scientific researcher in a STEM field that was affiliated with a University, with the remaining six respondents having employment history as a scientific researcher at a National Laboratory in a STEM field. The interviews took approximately 45 to 60 minutes each to complete. Figure 4 shows representation by terminal degree and gender. Table 6 provides interview group composition. All names are pseudonyms.

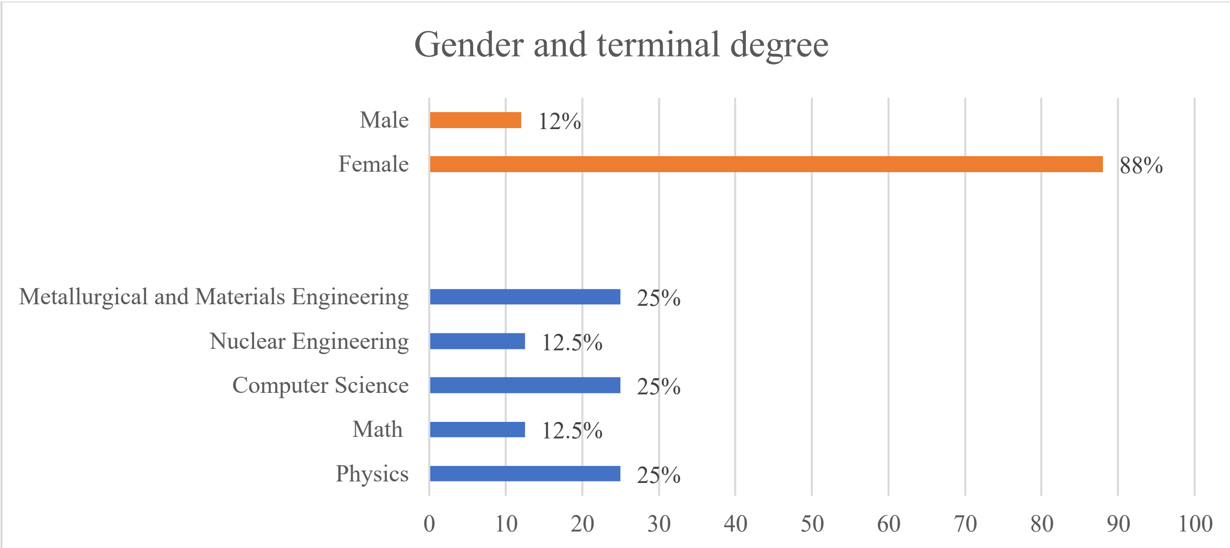

Figure 4. Interview participants composition of gender and terminal degree.

Table 6

Interview Group Composition

Pseudonym	Gender	Employment Type	Number of Workshops
Ryan	Male	National Laboratory	10+
Melissa	Female	National Laboratory	3
Anna	Female	University	2
Jessica	Female	University	4
Angela	Female	National Laboratory	7
Sarah	Female	National Laboratory	2
Debra	Female	National Laboratory	2
Lisa	Female	National Laboratory	6

Findings

This section reports on the results of the survey and the findings of the interviews as they relate to the research questions. Thus, the results and findings are reported through the distinct lenses of knowledge, motivation, and organization influences identified in the conceptual framework and the literature. The data collected from surveys and interviews either validated or did not validate the assumed influences of the study. In the following sections, an influence that is considered validated means that the assumed influence had substantive evidence from the survey and interview data collection to be identified as a gap for the stakeholder or organization. An influence that was not validated means that there was not enough evidence from the survey and interviews for the it to be identified as a gap in the stakeholders or organization. The chapter concludes with a discussion of these results and findings.

Knowledge Findings

When an organization invests in resources to increase employees' knowledge and skills, there is a positive long-term impact on the organization's productivity (Clark & Estes, 2008). There are four knowledge types necessary for goal attainment: factual, conceptual, procedural, and metacognitive (Clark & Estes, 2008; Krathwohl, 2002; Rueda, 2011). Table 7 reports the complete list of assumed knowledge influences for this study. Procedural knowledge is the understanding of methodologies and techniques related to how to do something, Mentors who facilitate workshops at STEMaven need procedural knowledge, such as demonstration or modeling, that show effective and evidence-based skills that employ culturally responsive learning techniques. Culturally responsive learning techniques are methods used by teachers that encourage students to relate course content to his or her cultural context (Wlodkowski & Ginsberg, 1995). Mentors also need metacognitive knowledge, such as the awareness of one's cognition and having the ability to recognize when and why to undertake a task (Rueda, 2011). Mentors can apply metacognitive knowledge when they become aware of a student struggling with a concept and recognize the need to quickly provide a real-world example that fits the student's cultural context to help them relate the course material to a familiar viewpoint.

It is not about just finding the assets of a student, but, rather, being aware of when to pivot during a workshop and having the ability to demonstrate optional teaching strategies so all students can reach their full potential. This type of metacognition allows for mentors to build enthusiasm, strengthen relationships, and in turn, increase content comprehension. As outlined in Table 7, two of these knowledge types, procedural and metacognitive, were assumed influences for STEMaven's goal of mentors demonstrating improved knowledge and use of effective and evidence-based instruction proficiencies with both knowledge types validated as gaps: procedural and metacognitive.

Table 7

Knowledge Influences

Assumed Knowledge Influence	Validated as a Gap?
Mentors do not know effective and evidence-based skills that employ culturally responsive learning techniques. (Procedural)	Validated
Mentors do not understand how to demonstrate optional strategies of teaching so all students can reach their full potential when they encounter deficit thinking. (Metacognitive)	Validated

Procedural knowledge of effective and evidence-based skills that employ culturally responsive learning techniques. With each additional workshop, mentors can exercise procedural knowledge, which is crucial in the development to effectively facilitate a workshop that utilizes culturally responsive learning techniques. Clark and Estes (2008) stated that people need practice and corrective feedback to help them achieve specific work goals when it is directly applied to a task to solve a performance problem. It consists of knowing how to do something, the methods of inquiry, and criteria for using those skills, techniques, and methods. Survey participants were asked to rate their knowledge and application of effective and evidence-based teaching skills that employ culturally responsive teaching techniques while facilitating a workshop. Over 60% of participants surveyed stated they strongly agreed or agreed that they employ culturally responsive learning techniques and understand what skills are needed to employ a culturally responsive lesson. Furthermore, 39% stated that they disagreed or strongly disagreed. Figure 5 illustrates these results.

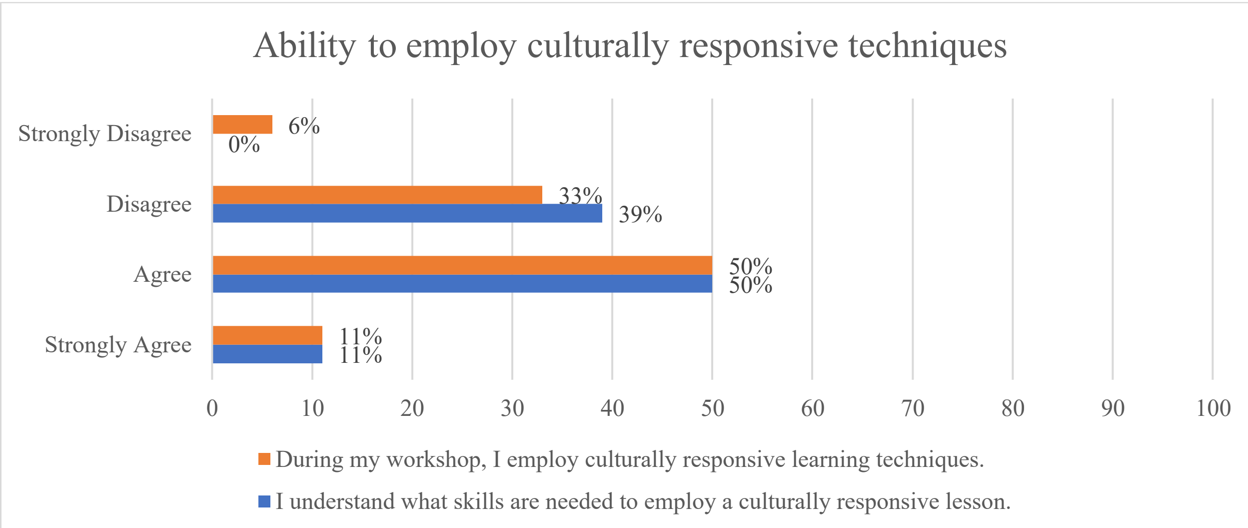

Figure 5: Ability to employ culturally responsive learning techniques and skills.

These findings suggest that there is still a need for increased knowledge related to effective and evidence-based teaching skills that employ culturally responsive learning techniques. Of the eight interview participants, three did not have this knowledge and could not reflect on using this skill. For example, Debra supplied a response of "I am still unclear on how to do this. [STEMaven] is trying to tailor the workshops to encompass strategies and lessons that fit the student's cultural context." Similarly, Ryan replied,

> That is a difficult one. I believe there are two aspects to answer this question. One is socioeconomic background. We have a mix of foreign national [students] but I haven't really observed the biggest difference of shy vs. outgoing. I don't think one behavior is attached to one group being in there, unless it is obvious were they are from.

Having the prior knowledge of culturally responsive teaching techniques can be key to reaching the students. Angela put it this way,

> I actually think that is one of the biggest aspects of how we learn. The fact that these girls are around other girls and a lot of mentors are female, that helps a lot and they seem more open to ask questions and be engaged. I've seen in the past if students are not around other girls, they shut down and don't open up as much. How do you include this in your lesson(s) to make them compatible with the social cultural contexts of middle school girls?

On the other hand, Anna said "I can bring tricks on how I learned a topic or how someone taught me different ways to learn a topic and how they were able to relate this back to a personal experience." Melissa mentioned, "When the students have an idea on how the workshop could be more interactive, the mentors become true facilitators of that interaction." The five participants that could employ a method, felt that it contributed to an overall positive experience to the students. Sarah declared, "I can relate and focus on the fun aspects of the workshop and recognize that the students are also having fun." She continued with, "You have to approach this supplemental learning in a way that gears them toward interest." A mentor who had only facilitated two workshops stated,

> Pop culture can influence learning, especially at this age and any cultural context. So, just as pop culture can have a big impact on interest, I show up as a scientist that is young, female, and extremely helpful to their needs. Hopefully, they see the correlation!

The comments from Anna and Sarah showed the importance of procedural knowledge; mentors who facilitate more workshops gain experiential learning that supports effective and evidence-based skills and techniques can be used to teach a culturally responsive workshop. This mirrors research by Hynes (2012) who noted that teachers in after-school programs gain knowledge by teaching lessons. They enhance their teaching strategies and content knowledge by using examples or analogies students understand. While none of the interviewed participants indicated that STEMaven had a structured professional development in this area, they did recognize that this type of learning would be impactful to both the body of mentors and student's success. Jessica stated,

> There is not a structured setting of support such as professional development, but I was introduced to a process called Dynamic Programming. It is a way of understanding how to explain things in the most simplistic fashion by breaking down problems into more simpler terms.

The data from the survey and interviews in this study validated that this assumed influence is a gap at STEMaven. The majority of participants questioned if there was a structured method of modeling, they would be better prepared to relate the lesson to a student's cultural context. The next section discusses the metacognitive knowledge influences explored in the participant interviews.

Metacognitive knowledge of mentors' skill strength in deficit thinking. Metacognitive knowledge refers to the realization of mentors' cognitive processes and allows them to reflect on why they are to undertake a task and when to do it, which is an important factor of strategic behavior in approaching problems (Rueda, 2011). This is directly related to deficient thinking, which is an approach, often unconscious, that views those of different identities (often racial, gender or other) as less able to succeed (Valencia, 1997). Survey participants were asked to rate their ability to define deficit thinking. Only 50% of survey participants answered that they strongly agreed or agreed that they could define deficit thinking. Figure 6 illustrates these results.

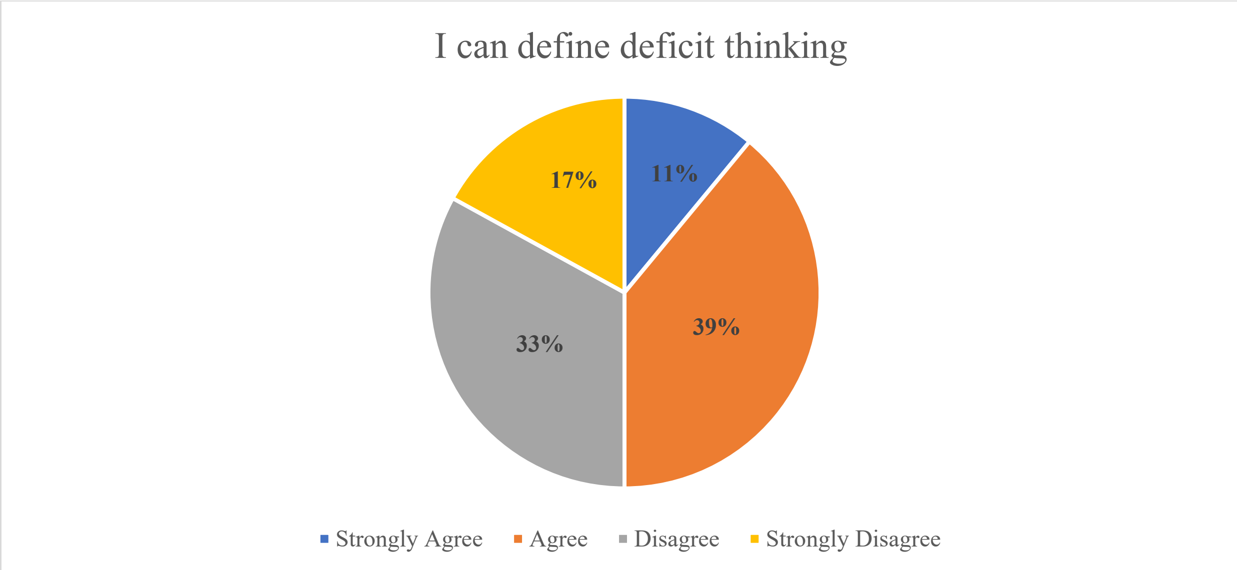

Figure 6: Survey and response: I can define deficit thinking.

The inability to define deficit thinking verbatim does not necessarily mean that one does not have the notion of a student, due to their race, ethnic or socioeconomic background, will struggle or fail with the course material. Moreover, they blame the student, not the structure of the lesson, for thwarting the learning process. When mentors can reflect on strategic behavior and techniques that increase the comprehension of a student, they are realizing their cognitive processes and reflecting on why they are to undertake a task and when to do it.

In contrast to the survey participants, none of the interview participants could define deficit thinking. However, once the definition was read to them, four could provide examples of the cognitive process in relation to deficit thinking during their facilitation of a workshop. The other four interviewees could not provide examples of demonstrating optional teaching strategies due to facilitating a low number of just two or three workshops. Lisa, who has facilitated six workshops, stated, "I quickly pivot my teaching to relate to the students and keep their interest." When probed to give a better understanding of how pivoting during her workshops refers to deficit thinking, Lisa explained,

> I am aware when a student is not understanding concept and begins to losing interest in the lesson. I go directly to that student, kneel down to their level or sit next to them, and work with them one-on-one using different strategies that help us both focus on their knowledge level and get them to a point of comprehension.

Lisa's comments illustrate the importance of metacognitive knowledge to analyze one's own ability in relation to deficit thinking.

Jessica also noted the importance of understanding how to demonstrate optional strategies of teaching so all students can reach their full potential when she encounters deficit thinking. As a mentor who has facilitated just four workshops, she noted that she has made a practice of reflection after each workshop so she can gain a better understanding of how to reach the students that struggle the most. She noted,

> I always learn and reflect from each workshop with the co-mentor. During the workshop we try to relate modern everyday things on their level, like social media or things they would do on an everyday basis. After the workshop, we reflect on additional real-life examples that could have been utilized and be better able to relate at a deeper level.

This metacognitive knowledge helps mentors adapt to the ways they think and operate to be more effective (Krathwohl, 2002).

The thought process of both Lisa and Jessica illustrated the type of metacognitive knowledge necessary to achieving the realization of mentors' cognitive processes that allows them to reflect on why they are to undertake a task and when to do it. Perhaps Ryan, who has facilitated well over 10 workshops throughout his tenure, summed up the critical importance of metacognitive knowledge best when he said, I don't think about this carefully enough and I do not consciously believe that I have deficit thinking. Usually, one of the elements I start with is where we have common ground. I start [the workshop] where the majority can relate to the topic and get them to talk about it with common knowledge and vocabulary and how this is related to real life. Learning their perspective on things. Being as inclusive as can be. Makes it seem as if the workshop if for everyone. Wonder if there are more ways to learn about this and if it really helps?

Clearly, there is a development of metacognitive knowledge around understanding how to demonstrate optional strategies of teaching so all students can reach their full potential when they encounter deficit thinking. One becomes more effective at a task after reflecting on the way one has performed it before (Di Stefano et al., 2014), which is directly related to a more thorough understanding of the cognitive processes related to deficit thinking.

The data from the survey and interviews in this study validated the assumed influences as noted in Table 7. The procedural and metacognitive knowledge needed to be successful in capturing the interest and retention of middle school girls in computer science is multifaceted and complex. Conversely, having just the comprehension of content is not enough, one must also have the motivation of capturing middle school girls' interest in computer science. The next section discusses the validation of the motivational findings from the current study.

Motivation Findings

Motivation is the second dimension examined in this study. Clark and Estes (2008) explained that motivation is centered on an employee's personal beliefs about themselves and their coworkers and that motivation encompasses active choice, persistence, and mental effort. Self-efficacy, collective efficacy, interest, expectancy value, goal orientation, and attributions influence motivation (Rueda, 2011). The motivation influences listed in Table 8 reflect the complete list of assumed influences before data collection. Assumed motivational influences for mentors at STEMaven are goal orientation and self-efficacy. By assessing and addressing motivational challenges, mentors can begin the process of closing the gaps between their current performance levels and their performance goals. When mentors' performance gaps are closed, the organization is closer to achieving its organizational goals (Bandura, 2000).

Table 8

Motivation Influences

Assumed Motivation Influence	Validated as a Gap?
Mentors lack the satisfaction and motivation of the stakeholder goal to facilitate a STEMaven workshop using improved knowledge and use of effective and evidence-based instruction proficiencies. (Goal Orientation)	Validated
Mentors lack efficacy while teaching a computer science related workshop to middle school girls. (Self-efficacy)	Not Validated

Goal orientation of effective teaching skills. According to goal orientation theory, goal commitment and implementation objectives are fundamental to achieving goal-directed behavior. Setting goals and having reasons to achieve goals is one of the motives for trying to accomplish and achieve tasks (Pintrich, 2003). If mentors are motivated and were willing to recognize their lack of goal orientation toward the stakeholder goal, then identifying areas of weakness and working toward improvement would be easier with the help of peers. Figure 7 reviews responses to the survey question asking participants if they were satisfied with their facilitation of a STEMaven workshop. Ninety-six percent of participants responded that they are very satisfied or satisfied. These data represent mentors' motivation to continually demonstrate knowledge and the use of effective and evidence-based instruction proficiencies. In contrast, to the almost 100%

response rate in satisfaction of teaching a workshop, only 72% of participants reported that they were very motivated to see their students succeed, represented in Figure 8.

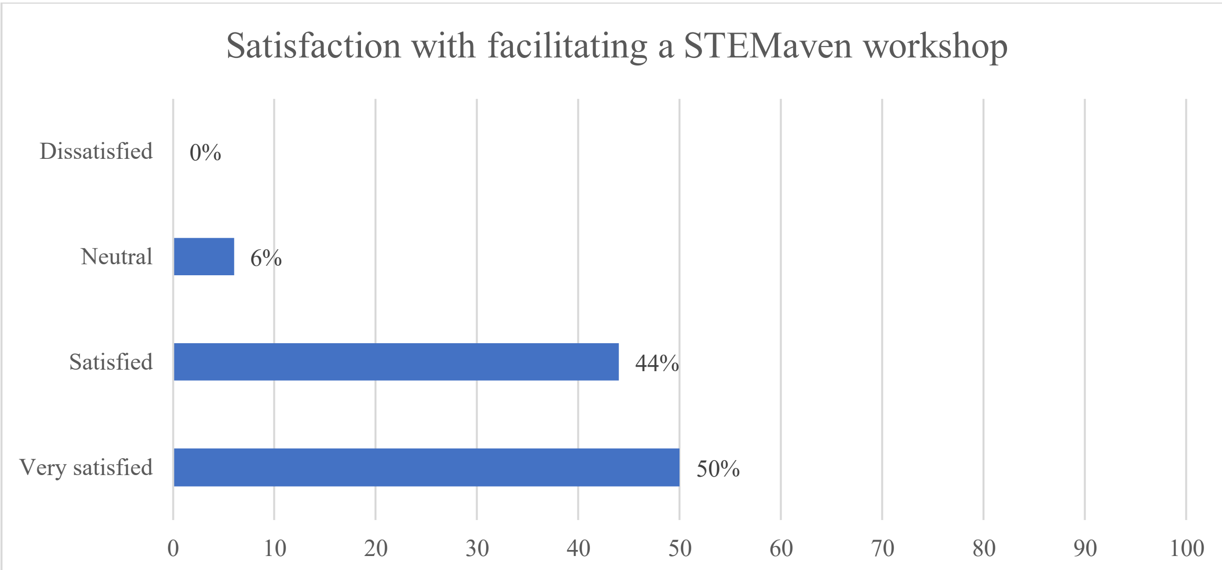

Figure 7: Survey and response: Overall, how satisfied are you with facilitating a STEMaven workshop?

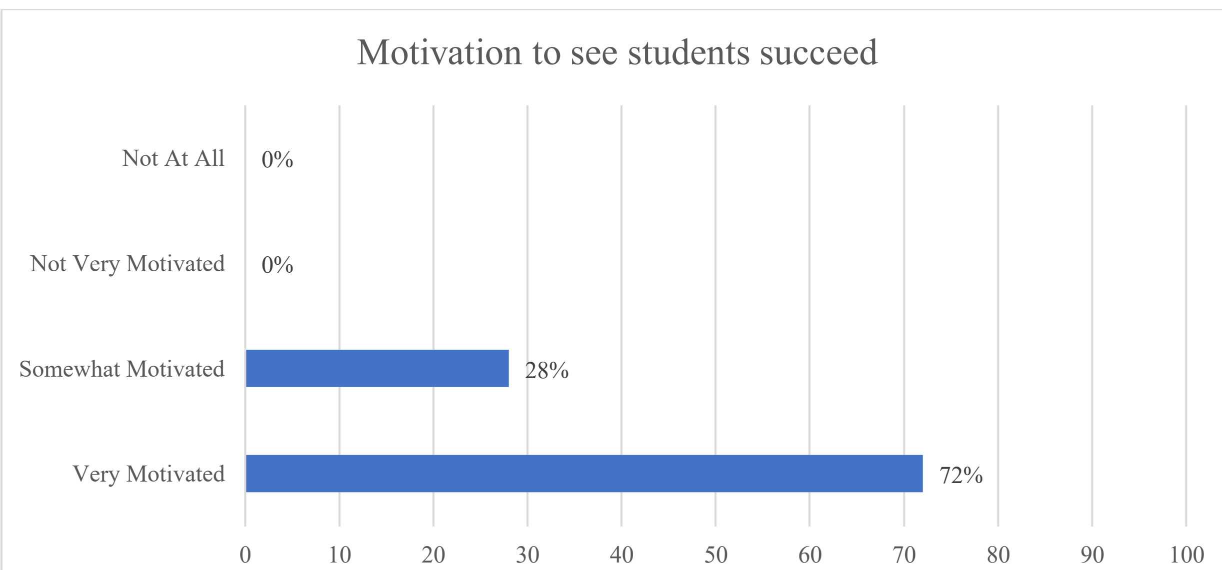

Figure 8: Survey and response: How motivated are you to see students succeed?

Interview data further expanded the survey data when asked about goal orientation in regard to satisfaction and motivation of facilitating a workshop using improved knowledge and use of effective and evidence-based instruction proficiencies. Anna replied,

> It is very cool to see the students get excited about coding and see what they pick up on. Watching the lightbulb go off and hearing the students shout sometimes that they got the right answer, that is my favorite part and my motivation.

Lisa, reflecting on her experience replied, "I would like see them come back as mentors one day, and, to me, I say I did a great job." Jessica summed it up when she said,

> I want kids to have the ability to see themselves in the future. If they can see a woman in power and successful, they would then see themselves in this person. Girls are discouraged to work hard and I want to see them be successful in their future. Most people in power in the U.S. are white males. I want them to see that they can look like me.

All of the interview participants cited fulfillment and motivation of teaching but could not provide direct correlation to improved knowledge and use of effective and evidence-based instruction proficiencies. However, interview participants did view effective teaching as vital to the success of retention and interest of middle school girls in computer science. These data provide a window into the lack of mentor's goal orientation and validates the assumed influence. If mentors are not continually motivated to see their students succeed, there would not be an attrition of mentors facilitating workshops and thus a potential drop in students attending the STEMaven program.

Individual self-efficacy for increased confidence of employing effective teaching skills. Self-efficacy theory posits that confidence increases when belief in one's own ability to successfully accomplish a task, or efficacy, is high (Pajares, 2006). When mentors believe they can be successful, their performance increases and students receive the benefits of achievement. Richter et al. (2012) found when an employee can harness their self-efficacy, they would proactively access resources such as team members' knowledge, expertise, and insights. Participant survey and interviews found evidence of self-efficacy in the STEMaven mentors' while teaching a computer-science related workshop to middle school girls. Figure 9 summarizes responses to the survey question asking participants if they are confident in their ability to teach middle school girls in computer science. Ninety-six percent of participants responded that they agree or strongly agree with this statement. Moreover, 89% of participants agreed or strongly agreed that they could successfully navigate the aspects of a workshop with which they had little previous experience (Figure 10).

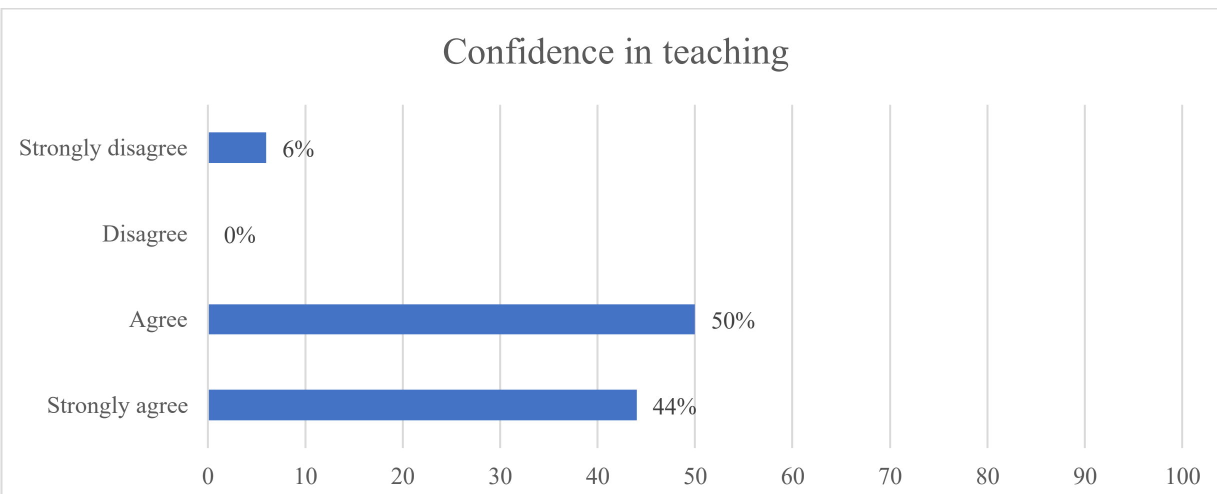

Figure 9: Survey and response: I feel confident in my ability to teach middle school girl's computer science.

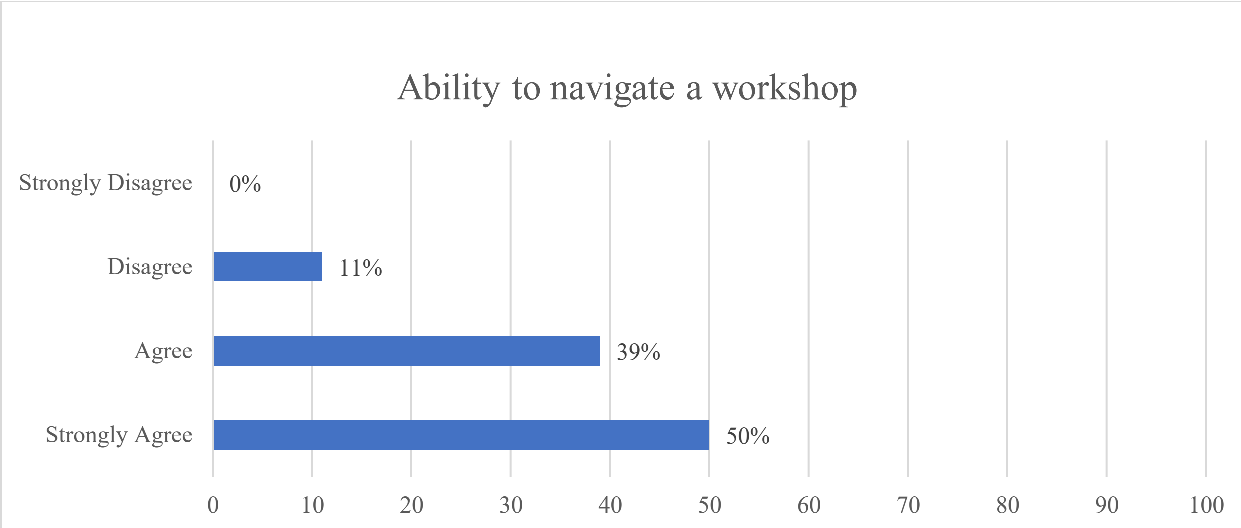

Figure 10: Survey and response: I can navigate the aspects of the workshops with little/no previous experience.

Similar to the survey questions, the interviews revealed the same responses. Angela, who has facilitated seven workshops, said, "I like to learn. I want the kids to have the ability to see themselves in the future. This is what builds my confidence each time." Similarly, Melissa, who has facilitated three workshops, stated,

> It has been great. It has been fun and I have learned from it as well. It has been really cool to see them get excited about coding and see what they pick up on. When students say, "We got the right answer!" that is my favorite part!

Self-efficacy is a key motivational factor that influences mentors in successfully facilitating each workshop. Not only does the data from the survey illustrate evidence of self-efficacy, but the voices of each interview participant assisted in not validating the assumed influence in regard to self-efficacy as noted in Table 8. Goal orientation, on the other hand, was validated through both the survey and interview populations (Table 8). Goal orientation and self-efficacy in relation to motivation are equally important to capture the interest and retention of middle school girls in computer science. In addition to knowledge and motivation, organizations influence the ability to achieve a goal. The next section looks at the organizational influences and their validation.

Organizational Findings

Culture plays a significant role in organizations (Clark & Estes, 2008). For a change effort to be successful, solutions must consider and adapt to the organizational culture (Clark & Estes, 2008). Ultimately, for STEMaven mentors to achieve their goal and implement effective teaching strategies that increase the interest and retention of middle school girls in computer science, issues related to organizational culture must be addressed alongside the previously outlined knowledge and motivation influences. The organization needs a culture that supports strengthening teaching strategies, founded on collective engagement, shared purpose, and collaboration to aid in motivating and retaining the interest of the participants. Therefore, organizational influences are a vital aspect of gap analysis. The organizational influences listed in Table 9 reflect the complete list of assumed influences and validation based upon data collection. The list includes two assumed cultural model gaps and two assumed cultural setting gaps.

Table 9

Organizational Influences

Assumed Organization Influence	Validated as a Gap?
Cultural Model Influence 1: The organization needs a culture that supports change in existing teaching strategies founded on collective engagement, shared purpose, and collaboration to aid in motivating and retaining interest of the participants.	Validated
Cultural Model Influence 2: Cultural Trust: There needs to be a culture of trust in the organization between leadership and mentors.	Not Validated
Cultural Setting Influence 1: Support systems: STEMaven needs professional development that is centered around effective and evidence-based strategies.	Validated
Cultural Settings Influence 2: Mentors and models: Mentors need effective role models who have succeeded in increasing interest, confidence, and perceptions of computer science.	Validated

In the survey, 67% of participants stated that STEMaven provides professional development that is centered around new teaching strategies a great deal or somewhat as shown in Figure 11. Figure 12 shows that 45% of surveyed participants believed a great deal or somewhat that professional development is beneficial to both the mentor and the organization.

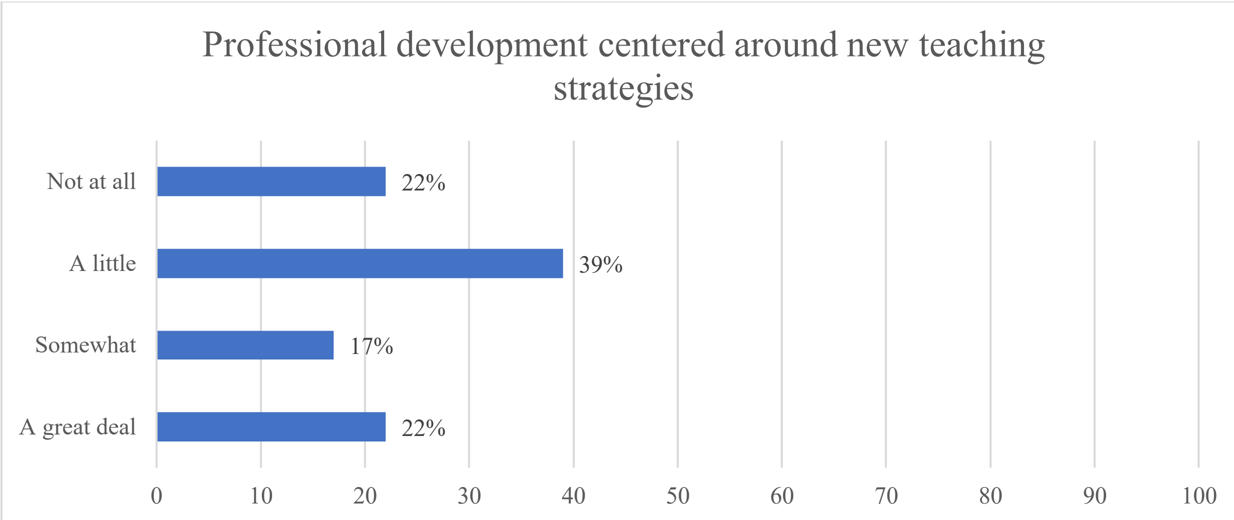

Figure 11: Survey question and response: The organization provides professional development that is centered around new teaching strategies.

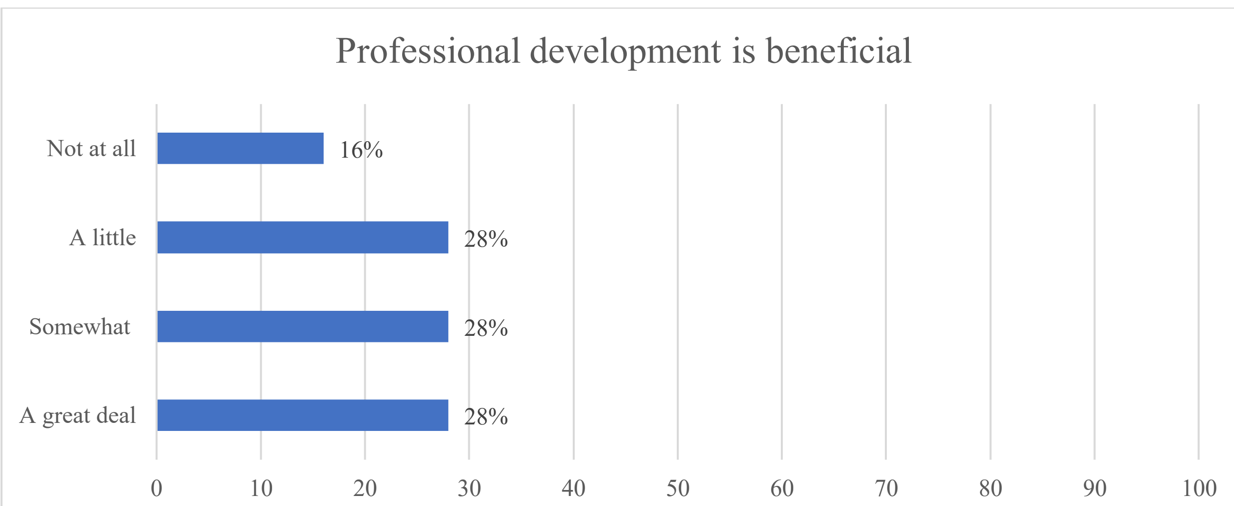

Figure 12: Survey question and result: The professional development is beneficial to both yourself and the organization.

In tandem to the survey responses, interview participants did not believe that the organization provided professional development and similar comments were heard from each in regard to what they thought should be the focus of their teaching development. Debra stated, "I would love to see consistent instructor professional development where all mentors are invited to one location. It probably should be focused on training on their role, not really for behavior." Anna expressed,

> I think the idea of a singular location to share ideas. I have done this with my current research and it has been very beneficial. I especially like Dropbox and Google Drive to collaborate. I think this would accelerate the mentoring process of ideas no matter the distance.

Three interview participants similarly stated that they were not aware of any professional development or observations that can provide feedback to strengthen teaching strategies. Angela replied, "One thing I don't have much experience in is working with middle school girls." After concluding her response, she asked, "Are there ways the program can improve its impact on my development?" To further her thoughts, she stated,

> One thing I know is that [STEMaven] hasn't really provided the mentors additional support or strategies that help with the [workshops] that they help out in over and over again. We never have meetings or a call to learn from each other except the other mentor you taught with. It would be very helpful if we had access to see what techniques work and see how this can help.

Ryan, thinking about ways that could improve the organization responded with,

> There needs to be more interaction with volunteers. There needs to be more scaling and allowing more mentors to run more as instructors, not just a few people that take the lead. It can be a little controlling. Professional development is needed to show the mentors a checklist they can run with confidence and that they can effectively teach, not just be in a mentor role. So yeah, mentors do need more training. Maybe as team of peers and training.

As we place organizational culture in dialogue with knowledge and motivation, and address them simultaneously, change efforts are more successful (Clark & Estes, 2008). The data from the survey and interviews in this study validated all but one the assumed influences as noted in Table 9. STEMaven should recognize the need to change the culture and support mentors throughout their tenure. The organization needs to update the existing teaching strategies and allow for collective engagement, shared purpose, and collaboration to aid in motivating and retaining interest of the participants. The organization needs to provide professional development that is centered around effective and evidence-based strategies. In addition, the organization needs to provide mentors with effective role models who have succeeded in increasing interest, confidence, and perceptions of computer science.

The next section explored additional themes found in the data.

Themes

STEMaven aims to increase the knowledge of its mentors to successfully utilize effective and evidence-based strategies necessary to achieve the goal of instruction that motivates and retains middle school girls' interest in computer science. The prior section examined the knowledge, motivation and organizational influences that affect how study participants perceive their teaching strategies. This section explores themes identified in the data that offer additional insight.

Among the important themes that emerged from this study is the importance of professional development. Mentoring is different from effective teaching. Having the knowledge of effective and evidence-based teaching strategies improves their teaching, which increases their mentoring of middle school girls.

Theme 1: The importance of professional development. When surveyed, 17 of 18 participants agreed or strongly agreed that they feel confident about their ability to effectively teach middle school girls computer science. Yet, only four out of eight interview participants reported that they had very little prior knowledge of effective and evidence-based strategies to utilize while facilitating a workshop. In addition, over 80% of surveyed participants noted that STEMaven does not provide professional development, which is noted in the literature review as key to developing the knowledge and skills needed to address learning challenges. Ryan, who shared a list of professional development strategies he thought would be useful for mentors at STEMaven said, "[would help foster] best practices on how to communicate and interact with middle school-aged girls from all socioeconomic backgrounds and how to identify real-life age-appropriate examples that can be used in the workshops." Moreover, all interviewed participants agreed that effective and evidence-based lessons are imbedded in each workshop and that STEMaven wants to increase the retention and interest of computer science for students. Debra said, "professional development is needed to show us and give us a checklist that we can run with confidence. We need training. Maybe as a team of peers." Moreover, Jessica added, "Mentors do a great job of how the workshop will flow but as far as how to work one-on-one and capture a deeper interest, we need additional training to make it even better." As presented in the literature, teachers in after-school programs gain knowledge by teaching lessons (Hynes, 2012). They enhance their teaching strategies and content knowledge by using examples or analogies students understand. After-school programs should provide an opportunity for teachers and mentors to enhance their professional skills and content knowledge.

Theme 2: Mentors recognized the need to employ culturally responsive teaching strategies. Survey data showed that 59% of participants understood what skills are needed to have a culturally responsive lesson, and, supporting this finding, the majority of interview participants were not able to describe what they do to incorporate these strategies during each workshop. In contrast, 71% of survey participants responded that they take the time to learn about the background of their students and learn why they are participating in a workshop. When mentors in after-school programs have this frame of mind, their expectations of their students are high and therefore impact student success more than a student's own motivation (National Center for Education Statistics, 2018). An overwhelming theme from the interviews provided a nuanced understanding that mentors did seem confident that they promote positive learning experiences.

Theme 3: Mentors acknowledged the need for self-efficacy for increased confidence in employing effective teaching skills. Both survey and interview participants overwhelmingly voiced they understood the importance of having confidence in their ability to facilitate a successful workshop, and six out of eight interviewed participants agreed that the organization should implement an ongoing and collaborative approach to reflection and feedback that occurs after the completion of a workshop. Bandura (2000) asserts that, if there is perceived collective efficacy, there is an impact on performance, commitment to the mission, and the ability to deal with challenges. Angela stated, "mentors do not have a specific set of expectations for self-growth communicated by and from the organization upon onboarding or during their mentorship." When mentors believe they can be successful, their performance increases and students receive the benefits of achievement. Additionally, when asked if there are ways the organization can improve its impact on mentor self-awareness, Sarah mentioned, "One thing I know they haven't really done for the mentors that teach the same class, is we never have meetings or a call to learn from each other except from the other mentor you taught with." Clark and Estes (2008) stated that people need practice and corrective feedback to help them achieve specific work goals.

Summary

This chapter has presented the results of the survey and the findings of the interviews as they have related to the first three research questions. The discussion included both the assumed influences presented in Chapter Three as well as the conceptual framework and the corresponding literature. The findings offer a unique look into the potential the organization seeks to provide increased opportunities through effective and evidence-based instruction and mentorship for middle school girls to engage in workshops that motivate and retain their interest in computer science.

It is not surprising that the data would reveal the mentors believe they are confident in teaching a computer science skill, that they know how to be self-aware, but lack the skills of effective and evidence-based teaching. Although there is a lack of professional development in effective and evidence-based teaching strategies, this has not led to a decrease in disengagement of students and frustration on the part of mentors.

One particularly unexpected finding in the study was how few participants in the survey responded that they could not define deficit thinking. The same lack of knowledge occurred during the interview. When given an example of deficit thinking in the classroom, all participants answered confidently, not to the definition of deficit thinking but to examples of themselves being able to identify assets in a student. They also provided examples of being aware of when to pivot during a workshop and being able to demonstrate optional strategies of teaching so all students can reach their full potential. While there were no major differences found in the mentor responses, for the most part, one thing mentors shared was their ability to employ culturally responsive learning techniques during their lesson(s), and overwhelmingly, mentioning that STEMaven adds to their rating on this topic. For STEMaven to truly nurture actively engaged learners, these markers must be defined. Though while the number of workshops facilitated on background knowledge of a STEM discipline and amount of time mentoring at STEMaven differ, engaged learning and the characteristics of the engaged mentor do not appear to discriminate.

Chapter Five offers an outline of such a framework. The chapter makes recommendations for the results and findings and provides an answer to the final research question, "What are the recommendations for STEMaven's practice in the areas of knowledge, motivation, and organizational resources to increase the interest, confidence, and perceptions in computer science?" The suggested interventions are offered based on the identified influences found through both modes of inquiry. These recommendations offer a systems approach to how STEMaven can support mentors as a collective force so they may, in turn, create the conditions for middle school girls to increase their interest in computer science.

CHAPTER FIVE: DISCUSSION

This chapter discusses the assumed knowledge, motivation and organizational influences related to achieving the organizational goal. Findings from this study showed there was gap in knowledge on effective and evidence-based teaching skills to use while facilitating a computer science workshop for middle school girls. Participants had similar motivational and organizational influences that limited their proficiency and their goals for successfully facilitating a computer science workshop. This chapter discusses several recommendations for improving practices, organized by the categories of knowledge, motivation, and organization. The new Kirkpatrick and Kirkpatrick (2016) methodology was used for an implementation and evaluation plan that includes reaction, learning, behavior, and results. The next section offers a concise review of the organizational goal, stakeholder groups and the purpose of the project.

Organizational Context and Mission

STEMaven is a 501(c)(3) nonprofit corporation founded in January 2017 to offer a variety of workshops for middle school-aged girls to explore technology, coding, and science. Their mission is to inspire middle school girls in East Tennessee to actively explore the fields of technology, to close the gender gap in the technology profession, and to foster participants' future careers. Additionally, STEMaven hosts 3-hour face-to-face workshops facilitated by mentors who have background knowledge in computer science or a technology-related skill. Since starting in 2018, STEMaven has continually grown in terms of number of participants each year and hosted 500 to 600 middle school girl participants (STEMaven, 2019).

Organizational Performance Goal

STEMaven wants to inspire and encourage local middle school girls to pursue careers related to computer science by providing free hands-on coding and technology-related workshops. By December 2020, mentors at STEMaven will demonstrate improved effective and evidence-based instruction proficiencies. The improvement of effective and evidence-based instruction proficiencies will result in an increased ability to teach their workshops and encourage the cultivation interest in computer science and aid in closing the gender gap in the technology profession.

Description of Stakeholder Groups

Three stakeholder groups play a role in the goal of this study. The STEMaven program director selects the workshops, recruits the mentors, and manages the program's overall performance. The mentors facilitate the learning of the curriculum, revise workshops to adapt to the students' learning level, and encourage the development of interest in computer science to ensure progress and growth of attendance rates. The student participants partake in workshops designed to embolden and retain an interest in computer science.

Goal of the Stakeholder Group for the Study

While the joint efforts of all stakeholders contributed to the achievement of the overall organizational goal of providing increased opportunities for middle school girls to engage in workshops that motivate and retain their interest in computer science, it is important to evaluate the gaps in mentor knowledge of effective and evidence-based teaching strategies. Therefore, the stakeholders of focus for this study were the mentors at STEMaven. The mentors contributed to the achievement of the organization's performance goal by facilitating workshops that increase interest, confidence, and perceptions of computer science by the end of November 2019. The program plays a significant role in bridging the gender gap in science, technology, engineering, and mathematics and improves the students' problem-solving skills.

Purpose of the Project and Questions

The purpose of this study was to evaluate the influences that affect how STEMaven mentors offer instruction that motivates and retains middle school girls' interest in computer science. The analysis focused on knowledge, motivation, and organizational influences related to achieving this organizational goal. While a complete needs analysis would focus on all STEMaven stakeholders, for practical purposes, the stakeholders in this analysis were all STEMaven mentors.

1. To what extent is STEMaven contributing to the development of effective and evidence-based teaching skills in the mentors?
2. What are the STEMaven mentors' knowledge and motivation related to improving their effective and evidence-based teaching skills?
3. What is the interaction between STEMaven's organizational culture and context and the mentors' knowledge and motivation to improving effective and evidence-based teaching skills?
4. What are the recommendations for STEMaven's practice in the areas of knowledge, motivation, and organizational resources?

Recommendations for Practice

The recommendations provide pathways for STEMaven to increase the knowledge and motivation of mentors in employing effective and evidence-base instruction proficiencies. Utilizing the recommendations, mentors will have an increased knowledge base to foster these proficiencies, reflect on their self-awareness, and successfully facilitate their workshops to increase interest in computer science for middle school girls. Moreover, with offering professional development that allows mentors access to these skills, the organizational culture will follow with a focused structure on development of these skills for mentors throughout their time mentoring at STEMaven.

Recommendation One

The first recommendation is to increase the mentors' knowledge about incorporating effective and evidence-based strategies to teach middle school girls' computer science. When surveyed, mentors signaled that they were confident in teaching their workshops, though interviews suggested that they need more in-depth procedural knowledge of how to incorporate effective and evidence-based strategies to teach middle school girls. Allison and Rehm (2007) found that teachers need to understand effective and evidence-based strategies to transfer skills and knowledge into the curriculum they are teaching to enhance the learning of computer science for middle school girls. This would suggest that providing mentors with access to digital and print resources would help them increase their knowledge of current best practices. The recommendation is to provide STEMaven mentors with access to these resources that explain effective teaching strategies. The use of visual aids and hands-on learning materials would define what practices are effective in retaining interest in computer science.

Shinn (1997) studied select principles of teaching and learning to determine the relationship between teaching strategies and their effective use of instructional methods and tools. Incorporating methods and tools during class time showed significant gains for teachers in procedural knowledge achievement. The study supports the recommendation to provide STEMaven mentors with access to these resources that explain effective teaching strategies.

Recommendation Two

The second recommendation is to increase the mentors' knowledge on how to best reflect on their skill strength in deficit thinking. Mentors need more in-depth metacognitive knowledge on how to reflect on their effectiveness in teaching middle school girls in computer science with regard to deficit thinking. A recommendation on the use of self-monitoring has been selected to close this metacognitive knowledge gap. Akl et al. (2007) found that creating goals where mentors can reflect on their workshops can have an impact on teaching and enhancement of those skills. This would suggest that providing mentors effective strategies on how to apply the knowledge and subsequently reflect on their effectiveness in utilizing deficit thinking would increase the knowledge in this area. The recommendation is to have the mentors keep a journal of their reflective thoughts and examination of methods they could have done differently during the development and implementation of a workshop.

Di Stefano et al. (2014) reported one becomes more effective at a task after reflecting on the way one has performed it before. The team conducted three studies based on the dual-process theory of thought, which is when a decision is made using two different systems of thinking, such as our intuition and conscious thought. The study found that when a group used reflection and sharing through group talk, they performed, on average, 18% better at reflecting on the who, what, when, where, and why. These reflective meetings can have a positive impact on group morale and learning. Helping mentors reflect on their strengths and weaknesses creates metacognition, which is a major factor of strategic behavior in approaching problems (Rueda, 2011) which is related to effective teaching skills.

Recommendation Three

The third recommendation is to expose mentors to best practices on how to evaluate an effective workshop. Goal orientation theory focuses on mastery, individual improvement, learning, and progress that promotes positive motivation. If mentors have the tools needed to assess whether a workshop was successful, they have a better understanding of what skills are needed to enhance their teaching. When a community of learners is created, motivation to improve occurs (Yough & Anderman, 2006). When the organization employs strategies based on strong goal orientation, productivity increases, with mentors reaching the goal along with utilizing current resources and skills. In addition, strong goal orientation allows mentors to see their personal contribution to the overall goal. The recommendation is to provide a job aid in the form of a procedural map that outlines steps to evaluate a workshop to increase knowledge on how to best evaluate a workshop and improve teaching practices. The process map must include a flow diagram that allows the mentor to document every step of the evaluation process. This allows for mentors to visualize the details of the evaluation process closely and in turn help mentors identify strengths and weaknesses in their current teaching.

Mentors who are familiar with evaluation practices often equate the quality of their workshop to the level of support, knowledge, and motivation of this process, and the capabilities and proficiency of the coordinator (Lundh et al., 2013). Having the ability to dissect a workshop is essential in ensuring the mentors understand the steps and techniques necessary to effectively teach a workshop. Clark and Estes (2008) found that people need practice and corrective feedback to help them achieve specific work goals. Understanding how to successfully evaluate a workshop is a major factor in successfully facilitating after-school workshops that increase interest and retainment of middle school girls in computer science. Having a structured evaluation plan is one way mentors can learn effective strategies and techniques to increase the engagement of students and encourage interactive learning.

Recommendation Four

The fourth recommendation is to increase the self-efficacy of mentors so they can confidently facilitate a culturally responsive workshop. Self-efficacy theory focuses on personal beliefs, expectations about one's own capability to organize and implement. Motivation needs to be supported by good evidence in line with one's conceptual reasoning (Pintrich, 2003). When the mentors are exposed to situations where they need to employ culturally responsive teaching techniques, they become more aware of the skills needed and have increased confidence to effectively apply this practice. The recommendation is to provide case studies describing evidence-based practices that demonstrate the success of teaching middle school girls in similar after-school computer science-based programs. Upon the implementation of evidence-based practices to increase the mentors' culturally responsive skills, mentors begin to grow their toolbox of skills and successfully facilitate a workshop to teach to various cultural differences.

Borgogni et al. (2011) stated that, to strengthen ones' self-confidence, one must work on self-efficacy and perception. According to Rueda (2011), individuals with higher beliefs in their competency and higher expectations of their role are more motivated to participate and retain their tasks. With more applied practice in using culturally responsive teaching techniques, mentors will be more motivated to improve their skills and be better prepared to effectively facilitate a workshop.

Recommendation Five

The fifth recommendation is that the organization should encourage and foster a culture that supports change in existing teaching strategies through professional development. The organization focuses on the core content for each workshop, that often the effective and evidence-based teaching strategies are not incorporated in the learning experience. If mentors were able to implement new evidence-based teaching strategies in a workshop, it would make them more effective teachers because they would be using best practices that fit their level of skill. With the application of knowledge improvement of teaching skills will follow. This can occur through the encouragement and fostering of a culture that supports new evidence-based teaching practices. Productive support systems targeting the specific levels of individual teachers increase peer support, roles, and job satisfaction (Kipps-Vaughan, 2013). For a change effort to be successful, solutions must consider and adapt to the organizational culture (Clark & Estes, 2008). With an increased focus on the availability of new effective and evidence-based teaching strategies, mentors would have more opportunities to learn about these best practices. The organization should provide professional development that provides the resources mentors need to enhance their knowledge and ability to demonstrate new evidence-based teaching strategies in the workshops.

A learning organization is capable of encouraging employees to acquire and transfer knowledge (Huffman et al., 2003). Although mentors may not facilitate a workshop on a weekly or monthly basis, they should all have access to the latest evidence-based practices and, thus, the ability to thrive in their workshop. This would suggest that, along with emphasizing long-term active support through engagement, connections between teachers work and their own students improved professional practice (Huffman et al., 2003).

Recommendation Six

The sixth recommendation is that the organization provide mentors with effective role models in workshops demonstrating effective and evidence-based teaching skills. If the mentors can witness other modeling effective and evidence-based teaching skills, they can reflect on those skills and incorporate them into their workshops. Utilizing mentors is an intuitive practice which provides teachers the support to solve problems and develop trustful relationships (Fresko & Alhija, 2012). The recommendation is for the organization to provide consistent interaction and observation opportunities of workshop facilitated by master teachers in various teaching scenarios that support the conceptual understanding of their role and helps to develop their practical skills as well as job satisfaction.

A key support system for improving the depth of knowledge for new and established teachers are mentors and models. In educational environments, a mentor is a more experienced coworker who supports teachers in the development and execution of instruction (Ulvik & Sunde, 2013). Therefore, creating a culture that reflects this belief is essential within the program to increase the interest and retention of middle school girls' in computer science.

Implementation and Evaluation Framework

To implement recommendations and to effectively evaluate the suggested recommendations, the plan utilizes the New World Kirkpatrick Model, which evolved from the original Kirkpatrick Four Level Model of Evaluation (Kirkpatrick & Kirkpatrick, 2016). The model includes four levels of training that revert in a backward design. This New World version presents the levels in reverse order from the original. To provide effective and evidence-based instruction and mentorship in workshops that motivate and retain their interest in computer science, this model looks at the New World version beginning with the end in mind (Level Four). Level Four (Results) refers to the degree to which participants achieve the stated outcomes from professional development. Leading indicators, or observable measurements, are then defined. Level Three (Behavior) then identifies the critical behaviors and required drivers to reinforce mentor performance. Level Two (Learning) then determines the degree to which learning occurred in the areas of knowledge and skills, attitude, confidence, and commitment. Finally, Level One (Reaction) measures the impressions of the participants and the degree to which they have found the experience relevant and engaging (Kirkpatrick & Kirkpatrick, 2016).

Implementation and Evaluation Plan

The New World Kirkpatrick Model is used to inform the implementation and evaluation plan designed to address the recommendations (Kirkpatrick & Kirkpatrick, 2016). The model proposes a backward design so that the starting point for any implementation and evaluation plan be the organization's goals. To implement effective curriculum with enhanced development of interpersonal and managerial skills, this model looks at Level Four, (Results) which refers to the degree to which participants achieve the stated outcome from the use of common language regarding effective and evidence-based teaching and learning, increased understanding of deficit thinking, and the accessibility to model teaching in computer science to middle-school-aged girls becomes a constant. Leading indicators, or observable measurements, are defined. Level Three (Behavior) identifies the critical behaviors and required drivers to reinforce effective and evidence-based teaching skill development. Level Two (Learning) shows the degree to which learning occurred in the areas of knowledge, skills, attitude, confidence, and commitment based on their participation in the training. Lastly, Level One (Reaction) evaluates the degree to which the learner finds the training positive, interesting, and relevant to their teaching. (Kirkpatrick & Kirkpatrick, 2016).

Level 4: Results and Leading Indicators

As STEMaven mentors facilitate new workshops, it is important to develop a mechanism by which to assess and measure the rate at which mentors successfully increase and retain middle school girls' interest in computer science. Observations and the gauging of proposed scenarios that suggest progress is being made to create positive results are called leading indicators (Kirkpatrick & Kirkpatrick, 2016). Leading indicators reassure stakeholders that the progress is contributing to organizational outcomes (Kirkpatrick & Kirkpatrick, 2016). As such there are specific leading indicators that act as flags throughout the implementation of the innovation, which will either serve to pinpoint ongoing adjustments to the workshops or denote goal attainment. These indicators are both internal and external short-term outcomes.

Internal outcomes include use of common language regarding effective and evidence-based teaching and learning, increased understanding of deficit thinking, and the accessibility to model teaching in computer science to middle-school-aged girls. As STEMaven achieves the internal outcomes, it can then expect to see the external outcomes also realized. External outcomes include increased retention rates of students and workshop facilitation satisfaction of mentors, and mentors actively engaged in after-hours professional development. Table 10 below outlines these internal and external outcomes and the related metrics and methods for measuring them.

Table 10

Outcomes, Metrics, and Methods for External and Internal Outcomes

Outcome	**Metric(s)**	**Method(s)**
	External Outcomes	
Increased retention rates of students.	Number of students returning for additional workshops. Number of students in each workshop.	Attendance rate data regarding number of students in each workshop.
Increased workshop facilitation satisfaction rates of mentors.	umber of mentors who report satisfaction while facilitating workshop(s) umber of parents/guardians who report satisfaction with their child's STEM workshop experience.	Mentor climate surveys.
Mentors actively engaged in professional development.	The types and number of professional development activities mentors are engaged in, based on the site-based definition of effective, evidence-based learning.	Aggregate data from observation forms, survey data, and task analysis from planning documentation.

Table 10, continued

Outcome	Metric(s)	Method(s)
	Internal Outcomes	
Common language utilized across STEMaven regarding effective and evidence-based teaching and learning practices.	Number of mentors who speak about effective and evidence-based teaching and learning practices in common ways across workshops.	Data from interviews regarding instructional and professional development practices at STEMaven.
Increased understanding of deficit thinking and how culture is a primary driver of instruction.	Number of mentors who report understanding of deficit thinking.	Mentor climate survey.
Mentors have models for best practices and effective teaching.	Number of mentors engaged with a model or mentor that has prior success with teaching middle school girls.	Data from interviews regarding instructional and professional development practices at STEMaven.

Level 3: Behavior

Critical behaviors. After training, Level Three is the most important, but also the most thought-provoking part of an implementation and evaluation plan because of the difficulty in supporting and holding stakeholders accountable for applying their learning (Kirkpatrick & Kirkpatrick, 2016). Therefore, it is imperative that mentor behaviors are supervised to safeguard goal attainment. These behaviors include learning components of the framework for effective and evidence-based teaching, document of effective and evidence-based teaching, identification of personal learning needs in regard to evidence-based teaching, and attendance and engagement in learning groups. Table 11 below outlines each of these critical behaviors, their related metrics, methods, and timing.

Table 11

Critical Behaviors, Metrics, Methods, and Timing for Evaluation

Critical Behavior	Metric(s)	Method(s)	Timing
1. Mentors will learn the components of the framework for effective and evidence-based teaching	The number of effective and evidence-based learning activities implemented.	Leadership will fund and make available training related to framework. Data collected during observations.	During every other workshop. Initially shared prior to a mentors first workshop, then repeated every six months.
2. Mentors will document effective and evidence-based learning goals	The completion of clear effective and evidence-based goals. The degree to which goals are evidence-based.	Mentor portfolio updated.	After each workshop a mentor facilitates
3. Mentors will identify personal learning needs in regard to evidence-based learning.	The number of identified needs from each mentor.	Mentors will report identified needs to leadership. Mentor models will review identified needs and discuss initial needs with leadership.	Before and after every 3 workshops.
4. STEMaven will provide learning opportunities where mentors can share resources, discuss issues, engage in effective instructional strategies and reflect on best practices.	The number of professional learning meetings attended by mentors.	Leadership will track attendance and request feedback on engagement.	Monthly with each mentor.

Required drivers. The critical behaviors above cannot occur on their own. The organization must also cultivate the environment with specific support for the critical behaviors to succeed. These supports are called required drivers. There are four types of drivers:

reinforcing, encouraging, rewarding, and monitoring. Reinforcing drivers are those that emphasize the importance of the transfer of the new skills into daily activity (Kirkpatrick & Kirkpatrick, 2016). These include the knowledge related solutions outlined previously in the chapter, such as provide job-aides that support effective teaching and learning strategies and use of effective teaching tools. Encouraging drivers are those systems, supports, and processes that provide consistent inspiration for participants to continue the transfer of the skills (Kirkpatrick & Kirkpatrick, 2016). The encouraging drivers include motivation related solutions such as rationales that provide utility value for effective and evidence-based teaching, the modeling of strategies, and targeted and useful feedback. Rewarding drivers are those which recognize the appropriate implementation of the skills (Kirkpatrick & Kirkpatrick, 2016). These rewarding drivers include recognition of mentors with best teaching practices awards and by providing a knowledge base of pedagogy and a system of support including trust and collaboration. Table 12 below outlines the reinforcing, encouraging, and rewarding drivers necessary for mentors to implement effective and evidence-based teaching in their workshops, and which critical behaviors they support.

Table 12

Required Drivers to Support Critical Behaviors

Method(s)	Timing	Critical Behaviors Supported 1, 2, 3, 4
Reinforcing		
Job aid containing a glossary of key terms found in handbooks that clearly outlines professional expectations.	Ongoing	1,2,3,
Job aid that includes a clear framework of STEMaven's definition and expectation of effective and evidence-based teaching	Ongoing	1,2,3
Job aid that details effective teaching strategies for meeting the needs of all students that align with the STEMaven goal.	Ongoing	1,2,3
Job aid that compares details of specific strategies associated with culturally based learning, including the benefits of each strategy and when and why a mentor should utilize the strategy.	Ongoing	1,2,3
Meetings for mentors to discuss strategies	Bi-monthly	1,2,3,4
Encouraging		
Rationale for effective and evidence-based teaching (utility value)	Ongoing	1,2,3
Mentor observations	Bi-monthly	1,2,3
Peer modeling during group discussions	Bi-monthly	1,2,3,4
Mentors receive targeted and useful feedback from peers and leadership	Workshop based	1,2,3,4
Rewarding		
Public recognition on STEMaven website and internal communication newsboard/emails when mentors successfully implement effective and evidence-based teaching that retains interest	Workshop based	1,2,3,4
Monitoring		
Leadership with review each workshop to evaluate that goals and outcomes are contained in content as well as effective teaching strategies	Prior to each workshop	1,2,3,4
Portfolios that contain key performance indicators along with individual interviews.	Bi-annually	1,2,3

Organizational support. Support and accountability are key to how an organization takes responsibility for what it offers to its community and must remain under a watchful eye to stay relevant (Conner & Rabovsky, 2011; Darling-Hammond & Snyder, 2015; Hentschke &

Wohlstetter, 2004). Therefore, to have reliable organizational support, mentors and leadership are both critical for the review and follow-up of the knowledge, motivation, and organizational needs. The outcomes and behaviors will need action plans along with consistent review of success or failure. Mentors will need access to systematic experiences both in and out of the workshop environment to provide growth and the skills necessary to facilitate workshops that increase interest, confidence, and perceptions of computer science. Additionally, dashboards that support mentors in self- and peer-monitoring with highlighted key performance indicators and bi-annual surveys and interviews also support accountability for the required drivers and critical behaviors (Kirkpatrick & Kirkpatrick, 2016).

Level 2: Learning

Learning goals. Following completion of the recommended solutions offered above, STEMaven mentors will be able to

1. Mentors need to know how to incorporate effective and evidence-based strategies of teaching middle school girl's computer science (Procedural Knowledge).
2. Mentors need to know what deficit thinking is so they can promote a positive learning experience for middle school girls and employ culturally responsive teaching strategies (Metacognitive).
3. Mentors need to see how effective their teaching is in increasing retention of interest in computer science (Goal Orientation).
4. Mentors need increased confidence that they can teach computer science to middle school girls (Self-Efficacy).
5. Actively engage with peers and leadership (Cultural Model).

6. Monitor progress toward culturally based learning goals and adjust where necessary (Self-Efficacy and Procedural).

Program. The evidence-based professional development program is a comprehensive plan that enhances effective teaching and learning strategies for mentors to facilitate workshops that motivate and retain middle school girls' interest in computer science. This program supports mentors in achieving the above stated learning goals through structure that enhances the comprehension of the elements to incorporate effective and evidence-based strategies of teaching middle school girl's computer science, applying a common language about the incorporation of effective and evidence-based strategies used in the workshops, and actively engaging in the execution of associated strategies and techniques. Additionally, the program will provide mentors the ability to engage in constructive dialogue centered around successful techniques, focused goal setting, and feedback that is aimed to encourage each mentor.

Throughout the process, the organization will provide job aids for effective and evidence-based teaching strategies and models that compare details of specific strategies associated with culturally based learning, including the benefits of each strategy and when and why a mentor should utilize the strategy. The professional development program will occur in an ongoing format before, during, and after the facilitation of a workshop. The program is designed to incorporate peer to peer learning and feedback, in conjunction with handbooks outlining definitions and expectations. To support the learning further, leadership, peer mentors, and mentors alike, will monitor comprehension and growth through observations and individual portfolios containing key performance indicators and feedback.

Evaluation of the components of learning. As mentors begin the process of implementation of effective and evidence-based strategies into their workshops, they need a sense that they are accomplishing applicable knowledge. Therefore, it is imperative to evaluate the level to which the mentors have learned the procedural and metacognitive knowledge. Table 13 outlines these methods for evaluation of these components as well as timing.

Table 13

Evaluation of the Components of Learning for the Program

Method(s) or Activity(ies)	Timing
Declarative Knowledge "I know it."	
Knowledge checks through the use of check-lists during professional development activities and peer discussions.	Periodically during in-person and virtual workshops.
Knowledge checks through the use of individual portfolios that contain goal setting to demonstrate understanding of expectations.	Upon completion of a workshop.
Procedural Skills "I can do it right now."	
Demonstration of individual job aids to successfully implement culturally responsive workshops.	Through observation notes from peers and leadership.
Demonstration of knowledge and skills to successfully engage in culturally responsive workshops.	Through observation notes from peers and leadership.
Attitude "I believe this is worthwhile."	
Pre- and post-surveys	After facilitating 2 workshops or quarterly-whichever comes first.
Discussions with peers and leadership on the value of deficit thinking and how this can influence learning.	During feedback sessions with peers and leadership.
Confidence "I think I can do it on the job."	
Scaled survey	After facilitating 2 workshops or quarterly-whichever comes first.
Discussions with leadership following workshops and feedback.	Following the facilitation of every other workshop.
Commitment "I will do it on the job."	
Creation of mentor goals related to individual action plans.	During professional development meetings.

Level 1: Reaction

Level One recommends utilizing three components to measure reactions to the program. They consist of engagement, relevance, and satisfaction (Kirkpatrick & Kirkpatrick, 2016). To ensure the desired outcomes, all three components are pivotal to the successful desired results.

As with the components of the professional development program above, Table 14 below outlines the needs to measure reactions from the program.

Table 14

Components to Measure Reactions to the Program

Method(s) or Tool(s)	Timing
Engagement	
Attendance	Required for each workshop
Completion of goals in individual portfolio	Prior to facilitation of a new workshop
Self-Assessment	Completion of each workshop
Observation	During a facilitated workshop
Participation in peer review and feedback	Throughout the year
Relevance	
Online brief survey to monitor if skills and knowledge are incorporated	After each facilitated workshop
Effectiveness of peer to peer learning, modeling, and feedback	At the end of every other month
Customer Satisfaction	
Online survey of mentors upon exit of STEMaven program	End of mentorship
Check-in scaled survey (online) and discussion (ongoing)	When new effective/evidence-based learning strategies are introduced

Evaluation Tools

Immediately following the program implementation. The following sections summarize the evaluation tools used during and immediately following the program implementation and delayed evaluation tools based on the timeline Kirkpatrick and Kirkpatrick (2016) suggest. To move the program forward and help guide the mentors obtain a wide range of understanding of their experience and outcomes, multiple methods will be used to advise the evaluation. Evaluation of the program through participant feedback helps to improve the program, to maximize transfer of learning to behavior and subsequent organizational results, and to demonstrate the value of training to the organization (Kirkpatrick & Kirkpatrick, 2016).

After the completion of a workshop, mentors will participate in a self-talk survey in their individual portfolio that will assess their self-efficacy in applying, relevant utilization, and obligation to the new skills, and general agreement with the content, delivery, and structure of the professional development program. The selected facilitators of the professional development program will request Level One feedback about application during the training through group discussion and pulse-check self-talk that ask mentors to share their comments on one thing they learned and one thing they are wanting to learn through a variety of outlets. The mentors can communicate their self-talk through verbal face-to-face communication, digitally, or handwritten on posters located throughout the room where all participants can add comments and suggestions. These pulse-checks allow for trainers to gain a perspective of Level One and Level Two comprehension or areas needing additional thought. Additionally, a final reflective question will probe mentors to ascertain how they can employ the material learned to their next workshop.

Delayed for a period after the program implementation. A supplemental evaluation will occur after a delayed period of time, customarily after the mentor has facilitated at least two workshops to allow for marination of thought and implementation of the strategies. A blended model, incorporating all the levels from reaction to results makes maximizing perspective on the experience more likely to (Kirkpatrick & Kirkpatrick, 2016). The evaluation tool should include survey items that measure engagement, relevance, and satisfaction (Level One), confidence in and value of knowledge acquired (Level Two), the degree to which the mentor applied the learning (Level Three), and the degree to which the training has impacted the successful facilitation of a workshop (Level Four).

Assessment Analysis and Reporting

The Level Four goals, which examine the degree to which the training has impacted the successful facilitation of mentors learning effective and evidence-based teaching strategies, consists of skills evaluations, effective and evidence-based teaching strategies learned through structured professional development, mentor and peer modeling, and time for reflection and feedback. Through mentor roundtables, one-on-one reflective meetings between mentors and director, mentors will be able to see if students are gaining interest in computer science. Mentors will be asked for information on knowledge acquired, how training changed their approach to teaching middle school girls and how it will impact their future workshop facilitation. Figure 13 shows the elements of professional development that supports the growth of effective and evidence-based teaching skills.

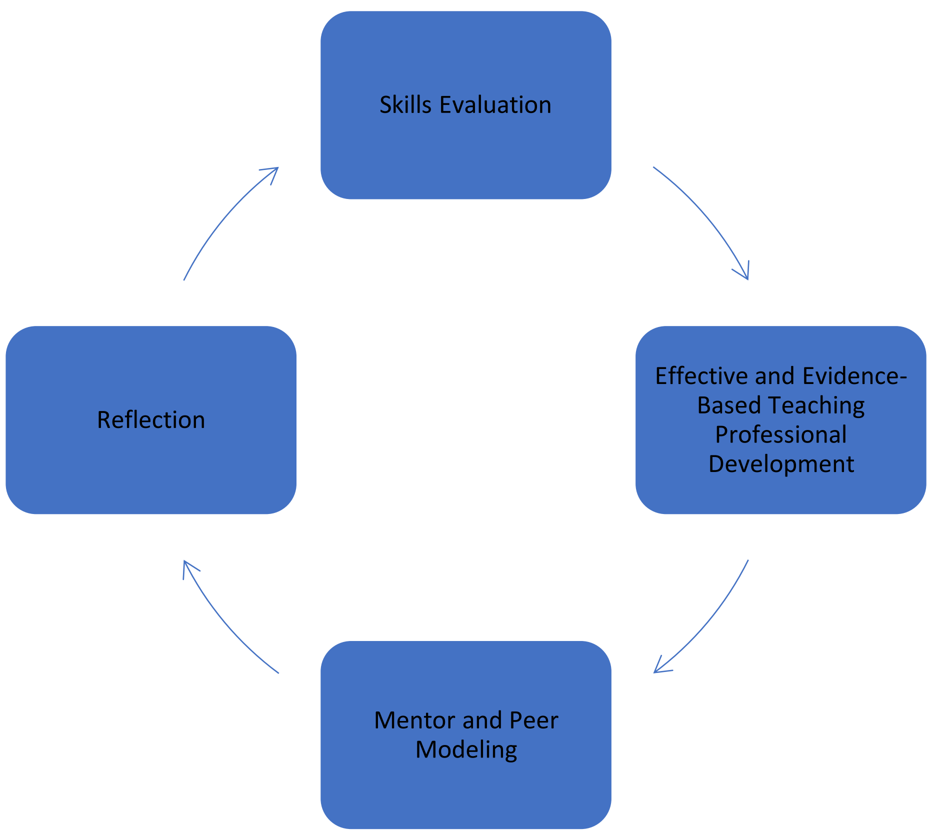

Figure 13. Elements of professional development that supports the growth of effective and evidence-based teaching skills.

Strengths and Weaknesses of the Approach

All methodological approaches have strengths and weaknesses. The Clark and Estes (2008) framework was beneficial to review how knowledge, motivation and organizational influences influenced mentor's awareness of effective and evidence-based teaching strategies. There are a variety of methods that may have exhibited diversified results. The framework was effective in creating both the survey and interview questions, although holding focus groups and reviewing historical documents may have shown additional themes. Nevertheless, the framework was productive for this specific problem and stakeholder group. The framework assisted in understanding mentor's proficiencies and by employing best practices the organization can impact mentors' knowledge on effective skills that can aid in the interest in computer science. Although the framework necessitated participant involvement, which took volunteering their personal time, I considered it a successful approach to measure and study the stakeholder goal and problem of practice.

Limitations and Delimitations

This study was limited in that survey results showed that participants felt they were confident in facilitating their workshops. However, in interviews, the majority of participants thought there was no practice of reflection or professional development to enhance and develop these skills. From the interviews, the mentor did not believe that STEMaven focused on these skills but, rather, concentrated on lessons pertaining to computer science. While the disparity was not overwhelming in the survey results, interviews also had similar themes but were not necessarily aligned with the survey results. Interviews also had limitations as some mentors had not facilitated a workshop in months and, in some cases, had to be emailed and rescheduled due to unforeseen circumstances. The survey response rate was high and the interviews were more difficult to schedule due to the constraints to qualify. Even though the survey had a larger number of participants than the interview portion, having a larger number of interviews could have shed light on more knowledge, motivation and organizational influences.

The recommendations could be utilized by both established and new after-school programs. Programs looking to increase mentors effective and evidence-based teaching strategies can all benefit from the results and recommendations. Having a focused professional development of effective and evidence-based strategies along with opportunities of self-awareness and reflection can benefit all after-school programs providing mentors with the tools necessary to increase the interest in a STEM field.

Future Research

Future research could study more innovative models of effective and evidence-based teaching strategies in successful STEM-related after-school programs. Many programs offer structured professional development and best practices on reflection and self-awareness. Some after-school programs partner with community businesses to provide real-world problems that can be utilized within the lessons to create and drive interest in STEM.

Research conducted with mentors in after-school STEM-related programs who have had time to develop and utilize their skills in workshops would also be very interesting to study. Having a chance to complete a longitudinal study of the student participants every five years would bring a very interesting perspective on where the students are now and if they are interested in having a career in STEM. Moreover, research conducted with the undergraduate students at the local university and community college could prove useful to see which students pursued their education in a STEM discipline due to the influence of a STEM-based after-school program. In researching this, other STEM-based after-school programs can be created that influence middle school girls to pursue a career in STEM.

Conclusion

To ensure that mentors at STEMaven will demonstrate improved effective and evidence-based teaching strategies as a result of the professional development, it made sense to conduct research with mentors who had facilitated a workshop(s) in the program and who had been a mentor since January 2018. Through surveys and interviews, the Clark and Estes (2008) framework allowed to study mentor's knowledge, motivation and organizational influences in regards to the importance of effective and evidence-based teaching skills. The study revealed many gaps in mentors' knowledge of what students need to create interest in computer science and gaps in the organizational culture that contribute to the gap in contributing to development of interest. The implementation and evaluation plan of recommendations was designed using the New World Kirkpatrick Model. The model, backward in design, starts with the ultimate organizational goal and then finds necessary learning and assessment components to slowly and consistently bring goals to completion. Methodical data analysis will offer the tools to maximize outcomes of all future initiatives (Kirkpatrick & Kirkpatrick, 2016). Through this model, STEM-related after-school programs can address knowledge, motivation and organizational influences identified and validated in this study, to ensure that mentors have a structured environment where effective and evidence-based teaching strategies are the core of the program. If and when this occurs, it will be embedded into the best practices mentors actively use and give them the ability to prosper as mentors and facilitate workshops with a conscience of deficit thinking.

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APPENDIX A

Survey Protocol

Confidentiality

All information that is collected in this study will be treated with confidentiality. While aggregate results will be made available to STEMaven, you are guaranteed that neither you, the program nor any of its personnel will be identified in any report of the results of the study. Participation in this survey is voluntary and any individual may withdraw at any time.

About the questionnaire

- This questionnaire asks for information about the program.
- This questionnaire should take approximately 5-10 minutes to complete.
- All questions can be answered by marking the one most appropriate answer.
- Please complete this questionnaire no later than October 25, 2019.
- When in doubt about how to answer a question, or if you would like more information about it or the study, you can reach me by phone at the following number 423-298-2142 or email at caseyjen@usc.edu.

Thank you for your cooperation!

Survey Items and Analysis

Key: Procedural Knowledge (P), Metacognitive (M) Self-Efficacy (SE), Goal orientation (GO), Cultural Setting Influence (CS), Cultural Model Influence (CM)

Research Question/ Data Type	KMO Construct	Survey Item (question and response)	Scale of Measure-ment	Potential Analyses	Visual Represent-ation
Demo-graphic: sample description	N/A (Used for summary statistics)	1. Please identify your current employment status *Mark only one. a. Full time b. Part-time c. Retired d. Unemployed	Nominal	Percentage, Frequency	Table
Demo-graphic: sample description	N/A (Used for summary statistics)	2.What is your gender? a. Female b. Male c. Decline to state	Nominal	Percentage, Frequency	Table
Demo-graphic: sample description	N/A (Used for summary statistics)	3. Do you currently volunteer as a mentor at another after-school STEM program? a. Yes, if yes, how many ____ b. No	Nominal	Percentage, Frequency	Table

Demo-graphic: sample description	N/A (Used for summary statistics)	4.Have you facilitated more than 2 workshops since January 2018? a. Yes. If more than 2, how many _______. b. No	Nominal	Percentage, Frequency	Table
Demo-graphic: sample description	N/A (Used for summary statistics)	5. What is the highest level of formal education that you have completed? a. High School b. Undergraduate c. Master's degree d. Doctoral degree. Please list your concentration____________	Nominal	Percentage, Frequency	Table
Demo-graphic: sample description	N/A (Used for summary statistics)	6.When did you begin working in your current position? a. 2019 b. 2018 c. 2017 d. 2016 e. 2015 f. 2014 g. 2013 or earlier	Nominal	Percentage, Frequency	Table
Demo-graphic: sample description	N/A (Used for summary statistics)	7.What is your employment outside of STEMaven? a. Computer Scientist b. Engineer (specify type) _________ c. Other (specify)___________	Nominal	Percentage, Frequency	Table
Demo-graphic: sample description	N/A (Used for summary statistics)	8.What is the primary location that you facilitate at STEMaven workshop? a. Local community college b. Local middle school c. Local high school d. Local community center e. Other (please list) ________	Nominal	Percentage, Frequency	Table
Demo-graphic: sample description	N/A (Used for summary statistics)	9. How many months have you been a mentor at STEMaven? *Please write the total number of months ___________	Nominal	Percentage, Frequency	Table
What is the stakeholder's knowledge related to increasing middle	Knowledge (P) (Mentors need knowledge of deficit thinking so they can	10. Please rate your knowledge of deficit thinking and how this can influence the learning environment for each of the following. Please also indicate how STEMaven added to your rating.			

school girls' interest in computer science?	promote a positive learning experience for middle school girls and employ culturally responsive teaching strategies.)	• I can define deficit thinking and . (strongly agree, agree, disagree, strongly disagree) • To what extent does STEMaven add to your rating on this question. (A great deal, somewhat, a little, not at all). • I understand what skills are needed to have a culturally responsive lesson. (strongly agree, agree, disagree, strongly disagree) • To what extent does STEMaven add to your rating on this question. (A great deal, somewhat, a little, not at all). • During my lesson(s) at STEMaven, I employ culturally responsive learning techniques. (strongly agree, agree, disagree, strongly disagree) • To what extent does STEMaven add to your rating on this question. (A great deal, somewhat, a little, not at all). • I take the time to learn about the background of my students and reasons to why they are participating in the program. (strongly agree, agree, disagree, strongly disagree) • To what extent does STEMaven add to your rating on this question. (A great deal, somewhat, a little, not at all).			
What is the stakeholder motivation related to increasing middle school girls' interest in computer science?	Motivation: SE (Mentors need increased confidence that they can teach computer science to middle	11. Please rate your self-efficacy (belief in yourself to be successful) for each of the following. Please also indicate how STEMaven added to your rating. • I feel confident about my ability to teach middle school girls in computer science.(strongly agree, agree, disagree, strongly disagree)	Ordinal	Expected to use: Percentage, Frequency, Might use: Mode, Range	Table, bar graph

	school girls in computer science discipline.)	• To what extent does STEMaven add to your rating on this question. (A great deal, somewhat, a little, not at all). • How do you feel about your ability to teach middle school girls in computer science? (strongly agree, agree, disagree, strongly disagree) • To what extent does STEMaven add to your rating on this question. (A great deal, somewhat, a little, not at all). • Navigate the aspects of the workshops with which I have/had little previous experience (strongly agree, agree, disagree, strongly disagree) • To what extent does STEMaven add to your rating on this question. (A great deal, somewhat, a little, not at all). • The program director encourages me to do my best. (strongly agree, agree, disagree, strongly disagree) • To what extent does STEMaven add to your rating on this question. (A great deal, somewhat, a little, not at all). • Mentors share strategies for successfully facilitating a workshop.(strongly agree, agree, disagree, strongly disagree) • To what extent does STEMaven add to your rating on this question. (A great deal, somewhat, a little, not at all).			
What is the stakeholder knowledge and motivation	Motivation: GO (Mentors need to see how	12. Please rate your goal orientation (commitment and implementation of objectives) for each of the following.	Ordinal	Expected to use: Percentage, Frequency,	Table, bar graph

related to increasing middle school girls' interest in computer science?	effective their teaching is in increasing retention of interest in computer science.)	• Overall how satisfied are you with facilitating a STEMaven lesson(s)?" (very satisfied, satisfied, neutral, dissatisfied, very dissatisfied) • How motivated are you to see students succeed?" (very motivated, somewhat motivated, not very motivated, not at all motivated, not sure).		Might use: Mode, Range	
To what extent is STEMaven meeting its goal of increasing middle school girls' interest in computer science?	Organizational Influences: CM (The organization needs a culture that supports change in existing teaching strategies founded on collective engagement, shared purpose, and collaboration.)	13. Please rate the organizational identity for each of the following. • The organization provides professional development that is centered around new teaching strategies. (A great deal, somewhat, a little, not at all). • PD is offered that is centered around new teaching strategies. (A great deal, somewhat, a little, not at all). • The PD is beneficial to both yourself and the organization. (very helpful, somewhat helpful, somewhat unhelpful, not helpful at all).	Ordinal	Expected to use: Percentage, Frequency Might use: Mode, Range	Table, bar graph

APPENDIX B

Interview Protocol

Welcome

Thank you again for taking the time out of your day to meet with me. This interview should take approximately one hour to conduct. Does that still work for you? Please feel free to enjoy some food and drink while we talk.

Before we get started with the interview questions, I would like to provide you with an overview of my study and answer any questions you may have. I am currently enrolled as a doctoral student at the University of Southern California (USC) in Los Angles, California. I am studying Organizational Change and Leadership (OCL) and part of my requirements for fulling a doctoral degree, I am conducting a study how the STEMaven Program increases the number of middle school girls' who attend the computer science program from year to year and how teachers and mentors have the ability to increase the number of middle school girls interested in attending the computer science program through their teaching strategies.

Before we begin, I want to assure you of my role and that I will not make judgements on your performance or role in the program. Also, I commit to keep all answers collected in strict confidence. You have received the information of the study; do you have any additional questions before we get started?

Follow-up after introduction: As we discussed in our initial communication, I would like to record the interview to accurately capture what you share with me today. May I please collect your signed form for consent to record now? If there are no additional questions or clarifications needed, may I have your permission to begin the interview?

Transition into Body of Interview

Now, as we begin the interview, I will give you a quick overview of the structure of our time together. I am going to ask some questions, and I would like to encourage you to answer honestly and opening. Feel free to ask me to clarify any question(s). There are no wrong or right answers and the goal today is to hear your answers and points of view as best as possible.

Body of the Interview

1. To begin, I am hoping we could start with you sharing a little about your professional background. What brought you to the STEMaven program? What interested you about becoming a mentor for this program?
2. Describe STEMaven, mentors and student demographics, and its' mission and vision statement.
3. How would you describe your experience as a mentor at STEMaven?
4. Explain the importance of how cultural can influence learning? How do you include this in your lesson(s) to make them compatible with the social cultural contexts of middle school girls?
5. Deficit thinking refers to mentors creating an environment that promotes a positive learning experience and employs culturally responsive teaching strategies. What does 'deficit thinking' mean to you?
6. What strategies do you employ to address deficit thinking with other mentors and/or the director? Are students included in these strategies?
7. Tell me your goals in becoming an effective mentor at STEMaven.

8. In what ways has STEMaven supported your development of becoming an effective mentor? Are there ways the program can improve its impact on your development?
9. What would mentors say in regard to the director as being proactive in identifying internal and external factors that may derail a workshop before it is facilitated?
10. Let's talk about mentor training. In your opinion, do you believe that this training is focused on how to teach the lesson(s) or more emphasis on how to capture the interest of the students?
11. What supports or structures would you like to see the STEMaven program put in place that could further support the goal of increasing the interest of middle school girls in computer science?
12. How do you think STEMaven has an impact on the learning and development of middle school girls in computer science?

Possible final wrap-up questions: You mentioned XXXXXX. Can you help me understand that a little more? Could you please tell me what you meant by XXXXX?

Final thoughts: Please let me know if there is anything that you would add to our conversation today that we did not discuss?

Closing: Thank you very much for sharing your thoughts with me today. What you have shared with me today is very helpful in my study and I greatly appreciate your time and willingness to be open with me.

APPENDIX C

Statement of Explanation About the Study to Accompany Email With Survey

Dear STEMaven mentor participant,

As a current STEMaven mentor, you are being invited to participate in a 5-minute survey. This survey is part of a dissertation research project investigating the knowledge, motivation, and organizational influences that affect middle school girls' interest in computer science.

Your participation in the survey is completely voluntary and all of your responses will be kept confidential. You may choose to skip any question. You may also choose to end your participation at any time. No personally identifiable information will be associated with your responses to any reports of these data.

If you meet specific study-related criteria, you may be asked to participate in a 60-minute interview. Interview participation is completely voluntary. If you choose to volunteer, you will be asked to provide contact information. Your contact information will be used to contact you to schedule a video or audio conference or in-person interview. You may decline to participate at any time. The identity of all interview participants will be kept confidential.

Thank you for your time and willingness to participate in this dissertation research project.

APPENDIX D

Information Sheet/Facts for Exempt Non-Medical Research

University of Southern California
USC Rossier School of Education
Waite Phillips Hall
3470 Trousdale Parkway
Los Angeles, CA 90089

INFORMATION/FACTS SHEET FOR EXEMPT NON-MEDICAL RESEARCH

You are invited to participate in a research study. Research studies include only people who voluntarily choose to take part. This document explains information about this study. You should ask questions about anything that is unclear to you.

PURPOSE OF THE STUDY

This research study aims to understand the knowledge, motivation, and organizational influences that affect middle school girls' interest in computer science. The study is being conducted to provide an understanding of the factors of how this program plays a significant role in bridging the gender gap in science, technology, engineering, and mathematics and improves the students' problem-solving skills. Furthermore, this study aims to shed light on how STEMaven has benefitted or failed to benefit middle school girls' interest in computer science. The knowledge gained from this study can be used to implement improvements and create other programs that equip middle school girls to successfully pursue and attain STEM-related careers.

PARTICIPANT INVOLVEMENT

If you agree to take part in this study, you will be asked to participate in a 5-minute survey. If you meet specific study-related criteria, you may also be asked to participate in a 60-minute audio-taped interview, conducted either in-person or via video-conferencing software. You do not have to answer any survey questions you don't want to. You do now have to participate in the interview if you don't want to. If you don't want to be taped, you cannot participate in the interview portion of this study.

PAYMENT/COMPENSATION FOR PARTICIPATION

You will not be compensated for participation in the survey. If you participate in the interview, you will receive $10 Starbucks gift card as a thank you for your time. You do not have to answer all of the questions in order to receive the card. The card will be emailed to you after completion of the interview.

CONFIDENTIALITY

Audio recordings will be kept in a password protected computer file until completion of the dissertation project, which is anticipated to be May 2020. At that time recordings will be destroyed. Transcripts will also be stored in a password protected computer file. You will not have access to recordings or transcripts. All participants will be assigned a pseudonym. The school or schools which employ or have employed the participants will also be assigned a pseudonym. An executive summary of the findings will be prepared and presented upon study completion.

The members of the research team and the University of Southern California's Human Subjects Protection Program (HSPP) may access the data. The HSPP reviews and monitors research studies to protect the rights and welfare of research subjects.

When the results of the research are published or discussed in conferences, no identifiable information will be used.

INVESTIGATOR CONTACT INFORMATION

Principal Investigator Jennifer Casey via email at caseyjen@usc.edu or phone at (423) 298-2142 or Faculty Advisor Dr. Tracy Poon Tambascia at tpoon@rossier.usc.edu or 213-740-9747

IRB CONTACT INFORMATION

University of Southern California Institutional Review Board, 1640 Marengo Street, Suite 700, Los Angeles, CA 90033-9269. Phone (323) 442-0114 or email irb@usc.edu.