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Critical Soft Skills And The Stem Professional

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CRITICAL SOFT SKILLS AND THE STEM PROFESSIONAL

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ABSTRACT

The purpose of this qualitative descriptive study was to explore the implementation of soft skills that are critical to the success, as defined by promotability and long-term career trajectory, of STEM professionals from the perspective of STEM professionals and those with whom they work closely. Participants for the study represented two professional categories, (a) late-career STEM professionals and (b) human resources professionals with experience in succession planning for STEM professionals. These two groups of participants were selected for their experience with the soft skills and capabilities necessary for STEM professional career progression.

The primary research question was: What components and activities of identified soft skills are most relevant to the professional STEM setting? The secondary research question was: What soft skills, based on value and applicability, are critical to advancing the success, as defined by promotability and long-term career trajectory, of a STEM professional? Tertiary investigation explored current soft skills development strategies in STEM professionals. The objective was to understand the implementation of soft skills that play a critical role in the promotability of STEM professionals and long-term STEM career trajectories based on the interpretation of the participants' experiences.

The results of the study emanated from two data collection procedures. First, a survey was administered to human resources professionals with succession planning experience for

STEM professionals. The survey asked human resources professionals to rank STEM professionals' implementation of 23 soft skills based on three categories: level of expertise, frequency of use, and career criticality. The survey portion of this study narrowed the vast list of soft skills to eight critical skills: communication/presentation/writing, ethics/inspiring moral trust, flexibility/resilience/adaptability, interpersonal skills, leadership/managing/coaching/mentoring, strategic thinking/problem solving, teamwork, and willingness to learn and accept responsibility for decisions. The survey results provided the focus for the second data collection process: interviews with late-career STEM professionals. The late-career STEM professionals were asked to share their experiences with the implementation of the eight critical soft skills and the role they played in their career success. A crosswalk matrix of the survey and interview results provides a visual representation of the qualitative data collected.

Keywords: soft skills, STEM, promotability, career preparation

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CHAPTER 1

INTRODUCTION

The purpose of this qualitative, descriptive study was to explore the implementation of soft skills that are critical to the long-term career success of science, technology, engineering, and mathematics (STEM) professionals. Soft skills, also called non-cognitive skills, are widely recognized as contributing to an individual's success in career and life (Bolli & Hof, 2018; Shukla & Kumar, 2017). STEM professionals have long been criticized for lacking soft skills (McGunagle & Zizka, 2018), yet, further studies have shown that STEM professionals are not exempt from the need for soft skills in the workplace (Donaldson, 2017, Gibert, Tozer, & Westoby, 2017). Past researchers have explored STEM job descriptions and have found an increased demand for soft skills in recent years (Börner et al., 2018; Hartman & Jahren, 2015; Lavy & Yadin, 2013). Additionally, past researchers have also focused on soft skills and leadership skills necessary for entry-level positions (Hartmann & Jahren, 2015). Systematic review of job description data omits the richness and level of detail that only a qualitative study can provide. A key area of interest is what soft skills, based on value and applicability, are critical to advancing the promotability and career longevity of STEM professionals. As such, the experiential knowledge of late-career STEM leaders and those who work closely with them remained underexplored.

Studies (Börner et al., 2018; Gibert et. al., 2017; Lavy & Yadin, 2013) have shown that soft skills are in-demand in technical STEM-related job descriptions and recruiting processes. Lavy and Yadin (2013) concluded that the trends illustrated by the skills requested in job listings demonstrated a soft skills profile that was equally as important as technological skills for IT jobs. Akdere, Hickman, and Kirchner (2019) asserted that a lack of soft skills negatively impacts the

professional effectiveness of the STEM employee regardless of the individual's level of hard skill knowledge. McGunagle (2016) found that employers seek graduates who possess soft skills and leadership skills for entry-level positions. Akdere et al. (2019) state that STEM graduates have the hard skills to attain an entry-level position, yet they lack the soft skills required for leadership roles. The consensus is that, regardless of field, employers expect STEM professionals to exhibit some measure of cultivated soft skills (Akdere et al. 2019; Lavy & Yadin, 2013; McGunagle, 2016; McGunagle & Zizka, 2018).

Qualitative descriptive research is suitable for studies designed to collect detailed experiential data from informants in order to achieve a comprehensive summary that moves beyond the report of any one individual (Willis, Sullivan-Bolyai, Knafl, & Cohen, 2016). Descriptive studies investigate and describe the characteristics of a phenomenon rather than how or why an event has occurred (Nassaji, 2015). Qualitative research takes on a holistic approach to reaching a deeper level of understanding through a more personal interaction with individual participants and their experiences, opinions, and perspectives (Nassaji, 2015). Therefore, a qualitative descriptive research approach was deemed to be well suited to explore the soft skills that are critical to the promotability of STEM professionals based on lived experience.

The remainder of the first chapter includes the statement of the problem, which highlights the demand for STEM professionals who possess soft skills and the lack of formal soft skills training to meet that demand. Chapter one also contains the purpose of the study, the research questions, and the conceptual framework for the study. This researcher uses the final sections of the chapter to address the assumptions and limitations of the study, the significance of the study to the STEM professional community, and the definition of relevant terms.

Background of the Study

Employability is an individual's ability to access a job and maintain satisfactory employment throughout one's career (Suleman, 2018). Universities cite gainful employment as a clear goal for their graduates; schools are reporting employment statistics directly on their university websites (Quinnipiac University, 2019). Western Connecticut State University (2019) has included career success in its university mission. Most importantly, university students will cite employability as an expectation from their degree. The time and money invested in a degree is an investment that expectedly pays dividends in the future (Fahnert, 2015). As students invest and amass debt, it calls to mind the consideration of whether the investment is worth it (Zaloom, 2018). The degree a student earns, and the cumulative skills represented by that degree, is widely expected to support a career trajectory. Institutions of higher education have largely accepted that employability is one of the primary measures of university outcomes (Clarke, 2018). As such, universities aim to incorporate skills associated with employability.

Research provides evidence of the role that soft skills play in the employability and career progression of all professionals (Scorza, Araya, Wuermli, & Betancourt, 2016; Shukla & Kumar, 2017). The smooth transition from student to professional is subject to an employee's ability to meet employer needs and expectations (McGunagle & Zizka, 2018). Subsequently, the transition from entry-level professional to promotable professional is subject to meeting employer needs and expectations as well as demonstrating potential, also called *promotability* (Wichramasinghe & Samaratunga, 2016). Lavy and Yadin (2013) noted that employers regard the non-technical soft skills as more valuable than technical skills when promoting employees. An increasingly recognized key driver in STEM professions is social context (Bickle, 2017;

Farmer, 2015; Gibert et al., 2017). Therefore, employers expect STEM professionals to possess a balance of hard skills and soft skills (Connolly & Reinicke, 2017; Lavrysh, 2016).

Demand for students to enter STEM-related careers is fast growing and projected to increase by up to 28.2 percent by 2024, depending on the STEM branch (Fayer, Lacey, & Watson, 2017). Universities, expectedly, prepare students for a lifetime of employability (Clarke, 2018). Reviews of syllabi for STEM programs from universities nationwide show a singular focus on technical, hard skills, with only peripheral treatment of the soft skills needed in the job market, for which the programs are preparing students (Börner et al., 2018). Therefore, an increased number of students are entering and leaving STEM degree programs without the sufficient soft skills training the marketplace demands. Akdere et al. (2019) assert that many STEM graduates possess hard skills sufficient for entry-level employment, yet lack the leadership skills required for demonstrating promotability. There is a need for research that explores the soft skills that are critical to the promotability and long-term career success of STEM professionals.

Qualitative descriptive studies focus on naturalistic data, free from intervention or variable manipulation (Nassaji, 2016). Kim, Sefcik, and Bradway (2017) asserted that qualitative descriptive research designs are most often selected when the researcher seeks to derive a straightforward description of a phenomenon while staying close to the data and true to the language of the participants. Thus, this researcher used a qualitative descriptive approach to address the gap in the literature and to contribute to the body of knowledge regarding soft skills that are critical to the success of STEM professionals.

Problem Statement

There is little research on how late-career STEM professionals and those who work closely with them would describe the soft skills that have been critical to their career success. There is little evidence that documents a specific career limitation that can result from underdeveloped soft skills. However, possession of exceptional soft skills has been shown to result in wage premiums (Blazquez, Herrarte, & Llorente-Heras, 2017). All soft skills can likely be cited as contributing to a successful career in some way; however, it is presumably possible to determine that certain soft skills are more important or more applicable than others for the STEM professional. The intent of this researcher was to explore those soft skills that are most critical to STEM professional career success.

Studies exist that delve into the skills and capabilities itemized in job descriptions (Lavy & Yadin, 2013; McGunagle, 2016). Other studies itemized soft skills useful to STEM professionals (Gibert et al., 2017). McGunagle and Zizka (2018) interviewed hiring managers to gain insight to their perspectives on new graduates' preparedness for the workplace. There is very little research that addresses the critical soft skills for promotability and career longevity in STEM professionals as explored from the experiential perspective of the STEM professionals and those with whom they work closely.

A qualitative descriptive study design provides a thematic summary of details of daily living as reported by participants (Willis et al., 2016). This research methodology relied on participants' experiences with soft skills that are critical to the promotability of STEM professionals that may resonate with other STEM leaders. This study may be particularly relevant to STEM degree students and those administrators who are responsible for STEM degree program design. Literature exists that aims to understand the soft skills that can be

incorporated into STEM professional preparation (Akdere et al., 2019; Canelas, Hill & Novicki, 2017; Connolly & Reinicke, 2017; Hartman & Jahren, 2015; Lavrysh, 2016; McGunagle, 2016; McGunagle & Zizka, 2018; Shukla & Kumar, 2017; Suleman, 2018). Descriptions of the critical soft skills for late-career STEM professionals add to the existing literature and may contribute to the preparation of future STEM leaders.

Purpose of the Study

The purpose of this qualitative descriptive study was to explore the implementation of soft skills that are critical to the success, as defined by promotability and long-term career trajectory, of STEM professionals from the perspective of STEM professionals and those with whom they work closely. Previous studies have addressed soft skills from the perspective of learnability, career and life success, hiring managers' reflections on candidates' preparedness, and job descriptions for STEM positions (Akdere et al., 2019; Canelas et al., 2017; Connolly & Reinicke, 2017; Fixsen & Ridge, 2018; Hartman & Jahren, 2015; Lavrysh, 2016; McGunagle, 2016; McGunagle & Zizka, 2018; Shukla & Kumar, 2017; Suleman, 2018). However, there is limited, if any, research that explores the soft skills evident in late-career STEM professionals. The study design was used to reveal the shared perspectives of late-career STEM leaders and those with whom they work closely.

Participants for the qualitative descriptive study represented two professional categories, (a) late-career STEM professionals and (b) human resources professionals with experience in succession planning for STEM professionals. These two groups of participants were selected for their experience with the soft skills and capabilities necessary for STEM professional career progression. Both sets of participants were asked to provide qualitative feedback based on professional experience and perspective. An overarching goal of qualitative descriptive research

is to describe and gain insight to the experiences of individuals regarding a particular phenomenon (Kim et al., 2017). Therefore, STEM professionals were asked to provide an internal, reflective perspective based on personal and professional experience. Human resources professionals access and discuss promotability ratings as part of the succession planning process (Van Vianen, Rosenauer, Homan, Horstmeier, & Voelpel, 2018). Human resources professionals with succession planning experience for STEM professionals were asked to provide an observational perspective of the soft skills that are critical in STEM professional promotability.

According to Nassaji (2015), surveys are often used in descriptive research. Willis et al. (2016) assert that the literature can guide the data collection process. This study employed a survey, developed based on the existing literature, and administered to the human resources population. Participation was restricted to those human resources professionals who have experience with succession planning sessions for STEM professionals. The human resources participants were asked to report a ranking for 23 soft skills, identified from the literature, with respect to three categories: (a) the level of expertise required of STEM professionals for each skill, (b) the frequency of use of each skill by STEM professionals, and (c) the criticality of the skill in the STEM professional's career.

According to Kim et al. (2017) one of the key features of qualitative descriptive design is individual interviews. The researcher conducted semi-structured interviews with late-career STEM professionals. Semi-structured interviews contain a mix of more and less structured questions for the purpose of seeking specific information from all respondents while also providing flexibility to explore the unique ways that individual respondents define their perspectives (Merriam & Tisdell, 2016). Kim et al. (2017) cited that purposeful sampling is a common strategy in qualitative descriptive research. The researcher interviewed STEM

professionals who met the following requirements: (a) possession of an earned STEM degree (BS/BA or higher) and (b) experience at or above the director level.

Knowledge of the critical soft skills for promotability in late-career STEM professionals may add to the existing literature and may contribute to the preparation of future STEM leaders. The soft skills categories and the components and activities that comprise them may be applied in educational and corporate settings (Shukla & Kumar, 2017). Educational settings that may also benefit from the soft skills knowledge include curriculum development at the undergraduate and graduate level and professional development programs. Further, the findings may assist business leaders in the development of job descriptions befitting of the STEM leadership roles and responsibilities within their organizations.

Research Questions

The researcher used a qualitative descriptive design to explore how STEM professionals and human resources professionals describe the critical soft skills that contribute to the promotability of STEM professionals. Research (Bickle, 2017; Blazquez et. al., 2017; Börner et al., 2018; Clarke, 2018; Gibert et al., 2017; McGunagle & Zizka, 2018; Shukla & Kumar, 2017) has shown a well-documented marketplace demand for soft skills in all fields, and specifically in STEM fields. Little evidence exists regarding the soft skills of late-career STEM professionals. Therefore, this study was explored from the perspective of late-career STEM professionals and human resources professionals who participate in succession planning sessions that evaluate the promotability of STEM professionals.

The primary research question was: What components and activities of identified soft skills are most relevant to the professional STEM setting? The secondary research question was: What soft skills, based on value and applicability, are critical to advancing the success, as

defined by promotability and long-term career trajectory, of a STEM professional? Tertiary investigation explored current soft skills development strategies in STEM professionals. The objective was to understand the implementation of soft skills that play a critical role in the promotability of STEM professionals and long-term STEM career trajectories based on the interpretation of the participants' experiences.

Conceptual Framework

A qualitative descriptive research design is typically used in research seeking to understand and describe the details of a phenomenon (Kim et al., 2017). The intent of this study was to understand and describe the soft skills that are critical to the promotability of STEM professionals. This researcher selected the qualitative descriptive study based on a match between the research objective and the typical application of the research strategy. Further, the method for reporting results of qualitative descriptive studies is a straightforward and comprehensive summary of the findings (Kim et al., 2017). Sets of descriptive themes and sub-themes are presented in common language, often using the terms expressed by participants (Willis et al., 2016). According to Merriam and Tisdell (2016), applied research aims at improving the quality of practice in a particular field. The findings of this study may be useful to informing decisions made by educational administrators who are responsible for developing and overseeing STEM degree programs; therefore, using common language and the language of STEM professionals may be likely to resonate with the potential target audience.

According to Merriam and Tisdell (2016), qualitative studies incorporate theoretical frameworks for the purpose of providing an underlying structure throughout the study as well as framing the phases of the research, such as developing the problem statement, formulating the research questions, and phrasing the interview questions. Alternatively, Kim et al. (2017) noted

that qualitative descriptive studies are less theory-driven than other qualitative approaches. Willis et al. (2016) suggested that a beginning framework in qualitative descriptive studies may provide a general direction for the topics that are addressed in the interview process. Additionally, it is suggested that cues from the literature can be organized to provide guidance for the data collection and analysis (Willis et al., 2016). Accordingly, this researcher sought to utilize a social constructionist theoretical framework combined with an organized set of concepts taken from the literature for the purpose of developing the research instrumentation, guiding the direction of the study and interpreting the results.

A social constructionist theoretical framework was selected to frame the study. Constructivism explains how an individual brings existing knowledge into new situations expecting to achieve results that mirror previous results; when the new situation does not yield the anticipated results, cognitive change occurs, or new knowledge is constructed (Piaget, 2001). A branch of constructivism is social constructionism which relies upon the notion that knowledge is constructed based on varying social contexts and communicated with language (Segre, 2016). Von Glasersfeld (1989) presented a social interpretation of constructivism by expanding to explain that individuals construct necessary knowledge.

Two key components from social constructionism provided the foundation for the study. First, all living beings construct necessary knowledge (von Glasersfeld, 1989). STEM professionals are experiencing a demand for skills, in the social context of the workplace, that are not included in their formal STEM degree training. Studies have shown that STEM degree programs remain largely focused on hard technical skills associated with the STEM disciplines (Börner et al., 2018). Consequently, according to constructionist theory, the STEM professional community is constructing new knowledge based on workplace contextual experiences. This

researcher sought to understand and describe the elements of the newly constructed knowledge regarding soft skills that contribute to the promotability of STEM professionals.

Second, the shared stock of knowledge generated by members of a social context is distributed such that it can be generally and easily deduced as to who is capable of sharing the socially constructed knowledge (Segre, 2016). This study included participants the researcher deduced to be capable of sharing insights into the soft skills critical to STEM professional promotability. Soft skills, as a documented predictor of career success according to Bolli and Hof (2018), contribute to promotability. Therefore, for this research, late-career STEM professionals in leadership roles of director or above were considered knowledgeable in the realm of soft skills required for promotability, based on personal experience. Human resources professionals with experience in assessing the promotability of STEM professionals also possess knowledge that may contribute to the understanding of soft skills in the STEM professional's career. The combined experiences of members of these two groups of professionals formed the basis from which the newly constructed knowledge formed.

The process of assessing the skills and promotability of STEM professionals in the workforce requires the consideration of the construct of the corporate environment in which these professionals function, as well as who might provide insight to such evaluations. Succession planning, a widely accepted practice in the workplace environment, is a well-documented strategy for evaluating the existing talent, that is current employees who would be eligible for promotion (Parfitt, 2017). Literature reviews and studies revealed that 40% - 60% of organizations have formal succession planning processes in place (Garman & Glawe, 2004). The succession planning process in the workplace is designed to enable a business to fill vacancies created by the sudden departure of key personnel as well as facilitate a smooth transition through

leadership changes (Parfitt, 2017; Peters-Hawkins, Reed, & Kingsberry, 2018). The process is an individualized evaluation of existing employees and their skills and capabilities based on a variety of experiences and observations over an extended period of time (Garman & Glawe, 2004). As such, succession planning meeting participants would be capable of summarizing the skills and capabilities deemed contributory to an individual's promotability.

Succession planning meeting participants within a STEM corporation or department, possess knowledge and information about the skills and capabilities of the employees discussed. Human resources professionals consider promotability ratings as part of the succession planning process (Van Vianen et al., 2018). Quality succession planning processes take place at all levels of the organization for optimized productivity, not just the executive level (Parfitt, 2017). As such, human resources professionals have knowledge and perspective regarding the skills and capabilities that are the most desirable in promotable STEM professionals at every level.

Qualitative descriptive studies seek naturalistic data representative of participant experiences in their natural settings (Nassaji, 2015). This researcher sought to understand the corporate experience of STEM professionals in terms of the soft skills that contribute to promotability. Therefore, the researcher targeted participants who have experience as STEM professionals as well as participants who are involved in the assessment of the promotability of STEM professionals. Accordingly, the study included STEM professionals who meet the following requirements: (a) possess an earned degree (BS/BA or higher) in a STEM discipline and (b) have professional experience at or above the director level. Human resources professionals with experience in succession planning for STEM professionals comprised the second population for the study.

A qualitative descriptive study design often uses multiple data collection methods, such as surveys and interviews (Nassaji, 2015). Willis et al. (2016) suggested that cues from the literature can be organized to provide guidance for the data collection and analysis. Thus, this study began with a survey, grounded in the literature, of the human resources professionals. A review of the literature was conducted to generate a list of soft skills referenced in recent research publications. This researcher then conducted a frequency analysis of the soft skills referenced in the literature. The 23 most frequently mentioned skills provided the foundation for the survey. Human resources professionals were asked to report on three aspects of each soft skill, as they are observed and assessed in the STEM professional's career: (a) level of expertise, (b) frequency of use, and (c) career criticality. The aim of the qualitative descriptive study is to describe and summarize the details of a phenomenon and its characteristics: what, where, when and to what extent rather than how and why (Nasaji, 2015). The survey collected specific feedback regarding what soft skills are important to STEM professionals, when (how often) those skills are employed, to what extent are STEM professionals expected to exercise expertise in those skills, and to what extent are those skills critical to the business and career of the STEM professionals.

Social constructionist theory relies on language for the communication of constructed knowledge (von Glasersfeld, 1989). The qualitative descriptive researcher seeks to build a rich descriptive database of detailed insights from participants, typically through qualitative interviews (Willis et al., 2016). Therefore, this study incorporated video conference interviews with STEM professionals. Merriam and Tisdell (2016) cited that qualitative investigation can employ a semi-structured interview using a mixture of more and less structured questions. As such, this study incorporated a semi-structured interview format including questions that offered

open-ended opportunities for participants to provide details regarding their experiences with soft skills in the professional setting as well as a core set of standard questions that all participants were asked to answer. A previous study (McGunagle & Zizka, 2018) used reviews of job descriptions to narrow the list of soft skills addressed in interviews with business executives. This study used the results of the survey to narrow the scope of the topics addressed in the interviews. The interview questions were designed to seek an understanding of the details of the components and activities of the critical soft skills that were identified in the previously conducted survey.

Qualitative descriptive researchers typically report findings as straightforward, comprehensive summaries of the details explored during the study (Kim et al., 2017). This study design employed a survey and an interview for the purpose of collecting data for analysis. An iterative analysis process is permitted in qualitative descriptive studies for the purpose of uncovering themes early in the process and adding them to the future exploratory discussions (Willis et al., 2016). As such an iterative analysis process was employed throughout this study, beginning with the survey. Survey tools are often used in qualitative studies to collect qualitative data that can be analyzed quantitatively (Nassaji, 2016). Summary statistical analysis was applied to the survey results for the purpose of focusing the interview topics to be explored. The iterative analysis process continued with a thematic analysis of each interview transcript as well as a final analysis of the survey and interview data for the assembly of a rich descriptive summary.

Assumptions and Limitations

Assumptions

Assumptions are the foundational concepts that the researcher brings to the study and accepts as true (Cunliffe & Scaratti, 2017). The first assumption is soft skills are critical to STEM professional success as defined by promotability and long-term career trajectory. Next, participants were assumed to be able to articulate their personal experiences in terms of the soft skills referenced. Finally, participants were assumed to be responding accurately and honestly to questions about their professional experience.

Limitations

Researchers identify limitations to a study for the purpose of defining the boundaries of the research (Brutus, Aguinis, Wassmer, 2013). The first limitation is that the data collected was dependent on informants' recollection, which could have been subject to error, inadvertent omission, and/or modification. The second limitation is because of the small sample of participants that were used for the study, broad generalizations may not be relevant.

Delimitations

Delimitations are the parameters of the research and the boundaries of the study (Ellis & Levy, 2010). The first delimitation is that STEM professional participants were selected based on a review of LinkedIn profiles, and therefore may not be wholly representative of the entire population of STEM professionals. The second delimitation is that succession planning, by nature, is a process of evaluating existing employees; therefore, human resources professionals were asked to provide feedback based on their experience with assessing existing employees, disregarding the external candidate interview and assessment process.

Rationale and Significance of the Study

A qualitative descriptive approach was selected for this study. This researcher aimed to explore the soft skills that are critical to promotability of STEM professionals. Qualitative descriptive research is applied when the researcher's objective is to construct a rich detailed description of the phenomenon (Kim et al., 2017). The justification for a qualitative descriptive study design lies within the need to explore the human experience. Qualitative research focuses on a holistic approach to understanding the participants' experience, opinions, perspectives, and reflections (Nassaji, 2016). Social constructionism relies on contextually constructed knowledge and its verbal communication (von Glasersfeld, 1989). Therefore, a framework that sought opinions, perceptions, and descriptions expressed through surveys and verbal interviews was deemed, by this researcher, as an appropriate match to the research objectives.

STEM professionals have long been criticized for demonstrating a lack of soft skills (McGunagle & Zizka, 2018). STEM disciplines are attracting increasing numbers of majors due to a global push to meet economic demand (McGunagle & Zizka, 2018). Recently, soft skills have gained attention as professional characteristics linked with career success (Blazquez et al., 2017; Bolli & Hof, 2018; Kell, 2018). Higher education has accepted the responsibility of preparing students for the workplace and aiding in the development of graduate employability (Clarke, 2018). Yet, syllabi for STEM undergraduate degree programs demonstrate a lack of focus on soft skills as learning objectives (Börner et al., 2018). Students expect a return on their investment in their education in terms of employability (Fahnert, 2015). This research was aimed at advancing the body of knowledge regarding the critical soft skills for long-term career progression of STEM professionals. The availability of the developing body of knowledge regarding soft skills for STEM professionals has the potential to assist educational decision

makers in developing programs that prepare STEM students to become successful STEM professionals.

Definition of Terms

Career progression – A typical career progression is considered to be successful transition to a position of higher responsibility associated with career advancement (Wichramasinghe & Samaratunga, 2016).

Hard Skills – Hard skills are specific, teachable abilities that can be defined, measured, and easily assessed (Devedzic et. al., 2018).

Soft Skills – Soft skills are generic (non-discipline specific), transferrable interpersonal skills that involve one's ability to manage self, people, relationships, and information (Clarke, 2018; Devedzic et. al., 2018).

Conclusion

The global society and economy has transformed into a knowledge and information based culture (Blazquez et al., 2017; Fahnert, 2015). As such, the skills required to thrive in the marketplace have also transformed, placing significantly greater emphasis on soft skills (Scorza et al., 2016). STEM professionals have long been criticized for exhibiting a lack of soft skills (McGunagle & Zizka, 2018). Nonetheless, requirements of STEM professionals now go well beyond the hard skills associated with the traditional degree plans, and now include a range of soft skills for long-term career success (Akdere et al., 2019; McGunagle & Zizka, 2018). Sustaining employability and promotability for STEM professionals includes the acquisition of soft skills. It is largely accepted that students, employers, and universities have the expectation that universities provide the foundation upon which a career may be built (Clarke, 2018). This research aims to contribute to the growing body of knowledge regarding the critical soft skills for

long-term career progression of STEM professionals (Akdere et al., 2019; Canelas et al., 2017; Connolly & Reinicke, 2017; Gibert et al., 2017; Hartman & Jahren, 2015; Lippman, Ryberg, Carney, & Moore, 2015; Lavrysh, 2016; McGunagle, 2016; McGunagle & Zizka, 2018; Overton & McGarvey, 2017; Prinsley & Baranyai, 2015; Shukla & Kumar, 2017). The availability of the developing body of knowledge regarding soft skills for STEM professionals has the potential to aid in the transformation of traditional STEM degree programs to include soft skills for the well-rounded development of future STEM leaders.

The first chapter introduced the study by providing an overview and focus of the topic to be explored, which included the purpose for seeking to understand the critical soft skills that contribute to the long-term career success of STEM professionals. The chapter included background information concerning the concept of employability, the resulting expectation and responsibility placed on universities, the workplace shift in priorities towards soft skills, and the gap between preparedness and expectations. STEM professionals need soft skills (Connolly & Reinicke, 2017; Gibert et al., 2017). STEM graduates lack soft skills (Akdere et al., 2019; McGunagle & Zizka, 2018). The chapter also addressed the purpose of the study, which is to contribute to the body of knowledge regarding soft skills that are critical to the successful STEM career by investigating the experiences of late-career STEM professionals and the human resources professional involved in succession planning evaluations of STEM professionals.

The second chapter contains the summary of the existing literature regarding employability, expectations of employers, employees and universities as they fulfill each of their roles in the preparation and employment cycle. The chapter continues to cover soft skills and their value in the marketplace, the expectations of STEM professionals, and the existing

understanding of the shortcomings of current STEM graduates. The researcher also explores the studies to date regarding soft skills in STEM professions.

The researcher uses the third chapter to provide the rationale for the methodology, the research questions and the research design. The fourth chapter reports the specific findings of the study. The final chapter summarizes the research and its conclusions, along with making recommendations for action as well as recommendations for future investigations based on the findings of the study.

CHAPTER 2

LITERATURE REVIEW

The purpose of this qualitative, descriptive study was to explore the implementation of soft skills that are critical to the success, as defined by promotability and long-term career trajectory, of STEM professionals. Research has shown that soft skills are in high demand, even in STEM professions typically associated with hard, technical skills (Börner et al., 2018; Gibert et al., 2017). Research also shows that STEM discipline coursework at the university level does not address the majority of soft skills as overt learning objectives (Börner et al., 2018; de Ridder, Meysman, Oluwagbemi, & Abeel, 2014). Soft skills as curricular objectives are particularly absent in the scientific and technical disciplines (de Ridder et al., 2014). The shift to a knowledge economy has led the marketplace to demand soft skills and competencies of university graduates (Clarke, 2018). Companies want to hire experience (Clarke, 2018; McGunagle & Zizka, 2018). There is some debate as to who is responsible for professional training and preparation; however, according to Clarke (2018) higher education institutions are generally expected, and have largely accepted the responsibility, to provide that experience as well as to prepare students for a lifetime of job changes and climbing the career ladder.

This researcher sought to explore the soft skills that are critical to the long-term career success of STEM professionals from the perspective of STEM professionals and those with whom they work closely. Existing research has shown that soft skills have been considered and explored from the perspective of learnability, career and life success, hiring managers' reflections on candidates' preparedness, and job descriptions for STEM positions (Akdere et al., 2019; Canelas et al., 2017; Connolly & Reinicke, 2017; Hartman & Jahren, 2015; Lavrysh, 2016;

McGunagle, 2016; McGunagle & Zizka, 2018; Shukla & Kumar, 2017; Suleman, 2018). However, there is nominal if any research that addresses the experiences of late-career STEM professionals. The study was targeted towards contributing to the existing body of knowledge by revealing the shared perspectives of late career STEM leaders and those with whom they work closely.

This chapter summarizes the established body of knowledge surrounding soft skills, STEM professionals and their employability, and the responsibility of training and professional preparation. A review of the existing literature led this researcher to identify four recurring themes. The themes uncovered in the literature are: (a) defining hard skills versus soft skills, (b) the role of soft skills in the STEM professional's career, (c) training availability, and (d) the concept of employability. The literature review explores, synthesizes, and compares and contrasts the findings and views of the existing researchers and experts on soft skills and the role they play in the STEM professional's career, within these four themes. Chapter two continues with a detailed integration of the conceptual framework linking the existing literature to the research and guiding the exploration forward. Additionally, the researcher articulates the connection between the problem statement, the study, the research questions, and the two informant populations selected for participation. Finally, the chapter closes with suggestions as to who may benefit from the information this study adds to the existing body of knowledge on soft skills and the promotability of STEM professionals.

Hard Skills and Soft Skills

Hard skills and soft skills are complementary parts of a whole set of capabilities. Hard skills, also known as cognitive skills, are specific, objective, measurable skills (Blazquez et al., 2017; Devedzic et. al., 2018). Hard skills examples include speaking a foreign language,

programming in specific coding languages such as R, Python, C++, etc., performing calculations, using computer software packages, analyzing a product against a code (such as an architectural design against building code), evaluating the quality of a scientific sample, or creating a product to meet specific criteria or perform a specific task (Blazquez et. al., 2017; Devedzic et. al., 2018). Conversely, soft skills, also known as people skills or non-cognitive skills, are less tangible personal qualities, attitudes, and behaviors that refer to the abilities one has to interact with other people (de Ridder et. al., 2014; Devedzic et. al., 2018). Soft skills examples include networking, cultural and diversity awareness, resilience, persuasion, flexibility, initiative, and inspiring moral trust (Gibert et al., 2017).

Recognition of the role soft skills play in the workplace is not new. As early as the 1960s, Argyris (1961) asserted that leadership competence includes intellectual and interpersonal competence. Boyatzis (2018) studied behavioral competencies at the managerial level in the 1980s, seeking efficient and accurate ways to capture a holistic perception of leadership capabilities, from supervisors, peers, and subordinates. The attention that soft skills and their role in the workplace receive has increased in recent decades (Blazquez et. al, 2017; Humphries & Kosse, 2017; Kell, 2018; Scorza et al., 2016), resulting in an evolution and maturation of the skills, capabilities, and terminology that comprise the soft skills category.

Elasticity promotes longevity (Kovalenko & Mortelmans, 2016; Prinsley & Baranyai, 2015). Soft skills include flexibility, resilience, willingness to learn, etc., all skills associated with professional elasticity. Lavy and Yadin (2013) conducted an international study of the transformation in skills itemized in job descriptions; the findings show that a shift has occurred in the IT hiring process from an initial focus on hard technical skills to an equal emphasis on hard skills and soft skills. Leaders in the IT field reported that in promoting existing employees

they were more likely to promote one with well-developed soft skills over one with well-developed technical skills (Lavy & Yadin, 2013). The Bureau of Labor Statistics (2016) reported a decrease in the median number of years that workers had been with their current employers from 4.6 years in 2014 to 4.2 years in 2016. One could assert that the typification of short job tenures emphasizes the significance of trans-situational soft skills. A global push to increase the volume of STEM trained professionals is increasing the number of students enrolled in STEM discipline degree programs (McGunagle & Zizka, 2018). STEM discipline degree programs do not typically include soft skills as overt learning objectives (Börner et al., 2018). Therefore, an increasing number of students are entering degree programs that do not inherently address the soft skills necessary for workplace success.

Soft skills, as a category has evolved through research to include communication, self-confidence, creativity, teamwork, negotiation, and networking, among many others. The STEM disciplines are the embodiment of the hard skills. STEM professionals are often criticized for a lack of soft skills (McGunagle & Zizka, 2018). Gwynne (2016) made an argument for hiring humanities-trained employees into leadership roles at STEM industry corporations because they possess skills that STEM discipline trained employees simply lack. STEM educational leaders suggest an alternative: make adjustments to the STEM discipline curriculum to incorporate the soft skills that STEM professionals need to be leaders (Akdere et al., 2019).

Soft skills, or non-cognitive skills, have been broadly described as everything that is not a hard skill (Humphries & Kosse, 2017). This researcher sought to narrow that boundless list to one that is focused on the soft skills that are most critical to the STEM professional for long-term career success. Furthermore, this researcher aimed to explore the activities and components of the soft skills that are most relevant to the long-term success of STEM professionals.

The Role of Soft Skills

Research (Farmer, 2015; Gibert et al., 2017; McGunagle & Zizka, 2018) has shown that STEM professionals have layers of opportunities to employ some degree of soft skill competency. The level of expertise with which the soft skills are behaviorally exhibited can determine the success of the interactions (Boyatzis, 2018). Figure 1 illustrates the scale of the interpersonal interactions a STEM professional can expect to encounter in a professional setting. STEM professionals can find themselves presenting to large groups of strangers representing the general public. STEM professionals can be called upon to meet with smaller special interest groups that are political or investor related clients or external stakeholders (McGunagle & Zizka, 2018). Special interest groups represent a subset of the public at large. Sometimes, such as with medical professionals or those on the receiving end of consulting services, these professionals interact with members of the public on a personal, one-on-one basis. According to Gibert et al., (2017) and Farmer (2015), the STEM professional will likely interact repetitively with colleagues and most intimately with direct teammates on a daily basis.

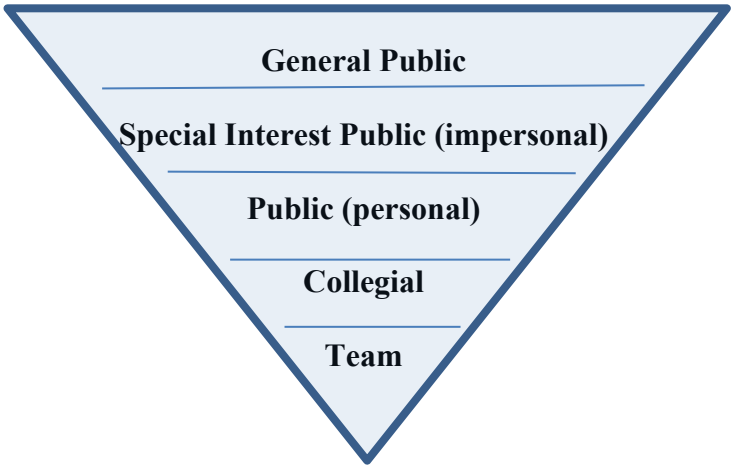


Figure 1: Scale of Personal Interactions – the STEM professional in various STEM professions can be expected to interact and/or communicate on a large scale with the general public at large all the way down to small-scale daily interactions with immediate teammates.

STEM professionals in the workforce are subject to changes in corporate missions, goals and objectives as well as reporting structures and job descriptions making flexibility and elasticity valuable skills for coping (Kovalenko & Mortelmans, 2016; Prinsley & Baranyai, 2015). The ways that careers develop (Kovalendo & Mortelmans, 2016) combined with the short job tenures (Bureau of Labor Statistics, 2018) have transformed the expectations of STEM professionals. Traditional STEM roles have changed as well; gone are the days when surgeons can expect that a surgical team will always be the same and will be ready to accommodate and anticipate personal processes and preferences (Farmer, 2015). Generally, according to Farmer (2015), professional flexibility is expected of STEM professionals, now, in arenas where compensations or excuses existed previously.

Considering STEM industries specifically, researchers have sought to establish what skills are needed as well as whether or not those skills are learnable or inherent. McGunagle (2016) found that employers expect STEM professionals to exhibit essential soft skills vital to workplace success: communication, team player, proactive problem solving and decision

making, ability to synthesize and gather data, leadership, self-confidence, self-motivation, customer focus, negotiation skills, and adaptability. Gibert et al. (2017) focused their research on scientific research teams: the soft skills that make the most effective teams and which of those skills can be learned versus which of those skills are inherent in one's personality. Four skills, emotional intelligence, flexibility, initiative, and resilience, were designated as a continuing personality trait by more than 25% of the leaders questioned (Gibert et al., 2017). The remaining 10 soft skills: cultural and diversity awareness, networking, empower talents of others, conflict resolution, inspiring competence-based trust, inspiring moral trust, persuasion, strategic thinking, elicit emotional engagement, and decision-making were all deemed learn-able to some extent (Gibert et al., 2017). Fixsen and Ridge (2018) and de Ridder et al. (2014) agree that the majority of soft skills are learnable through practice.

A discussion of lifelong employability includes notions of career motivation and promotability; a consideration in promotability is the assumption that the employee is not interested in maintaining the same entry-level position for an entire career (Van Vianen et al., 2018). The higher the rung on the ladder the more leadership skills and soft skills are required (Wichramasinghe & Samaratunga, 2016). The United States Bureau of Labor Statistics (2018) projects an increase of nearly one million computer, mathematical, architecture, engineering, and science occupations by 2026. This staggering increase in STEM personnel will likely call for skilled leadership of STEM teams. Gwynne (2016) proposed the hiring of humanities graduates into leadership roles in STEM companies because they bring with them creativity, empathy, vision, and the ability to listen, all soft skills that are cultivated in the study of the humanities versus the curriculum typically associated with the STEM disciplines. The argument made is that companies cannot grow without those soft skills, and STEM majors do not have them (Gwynne,

2016). Personal communications with STEM professionals have revealed a preference for being led by "one of their own." The conclusion: formal soft skills training for STEM professionals and STEM discipline degree students is essential.

Training Availability

Literature shows that the who, when, where, and how of soft skills training varies greatly. Hoeschler, Balestra, and Backes-Gellner (2018) showed that non-cognitive skills develop through adolescence. Reliance on this adolescent development suggests that if one's formative years were not filled with soft skills subtleties, then the resulting career trajectory is doomed to suffer. Some researchers, Pool, Qualter, and Sewell (2014) suggested that awareness is a key element and as such, the first step in enhancing an undergraduate student's soft skills for employability is merely to make that student overtly aware of soft skills, what they are and how they influence one's ability to get a job, keep a job, and ultimately earn a new bigger, better job. Some researchers (McGunagle & Zizka, 2018; Akdere et. al., 2019; Carnelas, 2017) argue for the establishment of soft skills incorporation into the university curriculum; an argument is also formed for employer involvement in curriculum development and delivery (Akdere et al., 2019). Finally, Tulgan (2015) and Scorza et al. (2016) suggested that the cultural and economic benefits of soft skills in the workplace and labor market make them a worthy corporate focus.

A key area of concern is the population of STEM professionals whose adolescence and higher education STEM degree program experience were void of sufficient soft skills training and whose workplace expects these skills to be inherently present in the proverbial toolbox. Research shows that the solution is the corporate coaching industry and that it is big business and growing (Fixsen & Ridge, 2018, International Coaching Federation, 2012, 2016). According to the International Coaching Federation (ICF), the number of coaches worldwide increased to

53,300 in 2016 from 41,300 in 2012. The majority of coach practitioners worldwide reported that they consult with executives, managers, and team leaders; however, in 2016, 34% of practitioners reported that their clients included staff members (International Coaching Federation, 2016). Plato's teachings state that necessity is the mother of invention (1992). A capitalist society is founded upon businesses that are born out of opportunity created by necessity or demand. Davidsson (2015) discussed the critical role that opportunity plays in entrepreneurial endeavors. When business is booming, there exists a need. Professionals at all levels of the marketplace are in need of developing soft skills, and they are seeking that development to enhance their careers.

Clarke (2018) asserted that it is widely accepted that universities serve the purpose of preparing graduates for the marketplace. The shift to a knowledge economy has changed the demands on professionals and the skills they bring to their career (Blazquez et al., 2017). Börner et al. (2018) cited cyclical reactionary ripples in the marketplace, literature, and higher education settings. Börner et al. (2018) found that education is the mediator between research and jobs and that gaps between skills and jobs decrease with time. The purpose of this research is to contribute to the body of knowledge that may be used to facilitate the closing of the soft skills gap for STEM professionals that currently exists.

Employability

The fundamental, qualitative definition of employability is focused on the individual and the ability to be satisfactorily employed throughout a career (Kovalenko & Mortelmans, 2016). Translating this definition to a quantitatively representable data set for research purposes has proven challenging and largely insufficient (Pool et al., 2014). Large-scale representations often consider employability statistics as the ability to get a job, or the ability to get a job within

six months of graduation, or even the ability to get a job in one's field of interest within six months of degree completion (Pool et al., 2014). Pool et al. (2014) and Clarke (2018) have argued that better ways need to be found for measuring this data. Assessing the factors that contribute to employability from a qualitative perspective has been more successfully accomplished. Researchers (Bolli & Hof, 2018; Scorza et al., 2016; Shukla & Kumar, 2017) have readily acknowledged that transferable skills, also referred to as soft skills, are directly linked to success in career and in life, long-term.

Institutions of higher education are acknowledging that the marketplace has increased in complexity, and a successful career trajectory depends upon an intricate network of soft and hard skill sets that combine to create a toolbox from which an employee can draw (University of Edinburgh, 2019). The definition of the employability of a college graduate has transformed. Akdere et al. (2019) cited that STEM graduates have the hard skills to attain an initial job upon graduation but lack the soft skills for leadership. Job-ready and career-ready are two different concepts. The University of Edinburgh (2019) regards employability as the capacity to maintain employment throughout one's life-long career, encompassing functioning successfully within a current role as well as progressing between roles. Researchers have established that non-cognitive, soft skills are directly linked to success in life and in career (Bolli & Hof, 2018; Lavy & Yadin, 2013). Workplace indicators show that soft skills are critical tools for long-term career success; however, an examination of the traditional STEM disciplines and their higher education curricular patterns that have a singular focus on the accumulation of hard skills reveals that the toolbox is not as full as a graduate may wish (Bickle, 2017; Börner et al., 2018; Lavy & Yadin, 2013).

Some debate exists regarding the onus of responsibility for preparing and maintaining one's employability. Universities are inextricably linked to employability statistics (Fahnert, 2015). However, the soft skills that have been linked to long-term employability are typically left unaddressed in STEM curricula (Akdere et al., 2019; Börner et al., 2018). Human resources departments have been cited to contribute through employer-provided programs (Akdere et al., 2019). However, Kovalenko and Mortelmans (2016) discussed the absence of job security and lifelong careers with a single company and thus the onus for maintaining lifelong employability has shifted to an individual responsibility. Kovalenko and Mortelmans (2016) and Pool et al. (2014) argue that individual agency and self-awareness leads to the identification of missing soft skills, which in turn leads to the pursuit of training in order to maintain one's employability. Researchers have cited self-perception as a soft skill (Blazquez et al., 2017). Therefore, in order to acknowledge that one needs to develop one's soft skills, one needs to possess soft skills in the first place.

The current workforce climate calls for establishment and maintenance of employability (Kovalenko & Mortelmans, 2016). The link between soft skills and career success (Bolli & Hof, 2018; Scorza et al., 2016) suggests a need for the development of soft skills. Hoeschler et al. (2018) argues that it can happen during adolescence. Fahnert (2015), Akdere et al. (2019), McGunagle and Zizka (2018) and Lavrysh (2016) argue that it can and should happen during the undergraduate degree program experience. Employers argue that it is not happening (Overton & McGarvey, 2017; McGunagle & Zizka, 2018). The shift to a knowledge-based economy has increased the career dependency on higher education degrees (Fahnert, 2015; Lavrysh, 2016). This researcher agrees that higher education is the correct placement for formal soft skill education. This researcher embarked on a qualitative descriptive study exploring the experiences

of late-career STEM professionals. The intention was to provide a rich description regarding the soft skills that contribute to the long-term employability such that universities can make decisions to overtly build learning objectives to meet this identified gap.

Conceptual Framework

A qualitative descriptive research design is often employed when a researcher is seeking to understand and describe the details of a phenomenon (Kim et al., 2017). The goal of the study was to understand and describe the soft skills that are critical to the promotability of STEM professionals from the perspective of late-career STEM professionals and those with whom they work closely. This researcher decided to use the qualitative descriptive study design based on a relative match between the research objective and the typical application of the research design. Additionally, qualitative descriptive researchers frequently report their findings in the form of straightforward and comprehensive summaries (Kim et al., 2017). Summaries of the findings in a qualitative descriptive study using common terminology and the vocabulary of the informants is a tenet of qualitative descriptive research (Willis et al., 2016). According to Merriam and Tisdell (2016), applied research aims at improving the quality of practice in a particular field. The findings of this study may be useful to informing decisions made by educational administrators who are responsible for developing and overseeing STEM degree programs, therefore, using common language and the language of STEM professionals may be likely to resonate with the potential target audience.

Theoretical frameworks are incorporated into qualitative studies for the sake of establishing a structure for developing the problem statement, determining the research questions and phrasing the questions incorporated in the instrumentation (Merriam & Tisdell, 2016). Alternatively, Kim et al. (2017) cited that qualitative descriptive studies, specifically, have been

found to be less theory dependent than other qualitative approaches. An intermediate approach suggests that an initial framework in qualitative descriptive studies may support a general direction for guiding the discussion topics in the interview process (Willis et al., 2016). Willis et al., (2016) also suggested that a literature review can be used to provide a launching point for the data collection and analysis. As such, this researcher chose to develop the research instruments, structure the study, and interpret the findings based on a social constructionist theoretical framework combined with an organized set of concepts taken from the literature.

This researcher selected a social constructionist theoretical framework to frame the study. Piaget's (2001) constructivist theory is based on the notion that cognitive change, or learning, occurs when an individual brings established knowledge and expectations to a new situation and yields unexpected results. More modern developments in constructivist theory have led to social constructionism which gives significance to the idea that knowledge is constructed based on social context, and the sharing of this knowledge is language dependent (Segre, 2016). Von Glasersfeld (1989) expanded on the theory to explain that individuals construct necessary and critical knowledge.

The research study hinges on two key components from social constructionism. First, according to von Glasersfeld (1989), individuals construct the knowledge they need. STEM professionals are encountering a need for soft skills, in the social context of the workplace, that are not included in their formal STEM degree programs. Studies have shown that STEM degree programs remain largely focused on hard technical skills typically associated with the STEM disciplines (Börner et al., 2018). The response, according to constructionist theory, is that STEM professionals are constructing new knowledge based on their workplace contextual experiences.

This researcher sought to understand and describe the details of the newly constructed knowledge regarding the soft skills that contribute to the promotability of STEM professionals.

Second, a socially constructed store of knowledge in a given social construct is shared among members of the social context such that any member can be determined capable of sharing said knowledge (Segre, 2016). Soft skills, which are a well-documented predictor of career success according to Bolli and Hof (2018), contribute to promotability. Two populations of informants were selected for this study. One, late-career STEM professionals in leadership roles of director level or above may be considered knowledgeable in the realm of soft skills required for promotability, as members of the selected social context. Two, human resources professionals, as individuals with regular observation, interaction, and assessment opportunities with the selected social context, also possess knowledge that may contribute to the understanding of soft skills in the STEM professional's career. The collective feedback and accounts of members of the two selected populations formed the basis from which the rich description of the newly constructed knowledge was generated.

The succession planning process is widely practiced in corporate settings as a means for evaluating the current employees who would be eligible for promotion, or who exhibit promotability (Parfitt, 2017). The succession planning process originated for the purpose of facilitating transitions in the event of leadership departures or changes (Parfitt, 2017; Peters-Hawkins et al., 2018). The process is an individualized evaluation of existing employees and their skills and capabilities based on a variety of experiences and observations over an extended period of time (Garman & Glawe, 2004).

Promotability ratings, or assessments, are a key consideration in the succession planning process (Van Vianen et al., 2018). Thus, the human resources professionals were able to

communicate feedback regarding the soft skills capabilities of the employees. All levels of an organization are included in a quality succession planning process, not just the executive level (Parfitt, 2017). Therefore, human resources professionals possess knowledge and experience regarding the skills and capabilities that are the most desirable in promotable STEM professionals at every level.

A key tenet of qualitative descriptive studies is the pursuit of naturalistic data indicative of informant experiences in their natural settings (Nassaji, 2015). This researcher sought to compile a rich description of the corporate experience of STEM professionals with respect to the soft skills that contribute to promotability. Therefore, the study included participants from two categories: (a) STEM professionals and (b) human resources professionals. Further qualifications for the STEM professionals required that they: (a) possess an earned degree (BS/BA or higher) in a STEM discipline and (b) have professional experience at or above the director level. Human resources participants were required to have experience in succession planning for STEM professionals.

Multiple data collection methods, such as surveys and interviews, are typical components of qualitative descriptive studies (Nassaji, 2015). Willis et al. (2016) assert that the literature review can provide guidance for the data collection. As such, this study began with a survey, grounded in the literature, of the human resources professionals. This researcher conducted a review of the literature for the purpose of compiling a list of soft skills referenced in recent literature. A frequency analysis of the soft skills referenced was then performed to determine the 23 most frequently mentioned soft skills. The list of most frequently mentioned soft skills provided the foundation for the survey. The survey was administered to human resources professionals. The informants were asked to report on three perspectives of each soft skill: (a) the

level of expertise demanded of STEM professionals, (b) the frequency of use in the STEM professional's career, and (c) the criticality of the skill to the success of the STEM professional and the business. The objective of qualitative descriptive research is to produce a rich summarized description of the details of a phenomenon and its characteristics: what, where, when and to what extent rather than how and why (Nasaji, 2015). The researcher used the survey to collect specific feedback regarding what soft skills are important to STEM professionals, when (how often) those skills are employed, to what extent are STEM professionals expected to exercise expertise in those skills, and to what extent are those skills critical to the business and career of the STEM professionals.

The use of language for the purpose of communicating constructed knowledge is a key component to social constructionist theory (von Glasersfeld, 1989). Qualitative descriptive research builds a database of detailed insights from informants, typically through qualitative interviews (Willis et al., 2016). Therefore, the study continued with video conference interviews with STEM professionals. Qualitative investigation can follow a semi-structured interview design using a blend of more and less structured questions (Merriam & Tisdell, 2016). Accordingly, this qualitative descriptive study utilized a semi-structured interview plan with open-ended questions that allowed informants to share details regarding their experiences with soft skills in the professional setting as well as a core set of standard questions that all participants were asked to answer. Past researchers (McGunagle & Zizka, 2018) have used references to soft skills in job descriptions as a means to focus the list of soft skills addressed in interviews with business executives. This study used the results of the survey to narrow the list of soft skills to be addressed in the interviews. The interview questions were crafted to guide

participants to share details of the components and activities of the critical soft skills that were identified in the previously conducted survey.

Qualitative descriptive study findings are frequently reported as straightforward, detailed summaries of the participant perspectives revealed during the study (Kim et al., 2017). This study design employed a survey and an interview for the purpose of collecting data for analysis. Willis et al. (2016) cited that an iterative analysis process can be employed in qualitative descriptive research for the sake of discovering themes early in the process and adding them to the future interview discussions. Accordingly, this researcher used an iterative analysis process throughout the study. Nassajii (2016) referenced the use of survey tools in qualitative studies to collect qualitative data that can then be analyzed quantitatively. Descriptive statistics were utilized to evaluate the survey results for the purpose of focusing discussion points in the interviews. The researcher continued the iterative analysis process with a thematic analysis of each interview transcript as well as a final analysis of the survey and interview data for a complete descriptive summary.

Conclusion

The literature review has shown the interdependence of student, institution, and marketplace employability with preparation, skills, and expectations. The themes were organized to show the importance of soft skills and the critical role that they play in the leadership of business entities across all industries. An analysis of the availability of and accessibility to soft skills training has demonstrated the cracks in the formal soft skills education, through which STEM professionals may fall. The conceptual framework was developed to delineate the structure that the study would follow, linking social constructionism theory with the goal of

understanding the details of the experiences of STEM professionals with respect to the soft skills that are critical to long-term career success.

CHAPTER 3

METHODOLOGY

There is little research on how late-career STEM professionals and those with whom they work closely would describe the soft skills that have been critical to their career success. STEM professionals have long been categorically criticized for a deficiency in soft skills to balance the hard skills associated with their academic disciplines (McGunagle & Zizka, 2018). Soft skills have gained increased attention in recent years for their definitive link to career and individual success (Blazquez et al., 2017; Bolli & Hof, 2018; Kell, 2018). The workplace climate is marked with decreased employer responsibility for career-long employment and a more transient workforce calling for the overt establishment and maintenance of employability (Kovalenko & Mortelmans, 2016). The connection between soft skills and career success (Bolli & Hof, 2018; Scorza et al., 2016), can be interpreted as a need for the development of soft skills. Yet, STEM undergraduate degree programs do not generally emphasize these skills (Akdere et. al., 2019; Börner et al., 2018; de Ridder et al., 2014). Therefore, many researchers have suggested that undergraduate degree programs should consider adjustments to more adeptly accommodate the workplace needs (Akdere et al., 2019; McGunagle & Zizka, 2018). The intent of this researcher was to investigate those soft skills that would be most beneficial to a STEM professional's career in order to contribute to the knowledge base available to academic decision makers.

The purpose of this qualitative descriptive study was to explore the implementation of soft skills that are critical to the success, as defined by promotability and long-term career trajectory, of STEM professionals from the perspective of STEM professionals and those with whom they work closely. A review of the literature showed potential gaps regarding the overt

provision of training in soft skills for professionals in STEM-related careers. Research (Bickle, 2017; Blazquez et. al., 2017; Börner et al., 2018; Clarke, 2018; Gibert et al., 2017; McGunagle & Zizka, 2018; Shukla & Kumar, 2017) has also shown a well-documented marketplace demand for soft skills in all fields, and specifically in STEM fields. Heightened awareness of the value of soft skills in STEM fields traditionally associated with hard skills leads to a need for a deeper understanding of those soft skills and the role that they play throughout the STEM professional's career (McGunagle, 2016). Professionals with a background and expertise in the STEM fields have often been criticized for a particular deficiency in the soft skills categories (McGunagle & Zizka, 2018). STEM graduates possess the hard skills to get hired, yet they are found to lack the skills required for leadership (Akdere et al., 2019). Researchers have previously explored soft skills from the perspective of learnability, life and career success, interview candidates' preparedness, and STEM-related job postings (Akdere et al., 2019; Canelas et al., 2017; Connolly & Reinicke, 2017; Fixsen & Ridge, 2018; Hartman & Jahren, 2015; Lavrysh, 2016; McGunagle, 2016; McGunagle & Zizka, 2018; Shukla & Kumar, 2017; Suleman, 2018). There is little, if any, research that explores the soft skills of late-career STEM professionals. This researcher's goal was to contribute to the knowledge and potential preparation of STEM professionals with an investigation into the soft skills, and their components and activities that are required to facilitate the long-term, promotability of STEM professionals.

The primary research question was: What components and activities of identified soft skills are most relevant to the professional STEM setting? The secondary research question was: What soft skills, based on value and applicability, are critical to advancing the success, as defined by promotability and long-term career trajectory, of a STEM professional? Tertiary investigation explored current soft skills development strategies in STEM professionals. The

objective was to understand the implementation of soft skills that play a critical role in the promotability of STEM professionals and long-term STEM career trajectories based on the interpretation of the participants' experiences.

The purpose of this research study was to explore the nature of the experiences of STEM professionals and those with whom they work closely, with respect to the critical soft skills for long-term career success. Quantitative methods approach the research process from the perspective that a singular set of knowledge is available to be discovered (Teherani, Martimianakis, Stenfors-Hayes, Wadhwa, & Varpio, 2015). Alternatively, one qualitative methodological approach takes on constructivist philosophy, which assumes that there is no one reality to be discovered and seeks to explore informants' perceptions of reality (Teherani et al., 2015). Researchers use a qualitative descriptive approach when the aim is to synthesize a rich detailed description of a phenomenon (Kim et al., 2017) As such, this researcher selected a qualitative, rather than quantitative, approach to the study. Specifically, a qualitative descriptive research approach was selected based on the match between the purpose of the study and the constructivist approach of the method.

A social constructionist theoretical framework was selected to frame the study. According to Teherani et al. (2015), constructivism is a good philosophical fit for qualitative research. More narrowly, Segre (2016) explains that social constructionism is a theory that relies on the belief that knowledge and understanding is built out of experience in social contexts.

Two key components from social constructionism guided the study. One, individuals construct necessary knowledge (von Glaserfled, 1989). The purpose of this study was to explore the critical, or most necessary, soft skills for the long-term career success of STEM professionals. Two, the shared stock of knowledge generated by members of a social context is

distributed such that one can generally and easily deduce who is capable of sharing the socially constructed knowledge (Segre, 2016). This study included participants who are assumed to be capable of sharing insights into the soft skills critical to STEM professional promotability. Each tenet lent itself to providing the framework for the study, from understanding the purpose to establishing and justifying the participant population, research questions, and data collection strategies.

Setting

This qualitative descriptive study was developed to investigate the critical soft skills of late-career STEM professionals as a community. Consequently, the STEM professional participant population for the study did not involve a brick and mortar setting. Instead, the STEM professional participants were sourced based on their LinkedIn professional network membership and the established professional and educational requirements: (a) earned degree (BA/BS or higher) in a STEM discipline and (b) professional experience at or above the director level.

STEM professionals were accessed initially via LinkedIn messaging and later via personal email addresses. The STEM professionals were sourced and recruited based on LinkedIn profiles that meet the participant criteria. LinkedIn is a diversified professional networking business model (About LinkedIn, 2019). LinkedIn provides a variety of free and fee-based services including housing profile pages for registered users, as well as advanced subscription, marketing, and recruitment functionalities to more than 610 million users worldwide (LinkedIn User Agreement, 2019; About LinkedIn, 2019). This researcher had previous experience assessing LinkedIn profile pages of professionals for the purpose of recruiting individuals who meet specified criteria and have expressed an interest in supporting educational projects. The LinkedIn profile pages reviewed by this researcher during the

participant recruitment process are available for public access to any registered member of the LinkedIn professional network.

Human resources professionals were accessed via the human resources employee database of a global life sciences corporation. Site permission was obtained for the ability to distribute the survey to human resources professionals via their corporate email accounts. Not all human resources professionals employed by the corporation have succession planning experience for STEM professionals. Therefore, the initial survey questions were used to confirm that the professionals completing the survey met the participation requirements.

Participants

Participants for the study represented two professional categories: (a) late-career STEM professionals and (b) human resources professionals with experience in succession planning for STEM professionals. These two groups of participants were selected for their experience with the soft skills and capabilities necessary for STEM professional career progression. Both sets of participants were asked to provide qualitative feedback based on profession experience and perspective. An overarching goal of qualitative descriptive research is to describe and summarize the shared experiences of individuals (Willis et al., 2016). Therefore, STEM professionals were asked to provide an internal, reflective perspective based on personal, professional experience. Akdere et al. (2019) suggest that human resource professionals have the knowledge to take an active role in the development of STEM program graduate success. Human resources professionals access and discuss promotability ratings as part of the succession planning process (Van Vianen et al., 2018). Thus, human resources professionals with succession planning experience for STEM professionals were asked to provide an objective, observational perspective on the soft skills that are critical to STEM professional career success.

Human resources participants were sourced from the human resources professionals employed at a global life sciences corporation and comprised the first population of study participants for the survey portion of the data collection. An invitation to participate in the survey was sent via email to human resources employees of the corporation. The email requested participation from those with succession planning experience for STEM professionals in the corporate setting. The qualifying criteria was included in the initial survey questions for verification purposes.

The second population of study participants were late-career STEM professionals. STEM professionals comprised the informant population for the interview portion of the data collection. Members of this group of participants were sourced via LinkedIn profiles. Once identified, potential late-career STEM professional participants were asked to verify that they meet the following minimum criteria: (a) earned degree (BA/BS or higher) in a STEM discipline and (b) current or previous professional experience at or above the director level in a business setting.

Data

Descriptive research often includes survey tools to collect data; qualitative research typically involves interviews to achieve a more holistic perspective from participants (Nassaji, 2015). This qualitative descriptive study employed both surveys and interviews. Surveys were conducted electronically. The qualitative survey feedback employed a Likert type scale (1 to 5), enabling quantitative analysis of results. Survey tools often collect data qualitatively yet are analyzed quantitatively, using summary statistics (Nassaii, 2015). Face-to-face interviews were conducted via video conference, using the Blackboard Collaborate Ultra platform.

The survey data for this study was collected and managed using REDCap™ electronic data capture tools hosted at the University of New England. REDCap™ (Research Electronic

Data Capture) is a secure, web-based application designed to support data capture for research studies, providing a) an intuitive interface for validated data entry, b) audit trails for tracking data manipulation and export procedures, and c) automated export procedures for seamless data downloads to common statistical packages (Harris et al., 2009). Following the completion of the data collection process, the survey data was exported to a Microsoft Excel® file for statistical analysis.

The survey questions were grouped in two clusters. The first question cluster contained demographic questions regarding the type of STEM professional (science, technology, engineering, or mathematics), career level, and years of experience. The second question cluster asked participants to rank the level of expertise, frequency of use and career criticality of soft skills as observed or discussed in succession planning meetings by human resources professionals.

Participant perceptions may be surveyed using two slightly different scales: Likert and Likert type (Joshi, Kale, Chandel, & Pal, 2015). A Likert scale is often employed to collect opinions and perceptions of a single latent variable using multiple questions; the intent being a composite score representing the collective impressions surrounding the single variable (Joshi et al., 2015). A Likert type scale does not result in a summative composite score; rather, the findings analyze results of individual categories as mutually exclusive entities (Joshi et al., 2015). Responses for this study were sought based on a Likert type scale. The primary interest of this researcher was to capture the perceptions of participants for the sake of analysis of individual soft skills and the role that each plays in the success of a STEM professional's career. The analysis of each soft skill is deemed mutually exclusive of the other soft skills in the list.

Willis et al. (2016) assert that the literature review can provide guidance for the data collection. As such, the survey questions designed to collect data regarding the experienced or observed value and applicability of critical soft skills in STEM professions are grounded in the literature. A review of the recent research revealed variation in the individual identified soft skills discussed by different researchers (Bickle, 2017; Blazquez et. al., 2017; Börner et al., 2018; Clarke, 2016; Clarke, 2018; de Ridder et. al., 2014; Gibert et al., 2017; Hartmann & Jahren, 2015; Humphries & Kosse, 2017; Lavy & Yadin, 2013; Lippman et al., 2015; McGunagle, 2016; McGunagle & Zizka, 2018; Raman & Koka, 2015; Shukla & Kumar, 2017; Suleman, 2018). McGunagle (2016) generated a list of valuable soft skills based on public source, websites, and social media. Other researchers (Hartman & Jahren, 2015; Lavy & Yadin, 2013) have reviewed job descriptions for references to soft skills. The researcher for this study created a frequency analysis of soft skills based on the academic literature (See Table 1). All literary references were reviewed for either soft skills assessment or soft skills definition. Each reference that defined soft skills using a list of examples or conducted studies using specific soft skills references or assessment earned a column in the frequency table. The soft skills were then sorted in order of frequency of reference, highest to lowest.

Table 1: Soft Skills Frequency Table

Soft Skill	Frequency
Communication/presentation/writing	14
Strategic Thinking/problem solving	13
Leadership/Managing/coaching/mentoring others	12
Self-confidence/ independence/motivation/self-perception	12
Teamwork	10
Willingness to learn and accept responsibility for decision making	9
Interpersonal skills	7
Negotiation/Conflict Resolution	6

Table 1 (continued)

Soft Skill	Frequency
Emotion Regulation/self-control	6
Time Management	5
Flexibility/Resilience/adaptability	5
Customer service	5
Creativity	5
Social	4
Enterprise, initiative and Entrepreneurship	4
Meeting management/facilitation/organization/planning	2
Networking/effective relationships	2
Inspiring Competence-Based Trust/Reliability/responsibility	2
Cultural and Diversity awareness	2
Persistence	2
Ability to synthesize and gather data	2
Proactive	2
Ethics/Inspiring Moral trust	2

All soft skills referenced in more than one publication were included in the survey for ranking. The list of skills was organized alphabetically, rather than in order of frequency in the survey. Survey participants were asked to consider the list of soft skills from three perspectives: (a) the level of expertise demanded of STEM professionals, (b) the frequency of use in the STEM professional's career, and (c) the criticality of the skill to the success of the STEM professional and the business. The objective of qualitative descriptive research is to produce a rich summarized description of the details of a phenomenon and its characteristics: what, where, when and to what extent rather than how and why (Nasaji, 2015). The survey sought to collect specific feedback regarding what soft skills are important to STEM professionals, when (how often) those skills are employed, to what extent are STEM professionals expected to exercise expertise in those skills, and to what extent are those skills critical to the business and career of

the STEM professionals. Human resources professionals were asked to report on the relative importance of each soft skill as it pertains to the STEM professional's career success.

The interview portion of the study was conducted with nine STEM professionals. STEM professional participants were provided with the most prevalent soft skills as revealed in the survey. The informants were asked to reflect on their own use of the soft skills identified in the survey and the components and activities associated with those soft skills categories. STEM professionals were also asked to share details about ideal characteristics for STEM professionals in leadership roles as well as ideal forums for cultivating soft skills in young STEM professionals.

Interviews were conducted one-on-one with the researcher. Blackboard Collaborate Ultra video conferencing platform was used to facilitate the face-to-face virtual discussions. Interviews were recorded for the purpose of facilitating transcription. A semi-structured question format calls for all participants to be asked a core set of questions with flexibility to allow for the opportunity for additional exploration (Merriam & Tisdell, 2016). The interview portion of this study followed a semi-structured question design. The possibility existed that a STEM professional would disagree with some survey results. Therefore, participants were offered the opportunity to decline to elaborate on a specific skill and to offer feedback that they felt was more consistent with their experience.

Reliability and Validity

Trustworthiness is a matter to be addressed from the perspective of research process as well as research findings. Establishing trustworthiness in quantitative data is deeply rooted in reliability and validity statistics (Merriam & Tisdell, 2016). Lincoln & Guba (1985) offered parallel concepts of dependability, credibility, transferability, and confirmability pertaining to the

trustworthiness of qualitative research studies. Table 2 shows the correlation mapping for quantitative and qualitative research. Elements of dependability, credibility, transferability and confirmability outlined in this section provide evidence of trustworthiness and rigor for the study.

Table 2: Correlation of Reliability and Validity Terminology to Qualitative Research

Quantitative Research	Qualitative Research
Reliability	Dependability
Validity	Credibility Transferability Confirmability

Dependability

Dependability of qualitative studies refers to the relationship between the data and the results. Lincoln and Guba (1985) were the first to suggest that reliability in qualitative research be conceptualized as the dependability or consistency of data and results. The objective is to provide evidence that the reported results of the study are consistent with the data that was collected during the study (Merriam & Tisdell, 2016). Evidence of dependability improves the trustworthiness of the research.

Member checking is one strategy qualitative researchers can use to confirm the accuracy of the results of a study (Birt, Scott, Cavers, Campbell, & Walter, 2016). Lincoln and Guba (1985) suggest that member checking can be conducted at various points during the data collection and analysis process. This researcher conducted member checks using analyzed data from the whole sample to confirm that the summaries were accurate and consistent with the data collected.

Credibility

The credibility of a study pertains to the congruence of the findings with the reality that those findings are proposed to represent (Merriam & Tisdell, 2016). Member checking is often employed by qualitative researchers to strengthen the credibility, or validity, of the findings of the study (Birt et al., 2016). Data saturation is a second strategy used to ensure data and findings are accurately representative of participants' shared perspectives, thus further strengthening credibility. A combination of member checks and data saturation were included in this study.

This researcher employed member checking as a means to confirm the closeness of the findings to the reality the participants were asked to share. Lincoln and Guba (1986) suggested that credibility is inherently present if the results are confirmed to accurately depict the participants' perceptions and interpretations of their experiences. The member checking process included the presentation of interview summaries to members of the interview participant population. Participants were asked to review and confirm the accuracy of the summaries or provide constructive feedback.

The notion of determining how much data is enough data is specific to each qualitative study (Fusch & Ness, 2015). This researcher sought to achieve data saturation in both the survey and interview phases of the study. Data saturation is reached when the data collection reaches a state of repetitiveness, such that no new information is surfacing (Merriam & Tisdell, 2016). Fusch and Ness (2015) refer to data saturation as a combination of thick and rich data, paying heed to the need for quantity and quality. The survey data collection process began to yield repetitive results after the 15th survey submission. Data collection continued until 38 surveys were submitted to be certain no new information would surface. The interview data collection began to yield repetitive results after the sixth interview. This researcher conducted three further

interviews to be certain no new information would surface. Thus, data saturation was achieved through both the survey and interviews yielding both thick and rich data.

Transferability

Qualitative studies are not generalizable by nature (Merriam & Tisdell, 2016). Transferability is the notion that research regarding a specific phenomenon can be determined to be applied to similar, or parallel, but different situations. Lincoln and Guba (1986) suggested that, instead of generalizability, qualitative researchers should seek to make available enough detail such that a reader can determine the level of transferability to a new situation.

An audit trail, also referred to as a chain of evidence, is a strategy available to qualitative researchers to provide organized evidence of process, such that readers can draw conclusions regarding transferability for themselves (Merriam & Tisdell, 2016; Yin, 2018). The audit trail, as suggested by Lincoln and Guba (1985), provided the detailed series of procedures and decisions throughout the inquiry. This researcher maintained an audit trail for this study, beginning with the literature-based survey development, continuing with participant selection and data collection and ending with analysis procedures.

Confirmability

Confirmability was the final component to Lincoln and Guba's (1985) outline for the reliability and validity of qualitative research. Confirmability in qualitative research pertains to securing the inter-subjectivity of the data and safeguarding against interpretation that is inherently based on the researcher's own bias (Korstjens & Moser, 2018). Qualitative researchers seek to establish confirmability as a means to strengthening the validity of the qualitative study (Merriam & Tisdell, 2016). Korstjens and Moser (2018) suggested that the strategy needed to

support the confirmability of a study is an audit trail. This researcher kept and consulted an audit trail through this study.

Analysis

Qualitative descriptive study findings are frequently reported as straightforward, detailed summaries of the participant perspectives revealed during the study (Kim et al., 2017). Willis et al. (2016) cited that an iterative analysis process can be employed in qualitative descriptive research for the sake of discovering themes early in the process and adding them to the future interview discussions. Accordingly, this researcher used an iterative analysis process throughout the study. Nassajii (2016) referenced the use of survey tools in qualitative studies to collect qualitative data that can then be analyzed quantitatively. Summary statistics were utilized to evaluate the survey results for the purpose of focusing discussion points in the interviews. The researcher continued the iterative analysis process with a thematic analysis of each interview transcript as well as a final analysis of the survey and interview data for a complete descriptive summary.

This researcher produced two sequential sets of data. Surveys collected qualitative feedback regarding expertise level, use frequency, and criticality of 23 soft skills that are referenced in recent literature. Qualitative survey results are often analyzed quantitatively (Nassaji, 2015). The Likert type scale used in the survey to rank levels of expertise, use frequency, and career criticality and produce ordinal values representing participant perceptions facilitated quantitative analysis, using a Microsoft Excel® spreadsheet (Joshi et al., 2015). Survey results were analyzed for frequency, percentages, and averages. The goal was to establish soft skills priority for the purposes of generating a hierarchy of soft skills that are considered

critically valued in the professional STEM setting. The survey results formed the basis for the interviews.

Interviews were conducted to delve deeper into participant perceptions regarding the implementation of soft skills that are critical to the promotability of STEM professionals. The analysis of both survey and interview sets of data may allow for potential data triangulation and strengthen the thematic presentation of information. According to Willis et. al. (2016), data triangulation is an important part of the research process for validity.

Video conference interviews were recorded. The recordings were uploaded into NVivo® Transcribe software to produce transcripts of all interviews. Merriam and Tisdell (2016) suggested storing data in multiple locations to avoid accidentally losing data. Hence, this researcher stored all transcript files on a flash drive and in cloud storage, as a precaution to safeguard against inadvertent loss of data.

Qualitative research is often subject to an inductive exploration for the purpose of identifying repetitive themes (Nassaji, 2015). NVivo® software is a qualitative data analysis software (QDAS) program widely recognized and used by qualitative researchers for analysis of interview transcripts (Woods, Paulus, Atkins, & Macklin, 2016). Interview transcripts were uploaded into NVivo® 12 Pro software for analysis. Interviews were analyzed inductively and assessed for recurring references leading to codes. Codes involved critical soft skills, soft skills components, professional activities that are soft skills related, and soft skills origins or training experiences. Results established detailed, subcategories of soft skills characteristics as well as a common strategic vision for soft skills development in future STEM professionals.

This researcher produced a crosswalk of the study results. A crosswalk is a method of examining and synthesizing information from multiple sources (Liljamo, Kinnunen, & Saranto,

2016). The synthesis of information produces a visual display used to efficiently and effectively draw connections and expand knowledge (Wojciechowski, Pearsall, Murphy, & French, 2016). Survey results summarizing the perceptions of the human resources professionals were crosswalked with the interview results illustrating the detail provided in the interviews with the late-career STEM professionals. The crosswalk method is consistent with the goals of qualitative descriptive research to provide straightforward data descriptions as well as staying close to the data and true to the language of the participants. As such, the visual display succinctly organized the findings from both groups of informants using language from the participant interviews.

Participant Rights

Methods of Data Collection and Analysis

This study is a qualitative descriptive study. The researcher collected data via a survey and a video conference interview. The survey was grounded in the literature, pertaining to the soft skills referenced in the current literature. The survey questions were built based on the qualitative descriptive research concern for what, where, when, and to what extent (Nasaji, 2015). The survey data for this study was collected and managed using REDCap™ electronic data capture tools hosted at the University of New England.

The surveys were sent to human resources professionals based on the employee database of a global life sciences corporation. The minimum qualifications of (a) past or present human resources experience and (b) succession planning experience with STEM professionals in a corporate setting were included in the initial survey questions for verification purposes. The survey results were exported to and analyzed with Microsoft Excel®. The researcher created narratives and descriptive statistics presented in tables from the survey data.

The researcher also conducted semi-structured interviews focused on the results of the survey data. The participants for the interviews were STEM professionals sourced via LinkedIn profiles that met the minimum criteria: (a) an earned degree (BA/BS or higher) in a STEM discipline and (b) experience as a STEM professional at or above the director level. Participation in interviews was voluntary. The interviews were conducted using Blackboard Collaborate Ultra video conferencing tool. All interviews were recorded. The recordings were uploaded into NVivo® Transcribe for the purpose of producing a text transcription of each interview. The transcripts were then uploaded to NVivo® 12 Pro, coded, analyzed, and synthesized with the survey results.

Procedures

The researcher utilized two different data collection procedures: a survey and interviews. As such, the researcher sought appropriate permissions for both procedures. The researcher received permission from a global life sciences corporation to distribute the survey to their human resources employee database. Individual consent was obtained from each STEM professional via email, after making contact via LinkedIn.

Informed Consent

All survey participants received an invitation to participate. The notice of consent to participate in anonymous survey research was included in the survey. Participants indicated their consent to participate by electronically submitting the survey. Interview participants also received an invitation to participate in the study. Each interview participant electronically signed a consent for participation in research through email prior to the interview

Provisions for Subject and Data Confidentiality

Survey participants were afforded anonymity. Interview participants were afforded confidentiality. Participation in both the survey and interview was voluntary.

Surveys were distributed based on a corporate employee database. Site permission to conduct research was obtained by this researcher. Results were not specifically linked to an individual participant's identity, and this researcher does not have a list of survey respondents.

Interview participation was on a voluntary basis. This researcher was the sole data collector for the study. Interview participants were coded by letters (i.e. Participant A, Participant B, etc.). This method was used to secure overall confidentiality for interview participants and ensure the anonymity of participants in the final written report of the findings.

Survey and interview questions were generic in nature so as to avoid unintended negative repercussions or retaliation towards STEM professionals who are connected to the research participants in an existing professional setting. The data was kept in NVivo® Cloud with encrypted password only known to the principal researcher. Back up files were stored on a password protected flash drive kept in a locked safe in the researcher's home along with any handwritten notes. All personally identifiable data was removed from the text of the dissertation.

Limitations and Delimitations

Assumptions

Assumptions are the foundational concepts that the researcher brings to the study and accepts as true (Cunliffe & Scaratti, 2017). The first assumption is soft skills are critical to STEM professional success as defined by promotability and long-term career trajectory. Next, participants were assumed to be able to articulate their personal experiences in terms of the soft

skills referenced. Finally, participants were assumed to be responding accurately and honestly to questions about their professional experience.

Limitations

Researchers identify limitations to a study for the purpose of defining the boundaries of the research (Brutus et al., 2013). The first limitation is that the data collected was dependent on informants' recollection, which could have been subject to error, inadvertent omission, and/or modification. The second limitation is because of the small sample of participants that were used for the study, broad generalizations may not be relevant.

Delimitations

Delimitations are the parameters of the research and the boundaries of the study (Ellis & Levy, 2010). The first delimitation is that STEM professional participants were selected based on a small sampling and therefore may not be wholly representative of the entire population of STEM professionals. The second delimitation is that succession planning, by nature, is a process of evaluating existing employees, therefore human resources professionals were asked to provide feedback based on their experience with assessing existing employees, disregarding the external candidate interview and assessment process.

Field Study

A critical component of a research study is the testing of the logistics and feasibility of a particular research plan and/or instrument (Maldaon & Hazzi, 2015). A field study was conducted by this researcher for the purpose of testing the survey instrumentation. The field study consisted of the survey only and no data was collected. Four experts were consulted regarding the logistics, feasibility, question wording and question clarity. The human resources executives consulted met the study requirements: (a) past or present human resources experience

and (b) succession planning experience with STEM professionals in a corporate setting. The expert feedback afforded the opportunity to adjust the online delivery, REDCap™ link functionality, wording, and scales.

The expert feedback led to three changes in the survey instrument. The first change was the vocabulary adjustment from "criticality" to "career criticality" in references to the third category presented for ranking the soft skills. The second change was the addition of "collaboration" to the teamwork soft skill for clarification. The third change was the allowance for selecting more than one professional level for which succession planning sessions were conducted. The final change was to accommodate the fact that individual contributors are greater in number in an organization than higher-level positions, and therefore all respondents would have been forced to select individual contributors as the most frequently planned position level.

Conclusion

Changes in the global economy have increased the workplace focus on valuable transferrable soft skills across all industries (Clarke, 2018). The shift towards a knowledge economy has also led to highlighting the soft skills deficiencies in STEM professionals (McGunagle & Zizka, 2016). There is little research on how late-career STEM professionals and the human resources professionals who work closely with them describe the critical soft skills that contribute to long-term promotability and career success. Therefore, the purpose of this qualitative descriptive study was to explore (a) what soft skills based on value and applicability, are critical to advancing the promotability of a STEM professional? (b) what components and activities of identified soft skills are most relevant to the professional STEM setting? and (c) what are current and potential future soft skills development strategies for STEM professionals. Participants represented two professional categories (a) late-career STEM professionals and (b)

human resources professionals with success planning experience for STEM professionals. Data was collected over two sequential phases. Survey data was used to focus the discussion in the interviews. All participant rights and confidentiality were preserved.

Chapter three detailed the methodology for the research study conducted. The chapter included the setting, participants, data collection and analysis, participant rights, potential limitations, and the field study. Chapter four explains the analysis methods, presents the results and summarizes the findings. Chapter five interprets the findings, discusses the implications of the study and the potential beneficiaries, makes recommendations for future investigations and remarks on the significance of the work as a contribution to the existing body of knowledge.

CHAPTER 4

RESULTS

The purpose of this qualitative descriptive study was to explore the implementation of soft skills that are critical to the success, as defined by promotability and long-term career trajectory, of STEM professionals from the perspective of STEM professionals and those with whom they work closely. This researcher sought to understand the activities and components of critical soft skills that contribute to the promotability of STEM professionals. This study addressed two research questions: (a) What components and activities of identified soft skills are most relevant to the professional STEM setting? and (b) What soft skills, based on value and applicability, are critical to advancing the success, as defined by promotability and long-term career trajectory, of a STEM professional? Additionally, the study included a tertiary exploration of existing soft skills training to further understand the origins of the skills in late-career STEM professionals.

The results of the study emanated from two data collection procedures. First, a survey was administered to 38 human resources professionals with succession planning experience for STEM professionals. The survey results provided the focus for the second data collection process: interviews with late-career STEM professionals. The interview results came from the analysis of transcripts of recorded one-on-one interviews with nine participants over a two-week period. Each interview lasted 45 to 75 minutes. All interviewees related their experience in English and in first-person account. Overall, this researcher conducted nine interviews to explore the implementation of the eight critical soft skills that were identified through the analysis of the survey results.

Chapter four summarizes the results of the study as well as answers the research questions. The researcher provides a commentary, discussing the meaning and reasons for the results. Chapter five addresses the interpretation of the results within the context of each research question. The researcher will also discuss the implications of the findings, recommendations for action and recommendations for further study.

Soft Skills Data

Survey Data

The survey instrument was distributed to the human resources employee email database of a global life sciences corporation. The emailed invitation to participate included a link to a REDCap™ survey. Thirty-eight complete survey responses were submitted. The completed responses included self-reported professional experience information as well as the responses regarding the ranking of each of the 23 soft skills provided.

This researcher analyzed the survey data in Microsoft Excel®. Survey results were exported from REDCap™ to Excel®. This researcher removed survey submission records with missing question responses. Forty-eight survey submissions were collected; 10 were removed, leaving 38 completed survey submissions for analysis.

This researcher began the survey data analysis with the participant experience data. First, verifying that each respondent confirmed fulfillment of the two requirements for participation: (a) experience as a human resources professional and (b) experience with succession planning sessions for STEM professionals. The analysis continued with a summary profile of participants' years of experience, collective total succession planning sessions, and experience with succession planning for STEM professionals by discipline and career level.

This researcher completed the survey data analysis by analyzing the results of the rankings of each of the 23 named soft skills within each of the three categories: level of expertise, frequency of use, and career criticality. First, this researcher calculated the average ranking for each soft skill in each category. Second, the soft skills were sorted based on average ranking, highest to lowest, within each category. Finally, lists of the top 50th percentile skills for each category were generated and examined to determine which skills were present on all three lists. This researcher deemed the resulting list of soft skills to be the foundation for the interview phase of data collection.

Participant Experience Summary. Thirty-eight human resources professionals responded to the survey. All respondents reported that they were human resources professionals with succession planning experience. Collectively, the respondents reported more than 450 years of combined human resources work experience with experience in more than 1400 succession planning sessions. Table 3: HR Succession Planning Experience by STEM Discipline shows the percent of respondents with experience in succession planning for STEM professionals by field. Ninety-two percent of the survey participants reported experience with succession planning for STEM professionals with a science background. Forty-five percent of the survey participants reported experience with succession planning for STEM professionals with a technology background. Fifty-five percent of the survey participants reported experience with succession planning for STEM professionals with an engineering background. Five percent of the survey participants reported experience with succession planning for STEM professionals with a mathematics background.

Table 3: HR Succession Planning Experience by STEM Discipline

	Science (S)	Technology (T)	Engineering (E)	Mathematics (M)
Percent of Respondents	92%	45%	55%	5%

Survey participants reported the career levels for which they have succession planning experience. Table 4: HR Succession Planning Experience by Career Level shows the percent of respondents with experience in succession planning for STEM professionals by the career level of the STEM professionals. The survey results demonstrate evidence consistent with Parfitt's (2017) assertion that succession planning take place at all levels of an organization, not just the executive level. Twenty-one percent of the survey participants reported experience with succession planning for STEM professionals at the C-Suite/Board level. Fifty-eight percent of the survey participants reported experience with succession planning for STEM professionals at the VP level. Eighty-two percent of the survey participants reported experience with succession planning for STEM professionals at the director level. Sixty-six percent of the survey participants reported experience with succession planning for STEM professionals at the supervisor level. Sixty-one percent of the survey participants reported experience with succession planning for STEM professionals at the individual contributor level.

Table 4: HR Succession Planning Experience by Career Level

	C-Suite/ Board	VP	Director	Supervisor	Individual Contributor
Percent of Respondents	21%	58%	82%	66%	61%

Critical soft skills summary. This researcher asked survey participants to rank 23 soft skills in three categories: level of expertise, frequency of use, and career criticality. The rankings were recorded on a Likert-type scale 1 to 5, with one representing a low ranking and five representing a high ranking, for each category. Overall, all soft skills received an average ranking of 3.33 or higher in all categories. The results are congruent with Lavrysh's (2016) assertion that soft skills are the most critical skills for the global job market. All 23 soft skills received average rankings ranging from 3.39 to 4.50 in the level of expertise category. All 23 soft skills received average rankings ranging from 3.54 to 4.65 in the frequency of use category. All 23 soft skills received average rankings ranging from 3.33 to 4.50 in the career criticality category. Figure 2: Average Soft Skill Rankings by Category provides graphs to illustrate the average ranking for each soft skill by category.

Figure 2: Average Soft Skill Rankings by Category

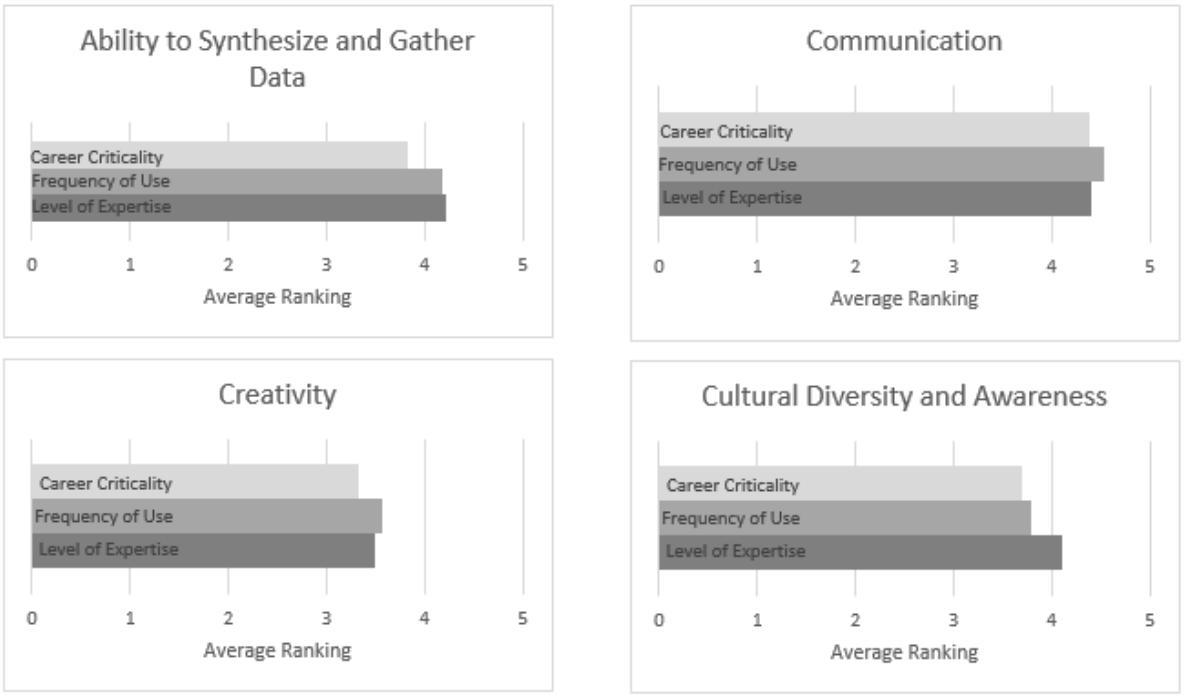


Figure 2 (continued)

Figure 2 (continued)

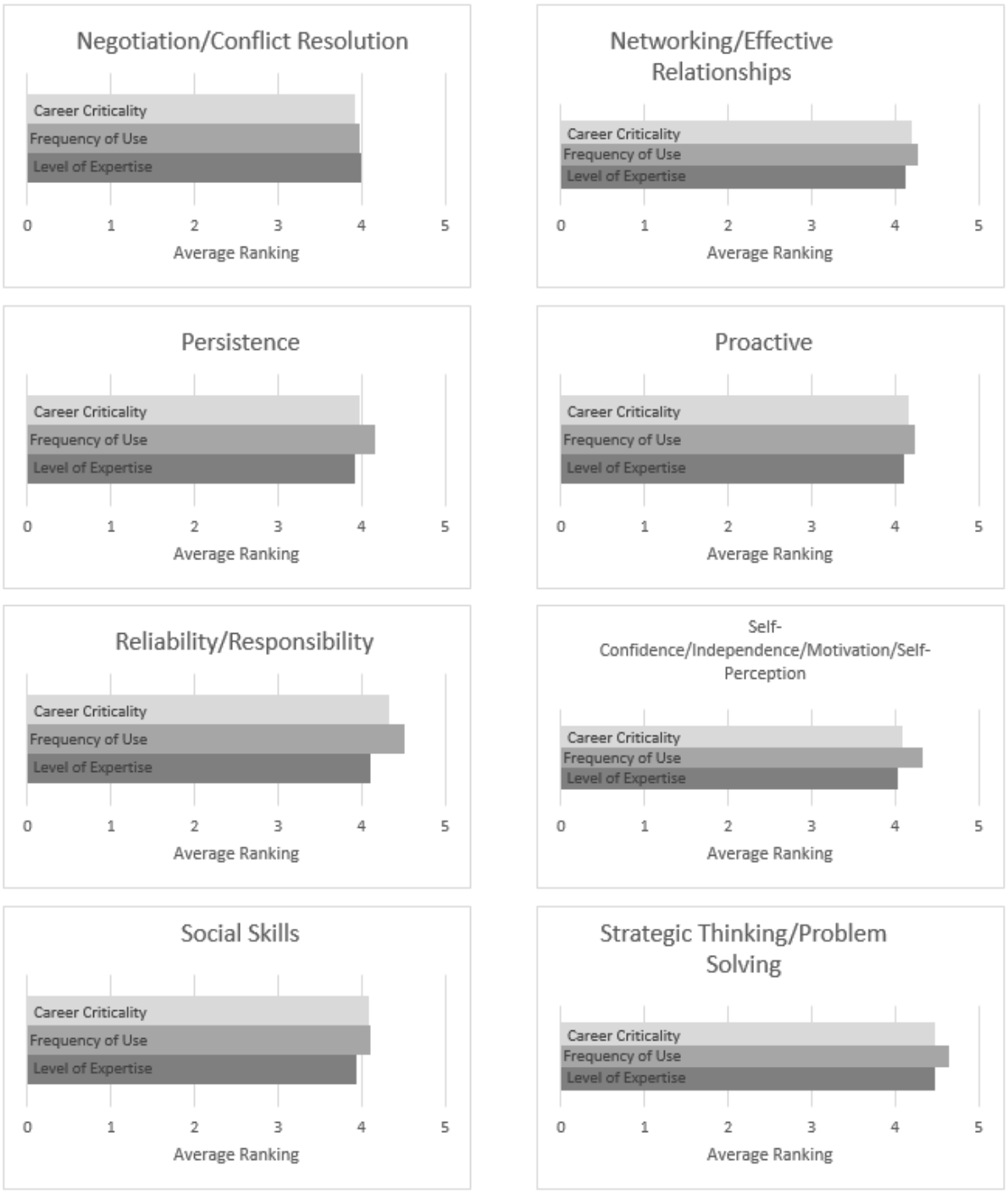
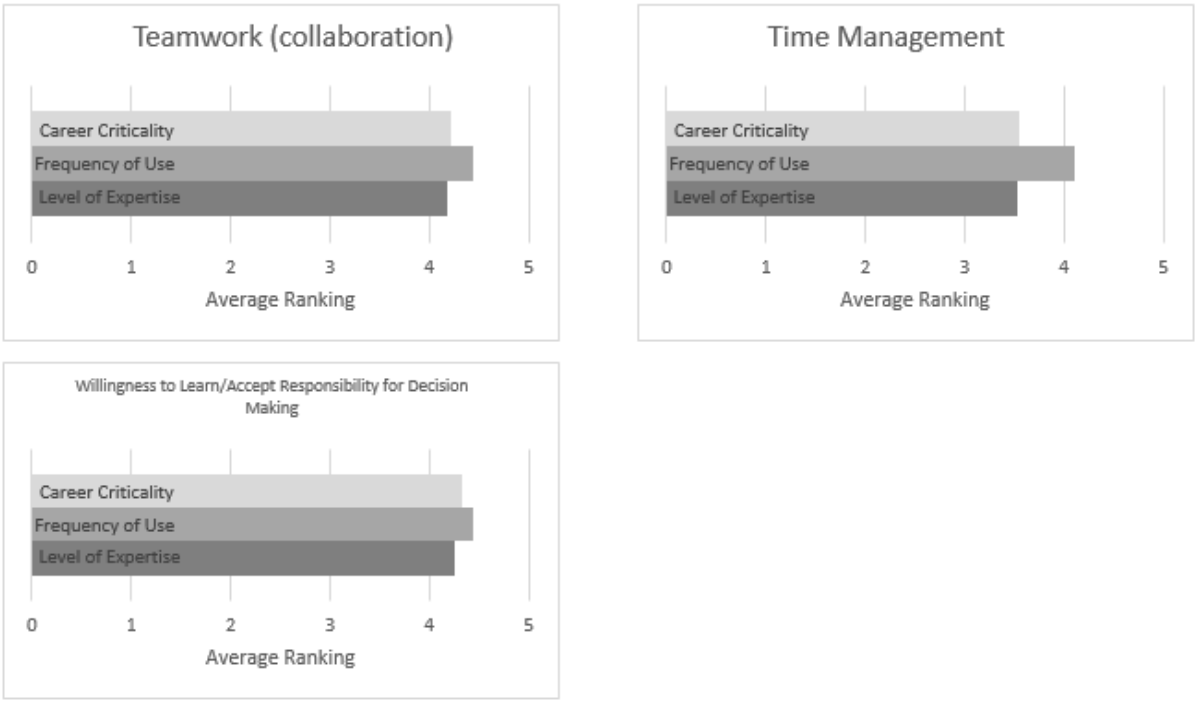


Figure 2 (continued)



The researcher aimed to use the results of the survey as the foundation for the focus of the interviews with STEM professionals. Therefore, the researcher continued the survey data analysis with the goal to achieve a finite list of critical soft skills. The skills in each of the three categories were sorted according to average ranking from highest to lowest. The researcher then generated a list of soft skills that appeared at the top of the list in all of the three categories: level of expertise, frequency of use, and career criticality. The results of the analysis are displayed in Table 5: Critical Soft Skills. The resulting list of critical soft skills (Table 5) is organized in alphabetical order. This researcher did not seek a cumulative ranking of the list of soft skills in comparison to each other, simply a summary list of critical soft skills that ranked highest in all of the three defined categories: level of expertise, frequency of use, and career criticality.

Table 5: Critical Soft Skills

Critical soft skills
Communication/presentation/writing
Ethics/Inspiring moral trust
Flexibility/Resilience/Adaptability
Interpersonal Skills
Leadership/Managing/Coaching/Mentoring
Strategic Thinking/Problem solving
Teamwork
Willingness to learn and accept responsibility for decisions

The critical soft skills (Table 5) that resulted from the survey analysis formed the basis for the interviews with STEM professionals. Each interview participant was asked to elaborate on their experiences with each of the eight critical soft skills. The STEM professionals' shared experiences comprised the interview data portion of the study.

Survey data saturation. This researcher put the survey data through an iterative analysis process. Table 6: Evidence of Data Saturation illustrates the results of each iterative analysis procedure. After the 15th survey submission, the analysis was completed in its entirety and preliminary results were found to include seven soft skills that ranked at the top of the list in all three categories. The analysis process was completed again after the 18th survey was submitted. Again, seven soft skills were found to be at the top of all three lists, six of them were identical to the previous analysis results. This researcher again conducted the data analysis process after the 21st survey submission and the resulting list contained six soft skills that mirrored those from the first two analysis procedures. The analysis after 30 survey submissions yielded a list of eight soft skills that included the six that had been consistently present in the top ranks plus the seventh from both the first two lists. Two final analysis procedures were conducted after the 33rd and 38th survey, yielding the same list of eight soft skills. The consistency of the results with each

iteration of the analysis indicated data saturation and supported the credibility of the survey results. This researcher determined that data saturation had been achieved and the final list of eight soft skills was accepted as the conclusion of the survey data collection and analysis.

Table 6: Evidence of Data Saturation

15 surveys	18 surveys
Communication/presentation/writing	Communication/presentation/writing
Flexibility/Resilience/Adaptability	Ethics/Inspiring Moral Trust
Interpersonal Skills	Interpersonal Skills
Leadership/Managing/Coaching/Mentoring	Leadership/Managing/Coaching/Mentoring
Strategic Thinking/Problem Solving	Strategic Thinking/Problem Solving
Teamwork	Teamwork
Willingness to Learn and Accept Responsibility for decisions	Willingness to Learn and Accept Responsibility for decisions

21 surveys	30 surveys
Communication/presentation/writing	Communication/presentation/writing
Interpersonal Skills	Ethics/Inspiring Moral Trust
Leadership/Managing/Coaching/Mentoring	Flexibility/Resilience/Adaptability
Strategic Thinking/Problem Solving	Interpersonal Skills
Teamwork	Leadership/Managing/Coaching/Mentoring
Willingness to Learn and Accept Responsibility for decisions	Strategic Thinking/Problem Solving
	Teamwork
	Willingness to Learn and Accept Responsibility for decisions

33 surveys	38 surveys
Communication/presentation/writing	Communication/presentation/writing
Ethics/Inspiring Moral Trust	Ethics/Inspiring Moral Trust
Flexibility/Resilience/Adaptability	Flexibility/Resilience/Adaptability
Interpersonal Skills	Interpersonal Skills
Leadership/Managing/Coaching/Mentoring	Leadership/Managing/Coaching/Mentoring
Strategic Thinking/Problem Solving	Strategic Thinking
Teamwork	Teamwork
Willingness to Learn and Accept Responsibility for decisions	Willingness to Learn and Accept Responsibility for decisions

Survey Data Summary. The purpose of this qualitative descriptive study was to explore the implementation of soft skills that are critical to the success, as defined by promotability and long-term career trajectory, of STEM professionals from the perspective of STEM professionals and those with whom they work closely. This researcher sought to understand the activities and components of critical soft skills that contribute to the promotability of STEM professionals. This study addressed two research questions: (a) What components and activities of identified soft skills are most relevant to the professional STEM setting? and (b) What soft skills, based on value and applicability, are critical to advancing the success, as defined by promotability and long-term career trajectory, of a STEM professional? The survey portion of this study narrowed the vast list of soft skills to eight critical skills: communication/presentation/writing, ethics/inspiring moral trust, flexibility/resilience/adaptability, interpersonal skills, leadership/managing/coaching/mentoring, strategic thinking/problem solving, teamwork, and willingness to learn and accept responsibility for decisions. These eight soft skills concurrently ranked the highest in three categories: level of expertise, frequency of use, and career criticality. This researcher deemed the resulting list of soft skills (Table 5) to be the foundation for the interview phase of data collection and the answer to the research question: What soft skills, based on value and applicability, are critical to advancing the success, as defined by promotability and long-term career trajectory, of a STEM professional?

Interview Data

The interview portion of the study was conducted after the survey data collection was closed and the data had been analyzed. This researcher conducted nine interviews. The focus of the interviews was guided by the eight critical soft skills resulting from the survey data analysis

plus additional probing into the participants' personal soft skills development journey and their recommendations for soft skills development strategies.

The researcher conducted interviews via video conference at times selected by the interviewees. The researcher recorded the video conference in MP4 format, using the record feature embedded in the video conference tool, and MP3 format using a handheld digital audio recorder. The video conference included a screen share, such that participants could see and read each question to be discussed. Each interview lasted 45-75 minutes.

The researcher prepared the interview data for analysis. The audio MP3 files were uploaded to NVivo® Transcribe software for transcript generation. The software-generated transcripts were then manually compared to the audio files to review and confirm accuracy. Finally, the transcripts were saved with lettered participant file names to shield participant identities.

This researcher prepared the transcript data for analysis. First, the transcripts were uploaded to NVivo® 12. A researcher improves the rigor of qualitative research when utilizing NVivo® to search for themes, codes, and patterns (Paulus, Woods, Atkins, & Macklin, 2015). All text was reviewed for references to the eight soft skills (communication/presentation/writing, ethics/inspiring moral trust, flexibility/resilience/adaptability, interpersonal skills, leadership, managing, coaching, mentoring, strategic thinking/problem solving, teamwork, and willingness to learn and accept responsibility for decisions) and references were organized into nodes. Eight nodes were generated, one for each of the soft skills, plus one node for responses regarding soft skills origins and one node for recommendations for soft skills development. The nodes were then deemed ready for individual analysis.

This researcher reviewed each node for commonalities. A code was created for each reference to a new discernable activity or component. The participant letter was paired with each code. Subsequent references to a code received a lettered notation for the additional participant letter.

Participant summary. This researcher interviewed nine late-career STEM professionals. Each participant met the study qualifications: (a) earned degree (BS/BA or higher) in a STEM discipline, and (b) professional experience at or above the director level. Table 7: Interview Participant Profiles includes the STEM degree and professional experience for each interview participant. All participants spoke openly about their experience.

Table 7: Interview Participant Profiles

Participant	STEM Degree	STEM Branch	Career Level
A	MA	S	CTO
B	MS	E	VP
C	BS	E	VP
D	PhD	S	VP
E	BS	E	Director
F	MS	E	COO
G	PhD	T	CEO
H	BS	E	VP
I	MS	E	Principal

Soft skills activities and components. This researcher used the results from the survey to pre-define the themes for the interview qualitative analysis. Each participant was asked to discuss the eight soft skills and the role they have played in career success and promotability. All

nine interviewees (100%) expressed significant overlap and interplay between the different soft skills.

The interconnectivity of the soft skills was evident in all (100%) participants' explanations of understanding of the soft skills as well as exemplar stories. For example, communication and strategic thinking were interwoven in leadership examples, interpersonal skills and trust were evident in teamwork descriptions, flexibility/adaptability/resilience was referenced in communication and leadership examples, and a willingness to learn and accept responsibility for decisions was heavily represented in leadership, teamwork and ethics/inspiring moral trust discussions. One participant (E) remarked "they are all important." A second participant (F) began the discussion with the summary statement, "I was reading that list and there are so many soft skills now that I have used and relied on and that have saved me an employment situation over the period of time." The overwhelming presence of the soft skills threaded throughout the targeted discrete responses combined with these remarks is consistent with Shukla and Kumar's (2017) claim that soft skills are critical to employability. Special attention was given to coding the soft skills that were referenced within responses targeted towards a different theme, so as not to miss undertones and implied experiences amid the overt examples.

Communication/presentation/writing. This researcher asked interview participants to discuss their use of communication and its role in their success and promotability. Communication is a broad topic. Some respondents elected to organize their responses based on forum, such as town hall meetings, training sessions, team meetings, and one-on-one meetings. Some participants organized responses based on professional relationships, such as communications with a supervisor, subordinate, or peer. Some opted to respond in terms of

format, such as written, verbal, non-verbal, presentation, and listening. Regardless of the structure of the response all nine (100%) emphasized the importance of adapting style, tone, language, message, and level of detail to fit the audience, purpose, and context of the communication.

Each interview participant expressed their experience with adapting their communication technique slightly differently. For example, Participant D referenced varying vocabulary between senior level executives and the most junior level members of the organization. Participant H referenced adjusting tone and message when motivating a group to meet a performance goal versus transitioning an individual to a new role after a site closure. Participant I mentioned varying the context and level of detail when responding to a question from the CEO versus an intern.

Participants expressed two personal traits that were important in their careers: confidence (33%) and self-awareness (33%). Participant I shared an example illustrating that preparedness led to a level of subject matter expertise that promoted confidence in communication. Participant D explained "whether you like it or not you are constantly communicating, and someone is always watching or listening." Therefore, self-awareness of one's impact on the people around oneself is essential.

Ethics/inspiring moral trust. This researcher asked interviewees to discuss the role of ethics and inspiring moral trust. Four respondents (44%) gave fairly short concise responses expressing a non-negotiable intolerance of unethical behavior. One participant (G) stated "if you're not ethical, then you're fired." Seven (78%) of 9 participants expressed a belief that ethics are communicated and represented from an organizational level. Six (67%) interviewees expanded their examples to include the critical components of authenticity, sincerity and

credibility. Examples of authenticity, sincerity, and credibility all centered around communication, interpersonal relationships, and information exchange. Five (56%) participants specifically referenced the importance of establishing trusting relationships with professional colleagues. Five (56%) provided examples of "doing the right thing" in the face of temptation or when there was no personal gain to be achieved.

Flexibility/Resilience/Adaptability. This researcher asked participants to share their professional experiences with flexibility/resilience/adaptability. Seven (78%) of the 9 participants referenced working in dynamic environments and a need to be prepared to change with new information. One participant (D) discussed the change curve, meaning the Kübler-Ross model (Kübler-Ross, 1970) for the five stages of grief and its parallels to organizational change similar to those suggested by Castillo, Fernandez, and Sallan (2018). Participant D recommended developing a self-awareness of how one progresses through change as well as an awareness of the differences in how others progress through change. Three participants (B, F, & I) mentioned a constant pursuit of new information through reading, learning, and "staying curious" as a means for facilitating flexibility and adaptability. Six (67%) of the 9 participants discussed learning from one's mistakes. One participant (F) specifically referenced the notion of failing forward in terms of learning from one's mistakes (Maxwell, 2000). Another participant (E) discussed the idea of being intellectually honest with oneself so as to recognize failures, analyze those failures and make adjustments so as to avoid repeating those failures. Finally, three participants (E, F, & I) referenced having the confidence to know when not to change and to stay the course.

Interpersonal skills. This researcher asked respondents to discuss their use of interpersonal skills and how they relate to their career success. The responses and examples

echoed four types of interpersonal skills: self-reflective, behavioral, personal actions, and engagement activities. All nine (100%) emphasized the importance of interpersonal skills for dealing with the people they work with on a daily basis.

Self-awareness and breadth of interests were the overarching ideas in terms of self-reflectiveness. Six (67%) of the 9 interviewees emphasized the need to be self-aware and know one's own strengths and weaknesses. Three participants (B, D, & F) specifically referenced playing to one's strengths. Two participants (A & H) mentioned the need to step outside one's comfort zone to learn and develop interpersonal skills.

The behavioral references included sincerity, empathy, compassion, emotion regulation, general pleasantness, and treat everyone with respect. Six (67%) interviewees referenced the value of sincerity. Seven (78%) of the respondents emphasized the importance of empathy. Participant A stated you may "walk in that person's moccasins one day." Four (44%) of the respondents shared stories that highlighted the value of compassion in the workplace. Four (44%) participants referenced the importance of emotion regulation. Two of those four shared examples where maintaining their own emotions aided in a colleague regaining control over their emotions. Finally, six (67%) of the respondents discussed the importance of treating everyone with respect and acknowledging that everyone has value and three (33%) specifically mentioned the simple notion of being pleasant.

Examples of actions that exhibit interpersonal skills included engaging successfully in a conversation, adapting to match the needs or behaviors of a person or group, and reading and managing non-verbal cues. Six (67%) of the participants referenced engaging in successful conversations. Participant I mentioned the value of preparing for a difficult conversation in advance to increase the odds of being able to manage the direction and outcome of the

discussion. Four (44%) of the interviewees referenced adapting style to match the needs or behaviors of a person or group. Participant A provided a general example of an extrovert "dialing it down" to match the intensity of an introvert so as to have a successful interaction. Finally, four (44%) participants mentioned non-verbal cues, suggesting the importance of reading and reacting to facial expressions, body language expressing discontent or distress and tone of voice as well as one's own non-verbal cues. Participant E referenced reading team members' expressions of professional distress. Participant A mentioned managing a discontented team member who refused to participate in meetings. Participant E also mentioned the power of a handshake to support a personal connection.

Engagement activities is the last of the groups of interpersonal skills discussed by interview participants. Eight (89%) of the 9 participants specifically referenced the value of developing personal connections. Four (44%) respondents recommended achieving this personal connection by seeking common "touch points" or common ground, such as sports, culture, travel, children. Three (33%) interviewees specifically mentioned the benefits of eating together with colleagues or teammates as an opportunity to foster interconnectivity. Overall, seven (78%) of the respondents emphasized the value of taking the time and care to get to know colleagues or teammates.

Leadership/managing/coaching/mentoring. This researcher asked the interview participants to share their experiences with leadership skills implementation in their careers. Common messages conveyed in the responses included remarks about general leadership philosophy, discussion of leadership strategies, and specific examples of successful leadership accomplishments. Participant D remarked "leadership is entirely about the team, it's not about me at all."

Leadership philosophy guided many of the interview respondents' discussion of leadership in their careers. Five (56%) of the 9 participants referenced leading by example and drawing on past experiences. Participant G stated "when I was CEO, I was the highest paid person in the company. So I think I need to be the hardest working person." Participants B and C referenced changing industries and finding parallels in problems and solutions that could be applied to new situations. Five (56%) of the 9 interviewees discussed the mission to help others as a leader. Participant D specifically called the approach servant leadership.

Strategies for helping included being visible and accessible, being self-aware, and playing to one's strengths, taking the time to understand the values and goals of the individual team members, adapting leadership style and approach to fit the needs of the people, developing leaders, and mentoring. Participant H specifically referenced situational leadership in discussing adapting to meet the needs of the people. Participant A shared an example in which he identified a team member with potential and facilitated exposure to stretch opportunities to develop the individual's talents. Participant A concluded the example with the statement "in that case I was a leader because I developed a leader."

Participants discussed specific leadership activities. Six (67%) of the 9 specifically referenced the role of the leader as sharing and maintaining a vision and goals. Participant E referred to the process as maintaining focus and drive towards a North Star. Six (67%) of the participants shared that motivating individuals was critical to their leadership process. Participant F remarked that "it is amazing what people can accomplish when properly motivated." Participant I shared that supporting ownership and passion for one's projects played a major role in promoting commitment and personal investment. Participant D shared that despite having responsibility for an organization of nearly 3000 people, carving an hour out

every week to write notes to individuals, sometimes at the most junior level, commending recent accomplishments has a huge impact towards promoting motivation, commitment, and personal investment.

Strategic thinking/problem solving. This researcher asked interview respondents to discuss their experience with strategic thinking/problem solving in their professional careers. Eight (89%) of the 9 participants discussed examples that demonstrated a connectivity between actions, resources, goals, and investments. Participant D expressed the need to carve out time and space for effective strategic thinking. Participants B, C, D, F and G expressed the need to combine high level (big picture) and low level (tactical) thinking. Eight (89%) of the interviewees discussed assessing the situation and the available information and determining the most appropriate course of action. Participant F discussed "collecting all the dots" then looking at how they relate to each other, then drawing the connecting lines. Participant B specifically referenced the idea of engaging with information from the perspective of always trying to add value. Five (56%) of the participants referenced the need to always be open to modifying a long term vision in the wake of new information.

Teamwork. This researcher queried interview participants about their teamwork experience in their careers. Responses were expressed in three categories: types of teams, critical components of effective teams, and strategies for being an effective team member. All nine (100%) expressed variations on the sentiment that teamwork was essential in their professional careers.

Interview respondents provided examples of strategic teams, tactical teams, diverse teams, learning teams, and problem solving teams. Participants D and F specifically referenced

the importance of assembling a team with the objective in mind. Participants B and I discussed the importance of learning as a team.

All nine (100%) participants discussed two critical components of effective teams: acknowledgement of the value and strengths of the individual members of the team and a sense of accountability to each other, not just to the team leader. Four (44%) participants specifically discussed the importance of celebrating successes. Eight (89%) discussed the notion of constantly helping each other and succeeding as a unit. Participant E stated "in no scenario does the team fail, but you succeed."

Participants shared examples that demonstrated strategies for being an effective team member. Six (56%) participants emphasized the importance of a personal connection among team members. Four (44%) suggested eating together as a means to build comradery. Four (44%) discussed the importance of being both a leader and a follower, building sentiments of empathy for the individuals fulfilling both roles.

Willingness to learn and accept responsibility for decisions. This researcher asked the interview participants to discuss the role that willingness to learn and accept responsibility for decisions has played in their careers. The general sentiment was an acknowledgement that change is inevitable and not everything will go right. Six (67%) respondents referenced the importance of setting aside time to reflect and learn from mistakes. Participant E referred to the process as being intellectually honest with oneself. Participant F referred to the process as failing forward. Participant A advised that owning decisions and learning from mistakes should begin early in one's career. Participant A drew a parallel to walking a tightrope. Early in one's career, the rope is low and there is a net; practice will get you to the point where the rope can be 200 feet above the ground with no net.

Interview data saturation. This researcher put the interview transcript data through an iterative analysis process. Each transcript was analyzed after the interview was concluded and the transcript had been prepared for analysis. A code was created for each reference to a new discernable activity or component within each soft skill node. The participant letter was paired with each code. Subsequent references to a code received a notation for the additional participant letter. The sixth interview revealed no newly created codes, indicating potential data saturation. Therefore, this researcher conducted three additional interviews, for a total of nine interviews, to enhance credibility and to confirm data saturation. No new codes were generated in the three final interviews. This researcher determined that data saturation had been achieved and the interview data collection was closed.

Crosswalk

This researcher produced a crosswalk of the results of the study. A crosswalk is a method of synthesizing information from multiple sources (Liljamo et al., 2016). The synthesis of information produces a visual display used to efficiently and effectively draw connections and expand knowledge (Wojciechowski et al., 2016). Survey results summarizing the perceptions of the human resources professionals were crosswalked with the interview results illustrating the detail provided in the interviews with the late-career STEM professionals. The crosswalk also includes the original frequency of literature references that led to the inclusion of the soft skill in the survey. The crosswalk method is consistent with the goals of qualitative descriptive research to provide straightforward data descriptions as well as staying close to the data and true to the language of the participants. As such, the visual display succinctly organized the findings from both groups of informants using language from the participant interviews.

Table 8: Crosswalk

Soft Skill	**Literature**	**Survey**			**Interviews**	
Listed alphabetically	Frequency of reference	Average score (1-5) by category (nearest hundredth)				
		Level of Expertise	Frequency of Use	Career Criticality	Activities & Components	
Communication /presentation/ writing	14	4.41	4.54	4.39	Town Halls Training Team Meetings One-on-one meetings Reflective Social media Written Verbal Non-verbal Listening Presentation	Adapt to your purpose/audience/ context Strategic Tactical Translation between contexts Persuasion Recognition of accomplishments Clarification of details Interpretation of needs Information exchange Confidence Self-awareness
Ethics/Inspiring Moral Trust	2	4.38	4.35	4.22	Do the right thing Non-negotiable standards Represent at organizational level	Trust Authenticity Credibility
Flexibility/ Adaptability/ Resilience	5	4.32	4.30	4.31	Read/learn Stay curious Experience other perspectives Be prepared to change with new information	Learn from mistakes Be intellectually honest Fail forward Be confident
Interpersonal Skills	7	4.35	4.40	4.46	Seek personal connections Take time to find commonalities Adapt to match others' behaviors Converse with a tone to match the purpose Read/manage non-verbal cues Regulate emotions Bond	Self-awareness Know your strengths & weaknesses Be sincere Be empathetic Be pleasant Treat everyone with respect Show compassion Develop a breadth of interests Step outside your comfort zone

Soft Skill	Literature	Survey			Interviews	
Listed alphabetically	Frequency of reference	Average score by category (nearest hundredth)				
		Level of Expertise	Frequency of Use	Career Criticality	Activities & Components	
Leadership	12	4.50	4.54	4.50	Share a vision Set goals Develop leaders Mentor Be visible/ accessible Help others Servant leader Adapt to fit your people Draw on your experience Lead by example Advocate Recognize success	Motivate Play to your strengths Take time to understand team members' goals/values Promote commitment and investment Self-awareness of impact Ask good questions Transparency
Strategic Thinking	13	4.47	4.65	4.47	Consider actions, resources, investments, developments against goals Determine appropriate action Make/modify vision based on new information	Always seek to add value Carve out time and space for focused decisions Combine high and low level thinking
Teamwork	10	4.18	4.43	4.22	Heterogeneous teams Learning teams Be leader & follower Personal connections Help succeed together Group problem solving Team building	Diversity Accountability Engagement Celebration of successes Compassion Empathy Recognition of Strengths and weaknesses
Willingness to Learn/Accept Responsibility for Decisions	9	4.26	4.43	4.33	Fail forward Set aside time to learn from mistakes Read to learn	Begin early - own your decisions Go outside your comfort zone Know things will not always go right Change is constant

Soft Skills Origins Data

This researcher queried participants to reflect on their own soft skills origins. Table 9: Soft Skills Origins illustrates the summary of their articulated responses. The most common response, expressed by 7 of the 9 (78%) participants was their youth. References to the elements of their youth that contributed to the soft skills development included parents, teachers, and extracurricular activities such as team sports and scouting. Five of the 9 (56%) participants referenced practice and learning from failures when talking about their own soft skills development journey. Five interviewees (56%) cited non-STEM coursework, such as an MBA program, leadership training courses, or a non-STEM minor, as contributing to their soft skills development. Four participants credited a portion of their soft skills development to a mentor-mentee relationship. Three of the 9 (33%) participants stated their soft skills development was simply out of awareness of the value of soft skills or the necessity of mastering soft skills to achieve career goals. One respondent (B) remarked "I had to, in my family it was not an option." Another respondent (E) alluded to the fact that he would have started sooner if he had been made aware that soft skills were important. These results are consistent with Pool et al.'s (2014) suggestion that awareness is a key element to conscious soft skills development and Hoeschler et al.'s (2018) findings that soft skills develop through adolescence. These results also largely support the stance that STEM degree programs do not provide soft skills training.

Table 9: Soft Skills Origins

Soft Skills Origins	Respondents (%)
Youth	7 (78%)
Practice	5 (56%)
Non-STEM coursework	5 (56%)
Mentors	4 (44%)
Awareness/necessity	3 (33%)

Soft Skills Development Data

This researcher asked participants to consider their experiences and then make suggestions as to how they would recommend developing soft skills in young, future STEM professionals. Table 10: Soft Skills Development Recommendations illustrates the summary of their shared responses. The most common suggestions, expressed by 7 of the 9 (78%) participants were a mentor-mentee relationship and practice. Along similar lines to practice, 6 of the 9 (67%) participants suggested immersion. One participant (B) suggested immersion, drawing a parallel to immersion as the best way to learn a language. Five interviewees (56%) recommended starting early. One participant (F) suggested that he felt his soft skills were "already pretty well set up" by the time he got to college. Expanding on the notion of practice and immersion, five (56%) of the participants suggested mandatory experiences. One participant (F) suggested that mandatory experiences would force individuals to break bad habits and reduce the ability to "dodge experiences that take you out of your comfort zone." Finally, 4 of the 9 (44%) interviewees suggested starting with awareness: awareness of the value of soft skills, awareness of one's own soft skills expertise, and awareness that soft skills can be developed. One participant (E) drew a parallel to capacity utilization, suggesting that perhaps all people do not have the same maximum potential capacity for soft skills expertise, but striving to maximize one's personal capacity begins with awareness.

Table 10: Soft Skills Development Recommendations

Soft Skills Development Recommendations	Respondents (%)
Mentor	7 (78%)
Practice	7 (78%)
Immersion	6 (67%)
Start early	5 (56%)
Mandatory exposure/experience	5 (56%)
Awareness	4 (44%)

Summary

The purpose of this qualitative descriptive study was to explore the implementation of soft skills that are critical to the success, as defined by promotability and long-term career trajectory, of STEM professionals from the perspective of STEM professionals and those with whom they work closely. This researcher sought to gather the perspectives of human resources professionals with knowledge of and perspective on the promotable characteristics of STEM professionals regarding the soft skills that are critical to their success. STEM professionals were then asked to reflect on their own experiences with soft skills for the purpose of co-constructing a newly conceived collection of soft skills knowledge pertaining specifically to the career success of STEM professionals.

Research provides a consensus that, regardless of field, employers expect STEM professionals to exhibit some measure of cultivated soft skills (Akdere et al., 2019; Lavy & Yadin, 2013; McGunagle, 2016; McGunagle & Zizka, 2018). This researcher sought to determine what soft skills, based on value and applicability, are critical to advancing the success, as defined by promotability and long-term career trajectory, of a STEM professional. The survey administered to human resources professionals was designed to collect their insights on the soft skills that are critical to late-career STEM professionals. The collective expertise of the survey participants supported the general statement that all soft skills are important; however, the results narrowed the very broad field of soft skills down to eight critical soft skills for the STEM professional. The eight soft skills are: communication/presentation/writing, ethics/inspiring moral trust, flexibility/resilience/adaptability, interpersonal skills, leadership/managing/coaching/mentoring, strategic thinking/problem solving, teamwork, and willingness to learn and accept responsibility for decisions.

Social constructionism relies on contextually constructed knowledge and its representation through language (von Glasersfeld, 1989). The interviews conducted in this study provided the opportunity for late-career STEM professionals to share their socially constructed knowledge with this researcher. The resulting crosswalk (Table 8) represents a newly conceived and co-constructed collection of soft skills knowledge pertaining specifically to the career success of STEM professionals.

Finally, the study included a tertiary exploration of soft skills training to further understand the origins of the skills in late-career STEM professionals. The soft skills development recommendations of mentoring, practicing, immersion, experience, exposure, and awareness provided by the interview participants indicate agreement with the notion expressed by Gibert et al. (2017), Fixsen and Ridge (2018), and de Ridder et al. (2014) that the majority of soft skills are learnable to some extent through practice. Participants frequently mentioned gaining experience outside one's comfort zone as a key launching point for learning. Several of the participants used the terms "mandatory" and "forced". Ultimatum-related terminology could imply that compulsory experiences in an academic setting may be appropriate measures for broadening the experiences available to future STEM professionals.

The fourth chapter explained the data collection and analysis of the study and presented the results. The fifth, and final chapter, interprets the findings and discusses the implications of the study results. The chapter continues with recommendations for action and further study. Finally, the chapter will conclude with an articulation of the significance of the study.

CHAPTER 5

CONCLUSION

The purpose of this qualitative, descriptive study was to explore the implementation of soft skills that are critical to the long-term career success of STEM professionals. Soft skills are widely recognized as contributing to an individual's success in career and life (Bolli & Hof, 2018; Shukla & Kumar, 2017). STEM professionals have long been criticized for lacking soft skills (McGunagle & Zizka, 2018), and some studies have shown that STEM professionals are not exempt from the need for soft skills in the workplace (Gibert et al., 2017; Donaldson, 2017). Therefore, a key area of focus for this study was what soft skills, based on value and applicability, are critical to advancing the promotability and career longevity of STEM professionals. As such, this research study explored the soft skills implementation of late-career STEM leaders as perceived by human resources professionals. Additionally, interview data demonstrated the value of soft skills as perceived by late-career STEM professionals.

This study addressed two research questions. The primary research question was: What components and activities of identified soft skills are most relevant to the professional STEM setting? The secondary research question was: What soft skills, based on value and applicability, are critical to advancing the success, as defined by promotability and long-term career trajectory, of a STEM professional? Additionally, the study included a tertiary exploration of existing soft skills training to further understand the origins of the skills in late-career STEM professionals.

The results of the study emanated from two data collection procedures. First, a survey was administered to human resources professionals with succession planning experience for STEM professionals. The survey asked human resources professionals to rank STEM

professionals' implementation of 23 soft skills based on three categories: level of expertise, frequency of use, and career criticality. The survey portion of this study narrowed the vast list of soft skills to eight critical skills: communication/presentation/writing, ethics/inspiring moral trust, flexibility/resilience/adaptability, interpersonal skills, leadership/managing/coaching/mentoring, strategic thinking/problem solving, teamwork, and willingness to learn and accept responsibility for decisions. The survey results provided the focus for the second data collection process: interviews with late-career STEM professionals. The late-career STEM professionals were asked to share their experiences with the implementation of the eight critical soft skills and the role they played in their career success. This researcher generated a crosswalk matrix (see Table 8) of the survey and interview results to provide a visual representation of the qualitative data collected.

Interpretation of the findings

This researcher asked survey participants to rank 23 soft skills in three categories: level of expertise, frequency of use, and career criticality. Overall, all soft skills received an average ranking of 3.33/5 or higher in all categories. This overall result is congruent with Lavrysh's (2016) assertion that soft skills are the most critical skills for the global job market. This researcher sought to use the survey results to focus the discussions in the second phase of the data collection. Therefore, the survey results were analyzed to determine the skills that received the highest average ranking in all three categories. The survey portion of this study narrowed the vast list of soft skills to eight critical skills: communication/presentation/writing, ethics/inspiring moral trust, flexibility/resilience/adaptability, interpersonal skills, leadership/managing/coaching/mentoring, strategic thinking/problem solving, teamwork, and willingness to learn and accept responsibility for decisions. These eight soft skills concurrently

ranked the highest in three categories: level of expertise, frequency of use, and career criticality. This researcher deemed the resulting list of soft skills to be the foundation for the interview phase of data collection and the answer to the research question: What soft skills, based on value and applicability, are critical to advancing the success, as defined by promotability and long-term career trajectory, of a STEM professional?

The interviews conducted in this study provided the opportunity for late-career STEM professionals to share their socially constructed knowledge with this researcher. Each participant was asked to discuss the eight soft skills and the role they have played in career success and promotability. All nine interviewees (100%) expressed significant overlap and interplay between the different soft skills.

The interconnectivity of the soft skills was evident in all (100%) participants' explanations of understanding of the soft skill as well as shared examples. For example, communication and strategic thinking were interwoven in leadership examples, interpersonal skills and trust were evident in teamwork descriptions, flexibility/adaptability/resilience was referenced in communication and leadership examples, and a willingness to learn and accept responsibility for decisions was heavily represented in leadership, teamwork and ethics/inspiring moral trust discussions.

Ultimately, the interview participants provided robust details regarding the activities and components of soft skills implementation in the STEM professionals' career. The results were organized into a matrix to provide an organized and detailed account of the study results. The culminating crosswalk (Table 8) represents a newly conceived and co-constructed collection of soft skills knowledge pertaining specifically to the career success of STEM professionals and

answering the primary research question: What components and activities of identified soft skills are most relevant to the professional STEM setting?

The study included a tertiary exploration of soft skills training. The exploration sought to further understand the origins of the skills in late-career STEM professionals. Furthermore, the discussion addressed ideas for soft skills development in future STEM professionals.

The majority (78%) of interview participants attributed their soft skills development to experiences in their youth or specifically their adolescence. The next most prevalent responses were practice, non-STEM coursework, mentorships, and awareness. These results are consistent with Pool et al.'s (2014) suggestion that awareness is a key element to conscious soft skills development and Hoeschler et al.'s (2018) findings that soft skills develop through adolescence. These results also largely support the stance that STEM degree programs do not provide soft skills training. References to non-STEM coursework suggests that complementary coursework, such as a minor in communications, business, psychology, etc. could be beneficial to undergraduate STEM discipline students.

Interview participants recommended mentoring, practicing, immersion, experience, exposure, and awareness for the development of soft skills in future STEM professionals. The recommendations were consistent with the notion expressed by Gibert et al. (2017), Fixsen and Ridge (2018), and de Ridder et al. (2014) that the majority of soft skills are learnable to some extent through practice. Participants frequently mentioned gaining experience outside one's comfort zone as a key launching point for learning. Several of the participants used the terms "mandatory" and "forced". Ultimatum-related terminology could imply that compulsory experiences in an academic setting may be appropriate measures for broadening the experiences available to future STEM professionals.

Implications

Soft skills are widely recognized as contributing to an individual's success in career and life (Bolli & Hof, 2018; Shukla & Kumar, 2017). Research provides evidence of the significant role that soft skills play in the employability and career progression of all professionals (Scorza et al., 2016; Shukla & Kumar, 2017). STEM professionals have long been criticized for lacking soft skills (McGunagle & Zizka, 2018). Further, a lack of soft skills negatively impacts the professional effectiveness of the STEM employee regardless of the individual's level of hard skill knowledge (Akdere et al., 2019).

Institutions of higher education have largely accepted that employability is one of the primary measures of university outcomes (Clarke, 2018). As such, universities aim to incorporate skills associated with employability. Demand for students to enter STEM-related careers is fast growing and projected to increase (Fayer et al., 2017). Reviews of syllabi from universities nationwide reflect a singular focus of higher education STEM coursework on technical, hard skills with only peripheral treatment of soft skills, despite the core value of soft skills in the job market for which the programs are designed to prepare students (Börner et al., 2018). Therefore, an increased number of students are entering and leaving STEM degree programs without receiving the soft skills training that the marketplace demands.

This study included a survey and an interview. The survey results showed that all soft skills are important in the careers of STEM professionals, consistent with the literature. The STEM professionals who participated in the interview portion of the study attributed their acquisition of soft skills largely to experiences in their youth, non-STEM coursework, and professional mentors. This finding is consistent with the research that shows STEM degree programs are largely void of soft skills training. The absence of soft skills training in STEM

degree programs provides an opportunity to develop or enhance soft skills training within the STEM discipline curricula at the undergraduate level. Further exploration into the youth experiences of successful STEM professionals may also uncover opportunities for early intervention and soft skills training at the K-12 and community levels.

The crosswalk of data representing the findings in this study may provide a possible foundation for transformation in STEM discipline degree programs. Institutions can use this study to support policy change towards providing soft skills training in STEM discipline degree programs. Institutions can use the crosswalk data to support curriculum development for incorporation into STEM discipline degree programs. Or institutions can use this study to begin further investigation into the soft skills training options for their student population.

Recommendations for Action

The purpose of this qualitative, descriptive study was to explore the implementation of soft skills that are critical to the long-term career success of STEM professionals. The results of the study can be used to benefit the development of future STEM professionals with awareness and targeted experiences. Individuals can seek specific opportunities to practice and develop the identified soft skills. Organizations and Universities can expand professional development and undergraduate or graduate curricula to promote practicing and developing soft skills.

The research findings from this study yielded data that may assist the STEM educational community with the identification of soft skills components and activities for overt training development. The findings may also assist individual future STEM professionals by creating awareness of soft skills value and identification of soft skills components and activities for practice and development. Furthermore, the results of this study might assist organizational

leaders in the decision to implement soft skills training in STEM education programs. This researcher recommends the following actions based on the study findings:

- STEM education administrators should adopt a policy affording overt soft skills training for all STEM discipline degree programs.
- STEM education curriculum developers should develop meaningful learning experiences to promote soft skills development in STEM discipline degree students.
- University career centers could develop strategies to build awareness of soft skills value among STEM discipline degree students.
- University career centers could develop strategies to support students in documenting soft skills acquisition in resume documents.
- Individual STEM students should act on their awareness of soft skills value to their career and seek opportunities to practice and develop their soft skills.

Recommendations for Further Study

Study findings may contribute to existing and future research regarding soft skills and the careers of STEM professionals. Opportunities exist to expand upon the depth and breadth of the study. Soft skills are widely recognized as contributing to an individual's success in career and life (Bolli & Hof, 2018; Shukla & Kumar, 2017). STEM professionals have long been criticized for lacking soft skills (McGunagle & Zizka, 2018). Therefore, the role of soft skills in the careers of STEM professionals as well as soft skills training for all individuals, regardless of discipline focus are foundations worthy of further investigation.

A limitation in this study was the small sample size. Future researchers may include more STEM professionals for interviewing or target specific industries. Subsequent research might also expand the scope of soft skills explored.

Researchers could focus on the soft skills capabilities based on demographics, such as gender, culture, socioeconomics, geography, or education level. This researcher identified that a common element in the soft skills development of study participants was experiences during their youth. Future researchers could delve into the soft skills development during adolescence or more broadly the K-12 educational years.

Researchers could also seek to implement soft skills training curriculum in STEM discipline degree programs. A longitudinal study could track soft skills development with targeted support. The subsequent career success could also be examined.

Conclusion

Research has shown a well-documented marketplace demand for soft skills in all fields, and specifically in STEM fields (McGunagle & Zizka, 2018; Shukla & Kumar, 2017). Globally, efforts are being made to encourage increasing enrollments in STEM degree programs (McGunagle & Zizka, 2018). Yet, research (Börner et al., 2018) also shows that STEM discipline degree programs do not overtly focus on the soft skills training that will ultimately contribute to much of these students' career success. This study explores the specific soft skills implementation of late-career STEM professionals who have experienced promotability and a long-term career trajectory. The crosswalk matrix produced provides tangible, organized soft skills and soft skills activities and components. The crosswalk is presented in a familiar format for educators with experience developing educational outcomes, learning objectives, and learning activities. The study findings cite soft skills development in youth and in professional settings, leaving an open opportunity for a transformation in undergraduate STEM discipline education.

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APPENDIX A – Survey Instrument

Do you have experience as a human resources leader supporting/observing succession planning discussions regarding business professionals with known or believed backgrounds in STEM (science, technology, engineering, mathematics) disciplines?	◯ Yes ◯ No
Which best describes the total number of years of human resources experience you have to date?	◯ 0-2 ◯ 2-5 ◯ 5-10 ◯ 10-15 ◯ 15+
Which best estimates the total number of individuals for whom you have participated in succession planning sessions?	◯ 0-5 ◯ 6-15 ◯ 16-25 ◯ 26-50 ◯ 51+
Which STEM discipline most closely describes the background of the professionals with whom you work? (select all that apply)	☐ S (science) ☐ T (technology) ☐ E (engineering) ☐ M (mathematics) ☐ unknown
Which best describes the type of team or department with whom you work? (select all that apply)	☐ Research & Development ☐ IT ☐ Engineering ☐ Manufacturing/Operations/Supply Chain ☐ Data Analytics ☐ Commercial Leaders ☐ Strategy/Business Development ☐ Health & Safety ☐ Quality & Regulatory ☐ Other
For what level position(s) have you participated in succession planning sessions? (select all that apply)	☐ Individual contributor ☐ Supervisor ☐ Director ☐ VP ☐ C-Suite/Board

LEVEL OF EXPERTISE

Based on your experience, rate the level of expertise required of professionals with known or believed backgrounds in STEM disciplines and holding positions at the director level or above for each soft skill listed.

	Little to No Expertise Required	Minimal Expertise Required	Moderate Expertise Required	Moderate to High Level of Expertise Required	High Level of Expertise Required
Ability to gather and synthesize data	○	○	○	○	○
Communication (oral/written/presentation)	○	○	○	○	○
Creativity	○	○	○	○	○
Cultural and diversity awareness	○	○	○	○	○
Customer service	○	○	○	○	○
Emotion regulation/self-control	○	○	○	○	○
Enterprise/entrepreneurship/initiative	○	○	○	○	○
Ethics/inspiring moral trust	○	○	○	○	○
Flexibility/resilience/adaptability	○	○	○	○	○
Interpersonal skills	○	○	○	○	○
Leadership/managing/mentoring	○	○	○	○	○
Meeting management/facilitation/organizing/planning	○	○	○	○	○
Negotiation/conflict resolution	○	○	○	○	○
Networking/building effective relationships	○	○	○	○	○
Persistence	○	○	○	○	○
Proactivity	○	○	○	○	○
Reliability/responsibility	○	○	○	○	○
Self-confidence/independence/motivation	○	○	○	○	○
Social skills	○	○	○	○	○
Strategic thinking/problem solving	○	○	○	○	○
Teamwork (collaboration)	○	○	○	○	○
Time management	○	○	○	○	○
Willingness to learn and accept responsibility for decision making	○	○	○	○	○

FREQUENCY OF USE

Based on your experience, rate the frequency with which professionals, with known or believed backgrounds in STEM disciplines and in positions at the director level or above, are called to enact each soft skill listed.

	Very frequently	Frequently	Occasionally	Rarely	Very rarely
Ability to gather and synthesize data	○	○	○	○	○
Communication	○	○	○	○	○
Creativity	○	○	○	○	○
Cultural and diversity awareness	○	○	○	○	○
Customer service	○	○	○	○	○
Emotion regulation/self-control	○	○	○	○	○
Enterprise/entrepreneurship/initiative	○	○	○	○	○
Ethics/inspiring moral trust	○	○	○	○	○
Flexibility/resilience/adaptability	○	○	○	○	○
Interpersonal skills	○	○	○	○	○
Leadership/managing/mentoring	○	○	○	○	○
Meeting management/facilitation/organizing	○	○	○	○	○
Negotiation/conflict resolution	○	○	○	○	○
Networking/building effective relationships	○	○	○	○	○
Persistence	○	○	○	○	○
Proactivity	○	○	○	○	○
Reliability/responsibility	○	○	○	○	○
Self-confidence/independence/motivation	○	○	○	○	○
Social skills	○	○	○	○	○
Strategic thinking/problem solving	○	○	○	○	○
Teamwork (collaboration)	○	○	○	○	○
Time management	○	○	○	○	○
Willingness to learn and accept responsiblity for decision making	○	○	○	○	○

CRITICALITY

Based on your experience, rate the level of career criticality of each soft skill with respect to the careers of professionals, with known or believed backgrounds in STEM disciplines and in positions at the director level or above.

	Little to no criticality	Minimally critical	Moderately critical	Highly critical	Career critical
Ability to gather and synthesize data	○	○	○	○	○
Communication	○	○	○	○	○
Creativity	○	○	○	○	○
Cultural and diversity awareness	○	○	○	○	○
Customer service	○	○	○	○	○
Emotion regulation/self-control	○	○	○	○	○
Enterprise/entrepreneurship/initiative	○	○	○	○	○
Ethics/inspiring moral trust	○	○	○	○	○
Flexibility/resilience/adaptability	○	○	○	○	○
Interpersonal skills	○	○	○	○	○
Leadership/managing/mentoring	○	○	○	○	○
Meeting management/facilitation/organizing	○	○	○	○	○
Negotiation/conflict resolution	○	○	○	○	○
Networking/building effective relationships	○	○	○	○	○
Persistence	○	○	○	○	○
Proactivity	○	○	○	○	○
Reliability/responsibility	○	○	○	○	○
Self-confidence/independence/motivation	○	○	○	○	○
Social skills	○	○	○	○	○
Strategic thinking/problem solving	○	○	○	○	○
Teamwork (collaboration)	○	○	○	○	○
Time management	○	○	○	○	○
Willingness to learn and accept responsibility for decision making	○	○	○	○	○

Based on your experience are there any soft skills that were not on the list that should have been included? Please list and/or explain.

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APPENDIX B: Interview Guide

INTERVIEW:
I'd like to begin the interview by discussing the components and activities of the skills ranked highest in the survey results, then discuss soft skills development and end with your thoughts on the accuracy of the results and any additions or deletions you might want taken into consideration.

1. **Communication.** There are many components to this soft skill category. Can you discuss examples of the kinds of communications you engage in and how they play a role in your long term career success?

2. **Leadership.** Consider how you use this skill and how it can positively impact successful interactions. Can you please share an example or examples of this soft skill and its components playing a key role in your professional interactions and promotability?

3. **Interpersonal Skills.** Can you please share an example of how the components of this soft skill may have played a key role in your promotability?

4. **Strategic Thinking.** Can you please share an example of this soft skill and its components playing a key role in your professional interactions and promotability?

5. **Teamwork.** How have you found this skill to play a critical role in your career?

6. **Willingness to learn and accept responsibility for decisions, ethics (inspiring moral trust), and flexibility/adaptability/resilience.** Can you speak about each of these, their components and activities and how you have seen or experienced career success in relation to them?

7. Consider your own soft skills and where they came from.
    a. To what would you attribute your personal soft skills development process?
    b. What is the ideal arena for developing soft skills in future STEM professionals?

8. One could say there are many roads to Chicago, hence there are an infinite number of successful combinations of skills and capabilities, but now that you've called to mind so many soft skills, capabilities and activities, if you could imagine one best possible scenario:
    a. How would you develop young STEM professionals' soft skills?
    b. What would you want them to know in order to promote long-term career success and promotability?