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Exemplary High School Teachers' Practice of Embedding Career Exploration in STEM Curricula

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This is to certify that the doctoral study by

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has been found to be complete and satisfactory in all respects,
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Walden University
2023

Abstract

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MEd, University of Massachusetts Boston, 2011

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Dissertation Submitted in Partial Fulfillment

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Abstract

The number of individuals entering the workforce with an interest in science, technology, engineering, and mathematics (STEM) careers is low across the United States. Although exposure to STEM careers through the intentional integration of career exploration can positively influence career choice, most student exposure to STEM career exploration occurs in after-school programs and dedicated summer programs but is limited in the general education curricula. The purpose of this study was to understand how and why high school STEM teachers embed career exploration into curricula even though local and national standards do not include these objectives. The conceptual framework for this study is grounded in a combination of constructs from social cognitive career theory and the ideas of situated cognition. This qualitative embedded case study used interview responses and lesson plan artifacts from nine award-winning teachers who embed STEM career exploration activities into curriculum to understand the instructional practices and the perceptions that drive teachers to include these practices. Embedded cases were created from coded interview responses and artifact content. Results confirm the connection between the use of authentic activities and STEM career exploration. Additional findings suggest a continuous connection between authentic activities and teacher-led instructional practices. This study also identified two constructs of social cognitive career theory, self-efficacy, and outcome expectations, as reason for embedding STEM career exploration in curricula. Identifying the reasons for the conscious instructional choices of STEM teachers is instrumental in supporting high school STEM teachers in their work, and ultimately influencing student STEM career choice and career retention in a positive way.

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Dedication

I dedicate this dissertation to the young people who have touched my life in many ways. Whether you refer to me as Cara, Toto, or Ms. P, I hope you know that I learn as much from you as you (I hope) learn from me. Completing this dissertation is the end of a goal, but it also marks a new beginning in my learning journey. I hope all the young people in my life recognize the importance of curiosity, exploration, and learning. Learning is a life-long experience, so be sure to seek every opportunity to increase your knowledge about yourself and the extraordinary people, places, and things throughout our world.

I also dedicate this dissertation to teachers navigating the ever-changing world of education with grace, professionalism, and dedication beyond measure. If I have learned anything during this process, no matter how different one classroom might look from another, there are similarities in the hard work, commitment, and love of the teachers in each room. Teachers, know you are not alone in wanting to do what is best for your students. Keep demanding that our classrooms are where *all* students have access to the best possible learning environment and, most importantly, to your kindness and support. Thank you for all that you do.

Acknowledgments

In the lyrics to "Just Breathe" by Pearl Jam, Eddie Vedder sings, "Oh, I'm a lucky man to count on both hands the ones I love." I am a lucky woman because I can do the same. The support and guidance of the ones I love help me pursue my dreams. My parents, Bill and Terry, always encourage me and never doubt my abilities. Mom and Dad, thank you for your support and love. To my sister Erin and niece Ella, thank you for keeping me real and always believing in me.

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I must also thank my NQHS family for always staying positive during this journey and Noreen for reviewing my work. To my TOY family, thanks for your wealth of knowledge and encouragement. Sharing this doctoral journey with many of you has added another facet to our professional relationship that I will forever value.

Finally, I extend my deepest appreciation to my dissertation committee. Dr. Hough, your availability, patience, professionalism, and unwavering support is an inspiration. I am thankful for your emphasis on learning and growth throughout this process. Thank you, Dr. Patrick, for your valuable feedback and endorsement, and Dr. Williams, for serving as my URR and providing comments on my proposal. I wish you all continued success in your work.

Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction to the Study

A committee convened by the National Academies of Sciences, Engineering, and Medicine published a report calling for the national need to prioritize improved, equitable science learning. The committee recommended deliberate reframing of the teaching and learning provided in STEM education (The National Academies Press, 2021). The report emphasized the need for a well-prepared, diverse teaching workforce and providing high-quality learning opportunities to increase students' abilities to make sense of the world and access STEM opportunities (The National Academies Press, 2021). Similar calls for change in STEM education included increasing student exposure to STEM careers through instructional strategies, exposure to STEM role models, and the use of socially relevant problems or career-based scenarios within the existing curriculum (Archer et al., 2020; Boyington, 2018; Drymiotou et al., 2021; Sasson, 2020). Though the need for change in STEM education exists, several factors decrease the likelihood of significant changes to the curriculum. A lack of student interest in STEM careers, teacher preparation, and training related to STEM career exploration, and the lack of access to information on how the implementation of career exploration occurs in STEM curriculum creates a barrier to the successful realization of STEM education transformations.

In the following chapter, I summarize current literature as a background to integrating career exploration in STEM instruction. Additionally, I provide an overview of the study, including the problem, purpose, research questions, conceptual framework, and nature of the study. In addition, I present operational definitions relevant to the study, assumptions, delimitations, and limitations, and conclude by discussing the significance of the study.

Background

Low Projected Interest in STEM Careers

In the next 10 years, STEM careers will increase faster than in non-STEM fields (U.S. Bureau of Labor Statistics, 2020; Zilberman & Ice, 2021). Although the availability of STEM careers will increase, the number of individuals prepared to begin working in these positions is low. In a National Center for Education Statistics report, less than 10% of first-year high school students surveyed in the 2009 High School Longitudinal Survey intended to pursue STEM careers after high school (Holian & Kelly, 2020). The need to better understand the career interests of students influenced the development of a STEM career interest survey (STEM-CIS) by Kier et al. (2014) and a STEM career interest scale by Kizilay et al. (2020). Though these measurement tools are available for use at both the middle school and high school levels, few studies exist that utilize these measurement tools to supply data to drive change in STEM education. Current research indicates the need to increase student interest in STEM careers and to understand the factors influencing career choices in STEM fields (Blustein et al., 2020; Murcia et al., 2020; Srikoom et al., 2018).

Even after college students complete a STEM degree, only some are pursuing jobs in these areas. The U.S. Census Bureau's 2019 American Community Survey found that of the 50 million employed college graduates aged 25 to 64, only 37% reported a bachelor’s degree in science or engineering (U.S. Census Bureau, 2019). Of these graduates, only 14% worked in STEM occupations (Cheeseman & Martinez, 2021). The lack of understanding of the influences of career choice and STEM career retention significantly impacts STEM career exploration and curriculum reform.

Career Choice Linked to Instructional Practice

Emerging research in career choice and interest identifies a positive link to teacher support, active-learning instructional models, career-related activities, and informal education programs that target STEM career development (M. D. Cohen et al., 2019; Gottfried et al., 2016; Hatisaru, 2021; Holmes et al., 2018; Li et al., 2021; Nugent et al., 2015; Pereira, 2018; Sasson, 2020). Curricula that explore current problems, use science practices, and purposefully integrate career components, such as educational requirements and job descriptions, help increase student awareness of potential STEM careers (The National Academies Press, 2021; Virtič & Šorgo, 2022). Exposure to STEM careers through the intentional, recurring, systemic integration of career exploration in the STEM curriculum can increase student career awareness and ultimately influence career choice (Li et al., 2021; Sahin et al., 2018; Schwartz et al., 2018). Furthermore, consistent exposure to STEM career options is valuable for increasing STEM career interest for marginalized groups (Brigandi et al., 2020; Gottlieb, 2018; Kurban & Cabrera, 2020; Nguyen et al., 2021; Stevens et al., 2016; Zaza et al., 2019).

Although research demonstrates the instructional practices used to influence STEM career choices and interests, many teachers do not have adequate training for providing this type of support to students (Ardura et al., 2021; Blustein et al., 2020; Geesa et al., 2021; Kartini & Widodo, 2020; van den Hurk et al., 2019). An early survey of over 70 high school science teachers and other science and career education experts noted that participants conveyed concern over the lack of preservice training related to promoting STEM careers in the classroom (C. Cohen et al., 2013). This opinion is still a concern for STEM education. In current research studies, veteran teachers identified the lack of available training, either through professional development (PD), continued education, and collaboration with peers, as a barrier to the successful integration of explicit career exploration in the curriculum (Kartini & Widodo, 2020; Kelley et al., 2020; Margot & Kettler, 2019).

Lack of Research Related to the Problem

Research points to the importance of STEM career exploration in middle school STEM curricula and high school afterschool programs (Kier & Blanchard, 2021). However, research specific to high school STEM career curricula is limited. Additionally, there is a lack of research that addresses how and why educators foster interest in a STEM career within their instructional practices when specific standards are not indicated in a STEM curriculum (Srikoom et al., 2018). Understanding the factors that influence teacher inclusion of STEM career exploration in the classroom can provide insight into curriculum changes to enhance student exposure to STEM career options. This curriculum change can, in turn, positively impact students' interest levels in pursuing STEM careers, particularly marginalized students who are underrepresented in STEM fields (Kartini & Widodo, 2020; Peterson, 2020; Soobard et al., 2021).

Problem Statement

Industry representatives, parents, guidance counselors, and teachers encourage high school students to pursue STEM careers (Craig et al., 2018; Sherman-Morris et al., 2019; Zilberman & Ice, 2021). However, national standards, such as those for science and engineering, do not include specifics on embedding career exploration into STEM curricula (Next Generation Science Standards [NGSS] Lead States, 2013). Teachers surveyed by C. Cohen et al. (2013) specifically identified the lack of standards related to career exploration and the lack of science careers topics on statewide student exams as a missed opportunity for imparting career information. Changing curricula to focus on career-exploration learning objectives is necessary to increase student interest in STEM careers (Reinhold et al., 2018). Because standards do not mandate the teaching of or about STEM careers, there is little information about how and why high school teachers might embed career exploration in their STEM classrooms. Understanding both instructional practices and the perceptions that drive teachers to include these practices is instrumental in supporting high school STEM teachers in their work. Current studies indicate the need to increase interest in STEM careers and evaluate the link between career choice and instructional practice (Avargil et al., 2020; Blotnicky et al., 2018; Drymiotou et al., 2021; van den Hurk et al., 2019). Despite the need to increase the number of students pursuing STEM degrees and careers, national standards, such as the NGSS, do not include specifics on how to embed career exploration into high school STEM curricula (NGSS Lead States, 2013). Moreover, there is a lack of research on how teachers might include career exploration into their instructional practice in formal education settings.

Purpose of the Study

My qualitative study was conducted to understand how and why high school STEM teachers embed career exploration into STEM curricula. STEM career exploration and career choice are decision-making processes influenced by multiple factors rather than a single, planned behavior (Kurban & Cabrera, 2020). This thinking matches the overarching constructivist notion that the concept of learning includes both the individual experience (individual or cognitive constructivism) and the experiences of an individual with other people (social constructivism; Elliott et al., 2000). The constructivist theory generates implications for knowledge development and how individuals learn the material in an educational setting (Duncan & Redwine, 2019). Therefore, researchers should consider the roles of formal education experiences that shape the development of career interests in students. STEM curricula that focus on the integration of context, practice, and modeling can directly influence a student's future career choices (Nguyen et al., 2021; Peterson, 2020; Rocker Yoel & Dori, 2021; Shah et al., 2021; van den Hurk et al., 2019). The contrast between the need for specific learning experiences to enhance STEM career interest and the lack of instructional standards related to career exploration justifies the need to investigate further how and why high school STEM teachers are choosing to add these items to their curriculum.

Research Questions

The following qualitative research questions and subquestions explore the practices and perceptions of high school STEM teachers who embed career exploration in their established curricula:

- RQ 1: What are teachers' experiences implementing classroom career exploration strategies?
  - SQ 1: How do STEM teachers embed career exploration in their curricula?
  - SQ 2: What instructional strategies related to career exploration do high school STEM teachers include in their lesson plans?
  - SQ 3: What barriers limit the inclusion of career exploration in STEM curricula?
- RQ 2: Why do STEM teachers embed career exploration in their curricula?

Conceptual Framework

I combined constructs from social cognitive career theory (SCCT; Lent et al., 1994) and situated cognition theory (Brown et al., 1988) to present a conceptual framework that supports a teacher’s choice to incorporate career exploration in the STEM classroom curriculum. This synthesis of theories also serves as a framework to create data collection tools to understand that choice.

The first theory, SCCT, provides context for the roles of personal, contextual, and experiential factors in influencing student career choice behavior (Lent et al., 1994). The SCCT model expands on the foundational ideas of Bandura’s (1986) social cognitive theory (SCT) to explain factors such as background context, social supports and barriers, and personal inputs like gender, race, ethnicity, and predispositions that can impact career interests, goals, and actions (Lent et al., 1994, 2010). Viewed through the lens of SCT and, more specifically, SCCT, classroom experiences, and teacher support can influence an individual's goals or career choice by positively affecting their self-efficacy beliefs and outcome expectations about that career (Beier et al., 2019; Kang et al., 2021; Lent et al., 1994; A. Şahin et al., 2018). SCCT can specifically target STEM career exploration by showing how continued exposure to STEM careers both increases knowledge in the activities related to different STEM careers and aids in sustaining or increasing student interest in the STEM professions (Beier et al., 2019; Emembolu et al., 2020; Kang et al., 2021; Lent et al., 1994; Mitsopoulou & Pavlatou, 2021). SCCT provides a framework to identify STEM teachers as external social supports that influence the development of STEM career outcomes.

Interest in a career is related to receiving new knowledge of jobs through external inputs and an individual's participation in specific activities. These activities provide contextual transfer of knowledge to encourage interest and future participation. This theoretical construct forms the foundation for Brown et al.'s (1988) idea of situated cognition theory. Though situated cognition shares a similar conclusion with the ideas of Lave and Wenger's (1991) situated learning theory, the tenets of situated cognition specifically explored the notion that knowledge is acquired by embedding subject matter and real-life context into the learning situation (Brown et al., 1988). Based on this description, STEM career exploration in school should include the subject content provided by teachers and also the exposure to careers to contextualize the information.

Knowledge of the experience of different STEM careers provides context for learners to refer to in future scenarios and apply to their understanding of career outcomes (Hacioğlu & Gülhan, 2021; Minshew et al., 2021).

Given the emphasis on contextual and experiential learning of both SCCT and situated cognition, there is reason to believe that the STEM teachers' career-related instructional practices and authentic learning opportunities positively influence student self-efficacy and career interest. This conceptual framework lays the groundwork for this study and can also be used to analyze STEM teacher use and perception of related STEM curricula and instructional practices. Combining concepts from two theories to focus on the curriculum and instructional practices that thoughtfully include authentic or situational learning opportunities identifies the focus of the study and provides a basis for the development of the research and interview questions. Questions related to understanding teacher perceptions and decisions can result in a better understanding of the determining factors that influence students' learning experiences and how these experiences may influence future career decisions.

Nature of the Study

Viewing the problem through the conceptual lens of SSCT and situated cognition, this study rests on the premise that experience and exposure to STEM careers help increase student interests and, ultimately, the pursuit of STEM careers. According to researchers, teachers are one of the essential factors that influence STEM career choice interests in students (Kartini & Widodo, 2020; Nguyen et al., 2021). A lack of formational experiences provided by STEM teachers is a detriment to STEM education and the future recruitment and retention of STEM career personnel. My qualitative study provides an understanding of the considerations and actions of high school STEM teachers who purposefully embed STEM career exploration in their curriculum. The study followed an embedded case study methodology to consider individual participants' thoughts and actions in a specific context or case (Budiyanto et al., 2019; Scholz & Tietje, 2002; Yin, 2017). I defined the case for this study as embedding career exploration into an established curriculum. I employed purposeful sampling to identify exemplary high school STEM teachers recognized for accomplished teaching (such as being awarded the State Teacher of the Year Award). I conducted semistructured interviews to understand the choices better. In addition, I analyzed lesson plans from participants to identify similarities in instructional practices. Data from interviews and document analysis were coded twice to establish patterns within each embedded unit and across the units. Interpretation of the codes and data patterns involved comparison to the conceptual framework and previous research in the literature review.

Definitions

The following list defines words and phrases about the context of the current study.

Authentic instruction: Multidimensional approach to STEM education that includes real-world and disciplinary authenticity through activities and tools representative of actual practices (Nachtigall et al., 2023; Schriebl et al., 2022).

Career exploration: The process of seeking information from multiple sources to explore an individual's vocational development (Jiang et al., 2019).

Goals: Symbolic representation of a future outcome that organizes and guides an individual's behavior (Lent et al., 1994).

Informal education: Programs that promote learning outside of a daily school environment and do not usually include score-based or standardized assessments; Program participants are generally voluntary (Sasson, 2019).

Instructional practices: Diverse methodology and tools used to formulate and implement instructional lessons and curriculum (Thibaut et al., 2018).

Outcome expectations: "Beliefs about the consequences of performing particular actions" (Almeda & Baker, 2020, p. 34). These expectations involve the imagined outcome of completing a specific task or job and may be physical, social, or personal (Bandura, 1986; Lent et al., 1994).

Science, technology, engineering, and mathematics (STEM) education: An interdisciplinary approach to education based on the concepts, strategies, and procedures from science, technology, engineering, and mathematics disciplines that utilize inquiry-based techniques to model real-world applications (Aguilera & Ortiz-Revilla, 2021; Sanders, 2008).

Self-efficacy: "People's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances" (Bandura, 1986, p. 391). This dynamic set of self-beliefs relates to a person's agency and sense of ability to accomplish a complex or challenging task (Lent et al., 1994).

Assumptions

In this study, I assumed that participants who volunteered for the study included some form of career exploration as part of the curriculum, not as an afterschool program or other informal education option. I also assumed participants would be available and able to participate in the study. Because I took steps to reduce social desirability bias (Bergen & Labonté, 2020; King & Bruner, 2000; Kwak et al., 2021; Larson, 2019), I assumed participants would be forthcoming and honest with their responses to interview questions. In other words, participants would refrain from providing socially responsible answers.

Another assumption was that some exemplary high school STEM teachers use career exploration in their curriculum and instructional practices as a personal choice, not just a pre-existing curriculum component. This assumption is critical in the current study because the goal is to understand the STEM teacher's reasoning for having STEM career exploration, not to verify a single outcome. Identifying this assumption can ensure that interview questions do not lead participants to specific answers but provide open-ended questions that allow STEM teachers to share their experiences and understandings.

Finally, I assumed that exemplary high school STEM teachers have access to and feel comfortable using video conferencing technology for interviews. The rationale for this assumption was the increase in the successful use of videoconferencing to conduct qualitative interviews during the data analysis phase and the increased use of videoconferencing software in the wake of the COVID-19 pandemic (Irani, 2019; Lobe et al., 2020).

Scope and Delimitations

The current study is limited in scope based on several factors. One restriction on the scope of the study is that interview participants included only high-school teachers who embed career exploration in their STEM curriculum. The study does not attempt to include middle school, elementary school, or informal educators as exemplars. Restricting the grade level of the teachers delimits the scope of the study. Still, it provides a specific context with selected individuals most appropriate for answering the research question (Johnson et al., 2020).

Another factor that narrowed the scope of the study was the deliberate choice of exemplary high school teachers as participants. This designation included teachers who received awards for their work in education, including semi-finalist, finalist, or State Teacher of the Year. These teachers may be more likely to incorporate STEM career exploration due to their experience, ingenuity, and leadership in STEM education. Although interviews with any high school STEM educator could provide insight into career exploration, career exploration is not an explicit instructional standard. Therefore, data from random or inexperienced high school STEM educators are beyond the scope of the study.

Though the study participants represented a specific pool of teachers, the outcomes of this study have potential transferability to larger groups. Specific findings related to how STEM teachers include career exploration in established curricula can inform other STEM teachers of the possible ways to increase career interest for students. The inflexibility of some curricula is a barrier to career exploration in class (Margot &

Kettler, 2019). Therefore, responses from study participants who consider their curriculum rigid may have practices and suggestions for working around this barrier. The potential ways to enhance current STEM instruction for other teachers are pronounced.

Limitations

A potential barrier when collecting data was finding teachers who utilize career exploration in their STEM curricula. In addition, the inclusion of STEM career exploration may vary across curricula. Because each state, district, school, or teacher can contribute to a classroom's curriculum, generalization of study results may not apply to all education scenarios.

I was also aware of personal biases that could impact my analysis of interview data. I was a marine mammal field biologist before working as a high school biology teacher. In both experiences, I placed a high value on science as a potential career opportunity. In my classroom, I actively expose biology students to career scientists and explore roles outside science, supporting all scientific research aspects. My interest in and experience working in STEM careers can act as a bias toward this research study. When conducting this research project, I knew how my desire to enter a STEM career field and my emphasis on STEM career exploration in my biology curriculum might influence the lens through which I approach this study. This reflective action helps recognize the researchers' pre-existing interest in the research topic and opinions on the issues that could create bias in interview question development and other data collection and analysis (Johnson et al., 2020). Reflexivity is needed when developing interview questions, protocols, and analysis techniques to ensure the complexity needed for an ethical, unbiased process (Ravitch & Carl, 2021).

To manage additional bias during the research study, I maintained a critical perspective of discovery and inductive exploration to ensure that I did not seek the answers I wanted but looked to understand the available solutions. In addition, I built a system of safeguards, such as peer-review from non-biased sources in the form of a literature review. Literature reviews allow a researcher to provide previous research findings that connect previous outcomes with the purpose of the current research study (Butin, 2010). This connection to an existing body of research enhances understanding of the context of the study and provides links that increase credibility. The literature review may serve as one part of an audit trail of the current study. Audit trails for qualitative research provide a detailed account of the research design, supporting documents for the study rationale, and support for the researcher's methodological, theoretical, and analytical choices (Carcary, 2020; Halpern, 1983; Lincoln & Guba, 1985). Carcary (2020) identified guidelines and developed a checklist to aid researchers in applying a research audit trail. These guidelines include specific content in this document, such as the research study's context, framework, methodology, and rationale for the research problem. Maintaining records of each phase of the research process will maintain transparency and reduce the possibility of partiality (D. Cohen & Crabtree, 2006).

Data triangulation is another recommended way to reduce bias, increase the credibility of qualitative research, and ensure a robust, comprehensive data set (D. Cohen & Crabtree, 2006). Triangulation involves using multiple data collection forms to understand the research outcomes (Ravitch & Carl, 2021; Shenton, 2004; Stahl & King, 2020). For example, qualitative data collection in education research might include observations, document reviews of standardized test scores, focus groups, and individual interviews. If analysis of these four data types reveals repeated patterns, then the data holds higher credibility than if the conclusion came from only one data collection source. The variety of data a researcher collects increases the likelihood of authentic, consistent interpretations of the outcomes (Ravitch & Carl, 2021). This study uses both semistructured interviews and lesson plan analysis to corroborate evidence during the data analysis process.

Significance

This study can benefit multiple stakeholders, including teachers, administrators, and students. The study addressed how and why exemplary high school STEM teachers intentionally provide students with career exploration opportunities. Opportunities to explore STEM careers within the context of STEM classes can increase interest and career choices for students (Birzina et al., 2021; Blustein et al., 2020). On a broad scale, school districts may benefit from an increased understanding of STEM career exploration as they continue to modify curricula to enhance the active learning and explicit instruction opportunities provided to students (Peterson, 2020). District administrators can gain knowledge of STEM career exploration practices to assess the use of these practices within their district. An understanding of these practices assists administrators in making informed decisions about local PD opportunities, professional learning network topics, and lesson-integration options that might increase practices in their respective districts. Insufficient PD opportunities related to STEM career exploration can impact the frequency and proficiency of these practices in the classroom (Ardura et al., 2021; Boyington, 2018; Coleman & Davis, 2020; Craig et al., 2018; Dare et al., 2018; Kartini & Widodo, 2020). All students may have increased exposure if teachers have opportunities to experience and practice STEM career exploration implementation.

The findings may also help administrators to identify STEM teachers who already incorporate these strategies in the classroom to promote teacher leadership opportunities within the district. These enhancements to the current system of curricula development, PD, and instruction help increase student awareness of potential STEM careers (The National Academies Press, 2021; Virtič & Šorgo, 2022). When students have more information regarding options for STEM careers, they are more likely to pursue higher education degrees and jobs related to these fields (Kang et al., 2021; Reinhold et al., 2018; Woo et al., 2021).

This intended outcome affects social change by providing an increased understanding of how curriculum and instructional practices that include authentic, situational STEM career experiences are accepted instructional practices in schools that help encourage and motivate students to pursue STEM careers. Study findings may further influence decisions made by STEM educators regarding incorporating instructional techniques and strategies into the current curriculum and lesson plans. The study results may also identify instructional practices to target during PD. More teachers may transform their STEM curriculum and instructional practices to serve better students' needs related to career exploration. Teachers may also desire to seek out training and PD opportunities related to career exploration. This continued education and advancement of practice create well-prepared educators who can reinforce STEM career exploration in the classroom (The National Academies Press, 2021)

Finally, findings from this study can directly affect social change by addressing instructional practices and district policies that positively impact career development in marginalized groups. Women, minority groups, and persons with disabilities are less likely to pursue and acquire STEM careers (Abe & Chikoko, 2020; Boyington, 2018; Kayan-Fadlelmula et al., 2022; National Science Foundation, 2015; The National Academies Press, 2021). Research points to consistent exposure to STEM career options as valuable for increasing STEM career interest for students of marginalized groups (Abe & Chikoko, 2020; Coleman & Davis, 2020; Gottfried et al., 2016; Gottlieb, 2018; Nguyen et al., 2021; Stevens et al., 2016). Not all marginalized students have access to counseling services, informal education opportunities, or other experiences that can enhance career exploration. Therefore, all students must have equitable career exploration opportunities during school (Corneille et al., 2020). Interest in STEM careers from students of all backgrounds can help maintain global and national economic competitiveness, active citizenship, social mobility, and future innovative discoveries in STEM fields (Archer et al., 2020; Jackson et al., 2021). Understanding current instructional practices STEM teachers use can provide insight into practices that build a more equitable approach to STEM career exploration.

Summary

Chapter 1 presented an overview of the current study to explain the need for further exploration of STEM career exploration in the formal high school setting. This overview includes a synopsis of the current challenges related to STEM career exploration. This first chapter also introduced the conceptual framework incorporating ideas from Lent et al.'s SCCT (1994) and Brown et al.'s (1998) situated cognition. The research question, problem statement, and purpose statement presented in Chapter 1 align with the constructs of the two theories as they relate to how learning, specific to career exploration, in this case, is constructed by experiences and influences such as a teacher's intentional instruction practice. The components identified here provide a foundation for understanding the current study. In the next chapter, I provide a more detailed summation of scholarly literature on the topic of STEM education and career exploration and a detailed overview of the conceptual framework that guides the current study.

Chapter 2: Literature Review

The purpose of this study was to understand how and why high school STEM teachers embed career exploration into STEM curricula. Exploring this problem has empirical and theoretical underpinnings related to best practices and ideal program development. The lack of specific directives for incorporating these practices into STEM curricula creates a gap in understanding. Chapter 2 contains background information related to the theoretical and empirical underpinnings of the current study to create a foundation for the present study. The chapter begins with an overview of the strategies used to search for seminal works and current literature on career exploration and STEM education. The chapter continues with a detailed overview of Lent et al.'s (1984) SCCT and Brown et al.'s (1989) situated cognition theory. The descriptions of these two theories include overviews of other influential works grounded in constructivism. The chapter concludes with an exhaustive overview of current research in STEM education related to career exploration, informal and formal STEM career exploration instruction, and the factors that influence these practices. The chapter also describes STEM career choices in students of various educational levels and demographics to understand how the conceptual framework links to current research.

Literature Search Strategy

The search strategy implemented throughout the literature review focused on exploring the scholarly databases available in the online Walden University Library. Academic databases included APA Psychinfo, EBSCO Host, Education Source, ERIC, Teacher Reference Center, SAGE Journals, and Taylor and Francis Online. The Thoreau multi-database search option was also frequently used to search for published articles. Database searches were limited to articles published between 2018 and 2022. The publication date limit expanded outside this date range for theoretical and conceptual frameworks and methodology publications. Keyword searches for the literature review included individual and combination searches of the following terms: *career exploration, career preparation, high school STEM education, STEM careers exploration, STEM curriculum, STEM education, teacher attitudes,* and *teachers' perceptions*. As several articles related to STEM career exploration were beyond the specified date range, Google Scholar helped find current articles referencing some of these older publications. This search strategy produced over 30 additional articles published between 2019 and 2022.

Conceptual Framework

The conceptual framework for the current study draws from the constructivist ideas found in SCCT (Lent et al., 1994) and situated cognition theory (Brown et al., 1989). Constructivist theories include the idea that individuals learn information through new experiences, integration of previous knowledge, and personal reflection (Elliott et al., 2000). The analysis of the theories presented in this section rationalized the importance of exposure, social and contextual interactions, and experiences in building career interest, specifically STEM career interest in students. SCCT is a well-documented model used to evaluate career choice (Blotnicky et al., 2018; Kang et al., 2021; Kier et al., 2014; Lent et al., 2010, 2018; Tokar et al., 2007; Turner et al., 2019). The pairing of SCCT with the constructs of situated cognition created a conceptual framework to explain factors related to curriculum and instruction that influence student career choices.

The following sections describe the associations between the chosen theories and propose a framework for helping to support strategies aimed at supporting STEM career exploration.

Social Cognitive Theory

Bandura (1986) used a constructivist lens to propose the SCT to explain how an individual's knowledge acquisition relates to interactions of the person, environment, and behavior. Bandura referred to the interactions of these three influences as *triadic reciprocity* (Bandura, 1986). Each encounter builds on an individual's past experiences to allow for continued impact on behavior (Bandura, 1986). The tenets of SCT explain how initiation and maintenance of behavior can ultimately result in goal-directed behavior (Bandura, 1986). In other words, the triadic causal factors ultimately affect social cognitive mechanisms such as self-efficacy (a person's belief in their abilities), motivation, and retention (Bandura, 1986, 2013; Lent et al., 1994; Ofem et al., 2021). Though the original theory was not specific to career decisions or career choices, self-efficacy plays a role in positively influencing outcome expectations, such as academic and career decisions (Bandura, 1993; Stewart et al., 2020). A more contemporary cognitive model based on SCT, called SCCT (Lent et al., 1994), builds on the connections between Bandura's triadic influences on career decisions.

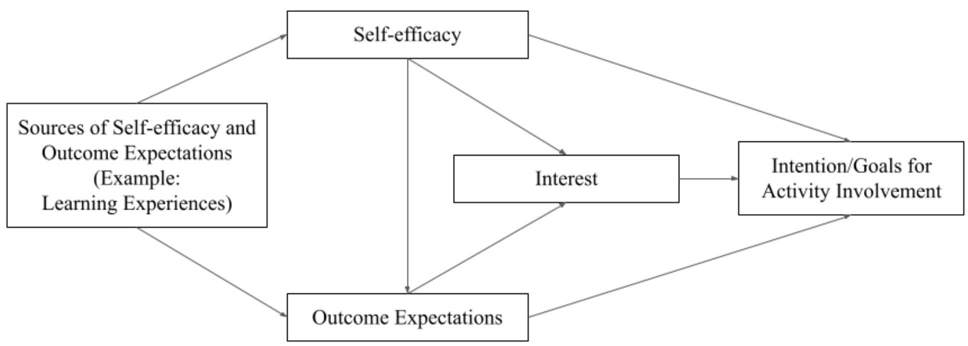
Several current studies have tested and expanded on SCT since its theory development in 1986. Some of this research illustrated the prominence of external influences on motivation and self-efficacy, such as classroom and teacher variables. For instance, Ardura et al. (2021) demonstrated a strong correlation between the external influences of family, teacher, and classroom methodology on students' self-efficacy and choice to enroll in physics and chemistry high school courses. Another application of SCT concluded that a combination of teacher-directed and inquiry-based science instruction significantly influenced student dispositions toward sciences (Areepattamannil et al., 2020). The results implied that a purposeful blend of teacher-centered and student-centered instructional practices could influence not only the student's belief that they could pursue a STEM career but also their future disposition toward science learning and science careers (Areepattamannil et al., 2020). Although SCT applies to fields such as psychology, education, and communication, no specific acquisition model for career choice and academic interests is described in the seminal work.

Social Cognitive Career Theory

Though SCT does not explicitly target career exploration or career choice, the triadic causal influences of SCT on an individual's self-efficacy provide a foundation for work specific to how an individual makes career-related decisions. Lent et al. (1994) derived the SCCT as a theoretical model to describe how behavioral, personal, and environmental determinants influence the behavior of career choice and development. SCCT utilized Bandura's original triadic idea of the interaction of self-efficacy beliefs, outcome expectations, and goals to present a model that explicitly addresses career interests (Lent et al., 1994, 2018). In SCCT, combining an individual's agency and changing contexts presents career and education pursuits as an active process (Kier & Blanchard, 2021; Lent et al., 1994). Lent et al. highlighted contextual factors, such as learning experiences, personal inputs (gender, race, health), and background contextual understanding as sources that create a chain of influence that ultimately affects an individual's goals related to a career (see Figure 1).

Figure 1

Simplified Model of Social Cognitive Career Theory



Note. Reprinted with permission from "An examination of preservice teachers' intentions to pursue career in special education," by D. Zhang, Q. Wang, M. Losinski, and A. Katsiyannis, 2014, *Journal of Teacher Education, 65*(2). https://doi.org/10.1177/0022487113510743. (see Appendix A).

Depending on the student's experiences, cognitive mechanisms can substantially impact the involvement in or avoidance of a particular behavior, such as a career (Casas & Blanco-Blanco, 2017; Lent et al., 2010). Additional analysis of the theory by various authors showed how different interpretations of SCCT model pathways predict interest, choice, performance, and satisfaction related to careers (Kurban & Cabrera, 2020; Lent et al., 1994; A. Şahin et al., 2018). The theory further explains specific cultural, cognitive, and contextual influences that impact an individual's self-efficacy, outcome expectations, and goals toward career choice (Lent et al., 1994, 2010).

Recent studies framed in SCCT tested the extent of the personal and external aspects of the theoretical model to understand better STEM career exploration and interest (Almeda & Baker, 2020; Avargil et al., 2020; Drymiotou et al., 2021; Lent et al., 2018; Li et al., 2021; Mau et al., 2021; Mau & Li, 2018; Reinhold et al., 2018; Rocker Yoel & Dori, 2021; Woo et al., 2021). These studies present the impact of multiple factors, including instructional practices, school environment, and curriculum development, on the three social cognitive mechanisms of SCCT. Although the results of these studies point to various school factors that can play a role in student career choice, each study emphasized the need to investigate further the specific factors that influence student outcomes. Further research can help to pinpoint how the school and classroom precisely function in the SCCT constructs of goal formation (Reinhold et al., 2018). There is a need for more information on the specific influences of these external factors. It is also essential to understand the perceptions and actions of classroom teachers who support the ideas in SCCT.

Self-Efficacy

One of the leading research areas connecting SCCT to the influences of classroom teachers relates to the teacher's role in increasing student self-efficacy. SCT initially described self-efficacy as a personal belief in an individual's capabilities to organize and execute actions (Bandura, 1986). This idea of self-efficacy is prominent in the SCCT model. It supports the social-cognitive view that human ability and learning require skill acquisition and a strong sense of belief in one's ability related to the idea (Lent et al., 1994). The original model proposed by Lent et al. (1994) focused on the learning experiences of an individual as the primary influence on self-efficacy.

Continued research framed in SCCT seeks the specific contextual and external forces that increase student self-efficacy. Mau et al. (2019) used longitudinal data to support the SCCT self-efficacy concept through findings that math and science self-efficacy significantly affected career aspirations in high school students. Murcia et al. (2020) also conducted a site-specific, qualitative study that used the lens of SCCT to understand how STEM career self-efficacy in middle school students is influenced by factors of learning environment, parents' attitudes, and career counselors' awareness. Analysis of interview data supported the role of external factors, such as classroom teachers and career counselors, in facilitating and strengthening student self-efficacy. This increase in self-efficacy stimulated engagement in STEM studies and career interests (Murcia et al., 2020). Kurban and Cabrera (2020) conducted the math and science self-efficacy analysis and found substantial impacts on math and science career interest, respectively. These findings demonstrate the critical role of self-efficacy in influencing STEM career choices. Though research framed in SCCT indicates the importance of the social-cognitive factor of self-efficacy, a gap exists to determine whether teachers who value career exploration in the classroom do so based on a desire to increase self-efficacy or for some other reason.

Situated Cognition

Central to situated cognition is the idea that the contexts and social interactions of an individual's everyday life influence learning (Brown et al., 1989). Individuals who experience authentic activities, context, and culture construct knowledge about the topics, which may lead to developing skills and understanding of new ideas (Altalib, 2002; Brown et al., 1989). These authentic activities support the transfer of content knowledge from inside the classroom to real-world situations (Brown et al., 1989; Putnam & Borko, 2000; Vakil, 2014). These situational factors can influence an individual's career track and an individual's desire to persist in the chosen career field (Jiang et al., 2019). These ideas correspond to work in various areas, such as diagnostic and therapeutic practices (McBee et al., 2017; Xin et al., 2021), engineering (Walker et al., 2020; Wyatt & Nunn, 2019), and business (Ho et al., 2022; Muñoz et al., 2020).

In the realm of STEM education, situated cognition forms the framework of understanding for the development of curriculum and lessons that promote scientific inquiry and skill development through real-world applications (Gersten & Baker, 1998; Goel et al., 2010; Han et al., 2021; Wilson & Myers, 2000). The broad idea of shaping understanding through authentic activities allows for the development of various learning environments that promote situated cognition transfer, including communities of practice, partnership programs, learning as an active participant, mediation of artifacts, and cognitive apprenticeships (Cakmakci et al., 2020; Hacioğlu & Gülhan, 2021; Han et al., 2021; Kelley & Knowles, 2016; Taylor et al., 2021; Wilson & Myers, 2000).

Kelley and Knowles's (2016) framework for integrated STEM education is one example of how situated cognition can inform STEM education. The authors used examples of inquiry-based curricula, such as engineering design, to conclude the strong connection between context and practice as a critical factor in STEM education:

> Often when learning is grounded within a situated context, learning is authentic and relevant, therefore representative of an experience found in actual STEM practice. When considering integrating STEM content, engineering design can become the situated context and the platform for STEM learning. (Kelley & Knowles, 2016, p. 4)

Hacioğlu and Gülhan (2021) produced similar outcomes in a convergent parallel design study to examine the effects of an engineering design-based curriculum on the STEM perceptions of middle school students. The study framed in situated cognition demonstrated increased critical thinking skills and positive STEM perceptions. Secondary to these findings, an indirect effect of increased STEM career awareness showed that when students engage in situated learning, the impacts move beyond content knowledge to affect career choice and STEM interest.

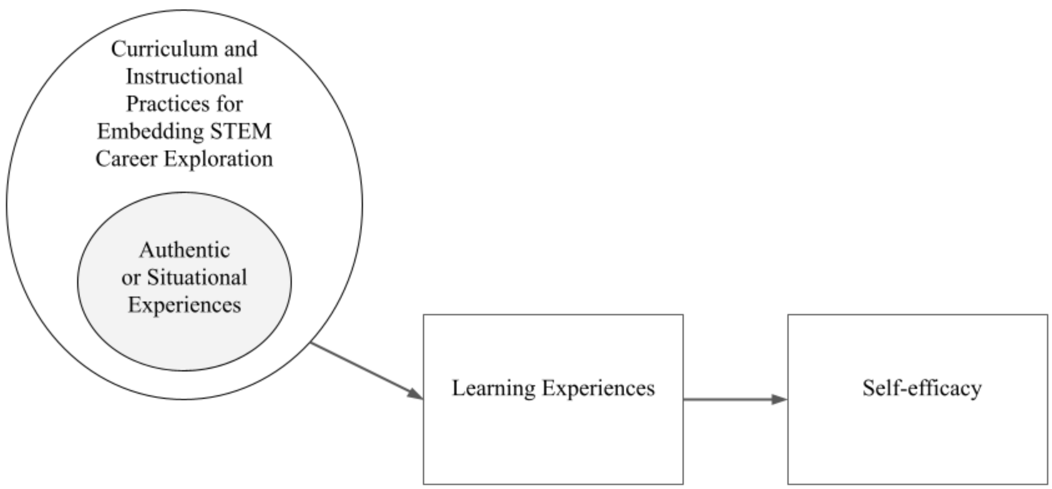
Integrating Two Theories

Developing a conceptual framework incorporating ideas from SCCT and situated cognition acknowledges the relationship between essential constructs from each theory. The proposed relationship of these constructs then helps to describe how a STEM teacher's actions and choices ultimately influence STEM career choices in students. SCCT acknowledges learning experiences such as career counselor practices, informal education opportunities, family influences, and curriculum and instructional practices (Lent et al., 1994, 2018). These learning experiences positively influence self-efficacy and, ultimately, interest and goals related to career choice. A conceptual framework proposed by Halim et al. (2021) also contends that external environmental factors such as media, family, out-of-school time, and inside-of-school time contribute to the STEM self-efficacy of learners. Similarly, a structural equation model proposed by Wang et al. (2021) compared the effect of formal and informal learning experiences on students' self-efficacy, career goals, and interests.

The current study narrows the scope of the social cognitive constructs to focus on the STEM teacher's choice of curriculum development, modifications, and instructional practices that contribute to students' learning experiences in their formal or inside-of-school education. Students' in-school participation in STEM curricula and activities can predict positive self-efficacy (Luo et al., 2021). Therefore, centering the study around this category of learning experiences allows an examination of teacher curriculum development, modifications, and instructional practices through an additional lens of situation cognition. Curriculum and lesson development that thoughtfully include authentic or situational learning opportunities related to STEM career exploration may significantly influence student self-efficacy, resulting in STEM career choice and interest (see Figure 2). In other words, teacher choice of curriculum modifications and instructional practices may provide students with authentic experiences that increase their self-efficacy toward a STEM career. Examining the perceptions and intentions of STEM teachers as they develop learning opportunities for students will help to understand whether the concepts of SCCT and situated cognition drive the learning environment in STEM classrooms.

Figure 2

Conceptual Framework of the Connection Between Constructs of Social Cognitive Career Theory and Situated Cognition



Note. This model specifically represents the learning experiences that, according to SCCT, influence an individual's self-efficacy and ultimately, career choice. In the model, I focus on the formal curriculum and instructional practices identified as one type of learning experience. The authentic or situational experiences emphasized in situated cognition are shown embedded within the context of curriculum and instructional practices to represent how these specific experiences are at the core of the instructional practices and curriculum used in the STEM classroom.

Literature Review Related to Key Concepts and Variables

Introduction to STEM and STEM Careers

Though numerous conceptualizations and definitions exist for the acronym STEM, the term is often associated with aspects of education and the workforce that incorporate STEM disciplines (Li et al., 2021; Smith & White, 2019; Woo et al., 2021; Zilberman & Ice, 2021). Occupations related to STEM include computer science specialists, architects, life scientists, medical doctors, veterinarians, mapping technicians, engineers, and many other careers that incorporate knowledge and training in the four content areas (Fayer et al., 2017; Sasson, 2019; Smith & White, 2019; Zilberman & Ice, 2021). A report by the National Science Board (2021) reported that in 2019, there were approximately 36 million STEM workers in the United States. This number describes nearly 23% of the United States workforce, either with or without bachelor's degrees (National Science Board, National Science Foundation, 2021). Future projections by the U.S. Bureau of Labor Statistics (BLS) show an increase in employment opportunities from 2019-2029 of approximately eight percent, compared to less than four percent for other occupations (Zilberman & Ice, 2021). Though the number of available STEM careers increases, the number of individuals entering the workforce with an interest in or preparation for these careers is low (P. J. Allen et al., 2019; Archer et al., 2020; Ayuso et al., 2022; Holian & Kelly, 2020; Shah et al., 2021; Woo et al., 2021).

One of the assumptions for the difference between the number of available STEM careers and the number of individuals entering these careers is the lack of STEM career education during an individual’s formal education (Almeda & Baker, 2020; Ardura et al., 2021; Beier et al., 2019; Mau & Li, 2018; Scott-Parker & Barone-Nugent, 2019). Students make choices about STEM careers during middle school (Almeda & Baker, 2020; Blotnicky et al., 2018; Boyington, 2018; Dare et al., 2018; Godbey & Gordon, 2019; Kier & Blanchard, 2021; Murcia et al., 2020) and high school (Holian & Kelly, 2020; Holmes et al., 2018; Kartini & Widodo, 2020; Shah et al., 2021). Establishing an early interest in the content areas of STEM is a critical factor in increasing interest in pursuing STEM careers (Abe & Chikoko, 2020; M. D. Cohen et al., 2019; Peterson, 2020). Additional research points to the importance of education in building student self-efficacy toward a STEM career (Beier et al., 2019; Dorfman & Fortus, 2019; Kang et al., 2021; Mitsopoulou & Pavlatou, 2021). However, in an annual survey conducted by Emerson, a global technology and engineering company, only 39% of the survey participants acknowledge ever receiving encouragement to pursue STEM careers (Emerson, 2019). Although there is a limited understanding of when and why students pursue STEM careers in the future, researchers suggest a lack of critical discourse regarding STEM career development in education, research, and public policy as a potential reason (Blustein et al., 2020). Without addressing the gaps in understanding regarding STEM career development during formal education, the interest in STEM careers may continue to decline (Areepattamannil et al., 2020; Blustein et al., 2020; Boyington, 2018; Emerson, 2019).

The Current State of STEM Curricula

Although the early years of STEM education focused on the agricultural sciences and engineering programs to support expansion and development across the United

States, a focus on STEM education and workforce emphasis increased in the 1950s (National Archives, 2022). After the successful launch of the Russian satellite Sputnik in 1957, education and industry in the United States focused on STEM to prepare a scientifically literate workforce that maintains a competitive global position in space exploration, technology, and medicine (E. Wang, 2021). As technological advancements increased the need to train and employ more people in the STEM fields, the education system on both a national and state level implemented changes to help boost achievement in STEM subjects and increase interest in STEM fields. Federal science programs and numerous education councils (National Science Education Standards) were established in the 1980s and 1990s to support STEM education nationwide (The National Academies Press, 2021). During this time, STEM education also shifted focus from a mindset of rote memorization and fact-based learning to an emphasis on critical thinking and problem-solving skills (Mohr-Schroeder et al., 2015; The National Academies Press, 2021). In recent years, this continued emphasis on critical thinking and problem-solving skills paved the way for additional shifts in STEM education that contribute to STEM education and specifically target creating a more effective and diverse STEM workforce.

In the past 20 years, education policy initiatives such as Educate to Innovate in 2009 and Change the Equation in 2010 focused on the connection between STEM education and the workforce (Mohr-Schroeder et al., 2015). The reauthorization of the Perkins Act (Perkins V) in 2018 and the reports of the STEM Education Advisory Panel (Committee) in 2017 provide examples of attempts to increase STEM and career and technical education at the national level (Granovskiy, 2018; National Science Foundation, n.d.). One of the most recent reforms to STEM education curriculum and instruction occurred in 2013 with the release of the Common Core State Standards and the NGSS (National Governors Association Center for Best Practices & Council of Chief State School Officers & Council of Chief State School Officers, 2010; NGSS Lead States, 2013). CCSS standards specific to mathematics target developing skills related to problem-solving, communication, reasoning, and making connections. The English Language Arts/Literacy Standards target development of scientific literacy skills that apply to various levels of the STEM content fields (National Governors Association Center for Best Practices & Council of Chief State School Officers & Council of Chief State School Officers, 2010). The NGSS standards emphasize crosscutting concepts, disciplinary core ideas, and science and engineering practices to present a set of rigorous, practice-based science standards for states to consider for implementation (Kelley & Knowles, 2016; NGSS Lead States, 2013). NGSS standards are not mandatory for state enactment. Therefore, some states, including Massachusetts, updated science standards to include the three core ideas, including science and engineering practices, modeled in the NGSS documents (Massachusetts Department of Elementary and Secondary Education, 2016). Despite these new contributions to STEM education practices and content to enhance STEM learning, most states do not include specific strategies or standards related to instructional practices that engage students in STEM career exploration.

Modifications to STEM curricula to include career exploration are available to students on a particularized basis if a state, school, or other entity intentionally updates or modifies existing curricula. A qualitative review of 95 peer-reviewed research articles detailed recent curriculum modifications at the graduate and undergraduate levels (Minshew et al., 2021). A repeated change included using cognitive apprenticeship (CA) frameworks to provide a meaningful academic experience for students to develop STEM skills and contextualize these skills to career opportunities (Minshew et al., 2021). Changes to an undergraduate engineering curriculum, which included emphasizing project-based learning (PBL) to support skills development and promote situated practices, helped maintain interest in STEM careers (Wyatt & Nunn, 2019). School-based initiatives emphasizing STEM career exploration may also help enhance the current curriculum and support teachers (Holmes et al., 2018).

At the high school level, NGSS is the curriculum frequently used in science education across the United States (NGSS Lead States, 2013). NGSS incorporates curriculum, practical instruction, and teacher development to allow students to learn and explore science practices (NGSS Lead States, 2013). These practices help students understand how scientists work (NGSS Lead States, 2013). However, curricula based on science and engineering practices are insufficient to evoke interest in STEM careers (Peterson, 2020). To increase interest in STEM careers, curriculum treatments with embedded career content are necessary (Peterson, 2020; Reiss & Mujtaba, 2017). Suppose states are mandated to follow a specific curriculum that only emphasizes science and engineering practices. In that case, it is up to the teacher to follow the curriculum while purposefully adopting instructional practices that add elements of STEM career exploration. Student career awareness and choice increase if the required frameworks and standards are paired with instructional practices that intentionally integrate career components or provide authentic examples and activities related to STEM careers. (Li et al., 2021; A. Şahin et al., 2018; Schwartz et al., 2018; van den Hurk et al., 2019).

The Role of Informal Education in STEM Career Exploration

Informal education settings, including designed spaces such as museums, environmental centers, National Parks, and other out-of-school-time programs, show promise in increasing student exposure to various STEM careers (Cantrell & Ewing-Taylor, 2009; M. D. Cohen et al., 2019; Habig et al., 2020; National Research Council, 2009; Pereira, 2018; Reinhold et al., 2018). These informal education opportunities can occur within the context of an afterschool program, include weekend programming, or take place during summer or other school vacations (P. J. Allen et al., 2019; Yao & Mohr-Schroeder, 2019). Regardless of the setting, informal education programs can supplement and complement formal STEM curricula and instruction (Burrows et al., 2018; M. D. Cohen et al., 2019; McDavid et al., 2020). Increasing student exposure to aspects of STEM through these informal education programs can build STEM skills, encourage interest in STEM content, and nurture student interest in STEM careers (Bussard, 2021; National Research Council, 2015; Yao & Mohr-Schroeder, 2019; Young et al., 2017). Halim et al. (2021) found that informal STEM learning programs significantly positively affected students' self-efficacy, more than in-school learning opportunities. The authors argued that these findings warrant the availability of these programs for more students (Halim et al.). However, these findings are specific to Malaysia's education system and should only be generalized to some populations of students as education standards and requirements may differ in other countries.

Research related to informal education and STEM career exploration focuses less on the social-cognitive influences of the programs and more on the STEM learning and career interest that result from these programs. Two recent longitudinal studies regarding informal education provide data showing the positive impact of out-of-school programs on student STEM career interests. Pre and post survey results following a PBL implementation indicated increased in STEM career interest after the five-day program. They showed interest increased two years after leaving the program (Shahali et al., 2019). In a more detailed empirical analysis of STEM career interest after an informal education program, Habig et al. (2020) followed students accepted into the Lang Science Program at the American Museum of Natural History. Students applied to this seven-year program in fifth grade. They participated in STEM accessible learning programs on alternate Saturdays during the school year and for three weeks during the summer vacation. The Lang Science Program alumni responded to post-survey questions related to variables such as science identity, science practices, and STEM majors and careers. Compared to national measures, including the National Science Foundation's Scientists and Engineers Data System, Lang Science Program alums engaged in STEM majors and secured STEM careers significantly more than peers (Habig & Gupta, 2021). These longitudinal findings suggest a possible connection between STEM informal education programs and STEM career interests. However, neither study accounted for other sources of exposure to STEM-based learning. If students received various forms of STEM-based knowledge throughout the study, it is prudent to explore where the teaching took place and the format of the learning experience.

Informal education conducted on a more short-term basis is also possible. Many of these programs occur during the summer months as camps (Donmez, 2021; Pereira, 2018; Tekbiyik et al., 2022; Yao & Mohr-Schroeder, 2019). The research focused on the influence of these camps and concluded that these informal programs positively impact student STEM career interests. For example, participants in a one-week residential STEM camp significantly increased their perceptions of STEM careers (Vela et al., 2020). High school students from across the United States who participated in college-run STEM summer programs were significantly more likely to express career aspirations than students who did not attend a program (Kitchen et al., 2022). These informal programs' engaging, hands-on nature may offer learning experiences that allow students to relate better to STEM careers (Maiorca et al., 2021). Summer research experiences providing high school students time and training in laboratory activities and other forms of hands-on research also positively influence students' STEM career aspirations (Bradley et al., 2021; Evans, 2021; Nadelson et al., 2022). Even during the COVID-19 pandemic, programs such as the University of Kentucky STEM Through Authentic Research Training Program provided virtual opportunities to students across the state (Bradley et al., 2021). Although both face-to-face and virtual informal learning experiences can improve students' perceptions of STEM fields and careers, the face-to-face versions showed a high impact (Baucum & Capraro, 2021). It is, therefore, essential to extend the scope of this research to understand what aspects of curriculum and activities are influential in this outcome and can be applied to formal school classrooms.

Programs like the STEM Through Authentic Research Training Program (Bradley et al., 2021) and the Lang Science Program (Habig & Gupta, 2021) targeted first-generation college students and underrepresented populations. There has been an increase in programs that target marginalized or underrepresented youth to increase diversity and close the gender gap in STEM career statistics (Donmez, 2021; Garibay & Teasdale, 2019; Godec et al., 2022; Griffiths et al., 2020; Tandrayen-Ragoobur & Gokulsing, 2021). Facilitating access to informal education and other types of out-of-school enrichment can reduce systemic barriers that often hinder participation by historically marginalized groups (Arif et al., 2021a). However, much informal STEM education is available only to privileged groups (Garibay & Teasdale, 2019). There is also evidence of limited access to these types of programs for rural communities across the country (Hartman et al., 2017).

A third way students can access informal education opportunities is in afterschool programs (P. J. Allen et al., 2019). Afterschool programs can extend the content covered in school and provide an opportunity to enhance skills, apply knowledge, and form new relationships without standards-based assessments or other data-driven records (M. D. Cohen et al., 2019). Robotics programs are one example of afterschool programs that expose students to STEM practices and possibly STEM careers (Blackley & Howell, 2019; Tekbiyik et al., 2022; Wu-Rorrer, 2019). Additional exposure to STEM learning experiences in competitions such as science fairs can also increase student interest in STEM careers (Miller et al., 2018).

Limitations also exist with afterschool opportunities, such as transportation, lack of staff, and discrimination (Garibay & Teasdale, 2019; Ma et al., 2020; The National Academies Press, 2021). Another challenge is the lack of standardized experiences across programs and experiences (S. Allen & Peterman, 2019). With expected outcomes and shared measures, empirically assessing effects is easy (S. Allen & Peterman, 2019; Hartman et al., 2017). The potential lack of equitable access to informal education creates complexities that warrant an understanding of STEM career exploration for in-school settings.

The Role of Formal Education in STEM Career Exploration

Though much of the literature shows that students are exposed to STEM career exploration in programs outside the classroom, formal schools can influence career exploration through targeted curricula and instructional practices. One survey of business leaders perceived the synergetic work of parents, educators, the business and industry community, and the government as essential in producing and maintaining STEM career interests and skills in students (Zaza et al., 2019). Empirical studies further demonstrate the role of educators in contributing to positive experiences with STEM career exploration and career development. Longitudinal data for U.S. high school students showed that instructional practices targeting STEM interests and strengthening self-efficacy in math and science through meaningful STEM career experiences can positively influence career choice and interest (Kurban & Cabrera, 2020). Similar findings in the Philippines identified multiple thematic similarities for why students pursue STEM careers, including personal aspiration, a field of study interest, the inspiration of teachers, and peer influence (Rafanan et al., 2020). According to SCCT, the external effect of teachers directly affects the pathway to career goals and career choices (Lent et al., 1994, 2018). Studies specific to educator impact confirm that teachers act as drivers of understanding for STEM career exploration and interest (Craig et al., 2018; Geesa et al., 2021; Murcia et al., 2020; Nguyen et al., 2021). These studies point to the role of teachers as influences that positively affect student STEM career choices (A. Şahin et al., 2018).

Instructional Practices that Support STEM Career Development

In the theory of situated cognition, Brown et al. (1989) stated that individuals have difficulty contextualizing careers without context. This contextualization can be accomplished in a classroom setting through instructional practices that provide continual activity to increase knowledge and application of a vocation to the classroom content (Brown et al., 1989). A research review of how secondary schools affect student STEM orientation noted numerous studies linking instructional practices as a factor influencing STEM career orientation (Reinhold et al., 2018). Standard practice methods, however, do not exist (Kurban & Cabrera, 2020). Specific instructional practices related to contextualizing STEM careers are absent from current STEM education standards (NGSS Lead States, 2013). This absence of career exploration and critical dialogue regarding STEM careers in national and state standards and curriculum invites studies to understand better instructional practices used by teachers currently attempting career exploration in their classroom (Abe & Chikoko, 2020; Areepattamannil et al., 2020; Blotnicky et al., 2018).

One of the instructional practices shown to play a role in increasing student STEM career interest is PBL. PBL is an instructional strategy that engages students in authentic activities and tasks centered around an initial problem or problem-based scenario (Abe & Chikoko, 2020; Birzina et al., 2021; LaForce et al., 2017; Savery & Duffy, 1996). Integrated methods of PBL used in STEM classes can increase rigor and engagement and expose students to STEM careers (A. Şahin, 2019). A secondary school PBL intervention using climate change scenarios and researcher interactions indicated that career-based scenarios supported students' development of understanding and interest in STEM careers (Drymiotou et al., 2021). Industry-aligned STEM PBL interventions incorporated into learning opportunities for Hawaiian high school students also demonstrated a significant increase in student STEM career interest and aspiration after a five-week intervention (Nariman, 2021). Both studies acknowledged the role of STEM-specific problems in influencing student career interests. In addition, both studies identified increased student self-efficacy as an outcome of the interventions (Drymiotou et al., 2021; Nariman, 2021). According to SCCT, this increase in self-efficacy directly affects career choice (Lent et al., 1994, 2018; A. Şahin & Waxman, 2021). Quantitative analysis also supports the relationship between PBL and increased intrinsic motivation and self-efficacy for STEM careers in a large sample of high school students attending a public, inclusive STEM high school in various parts of the United States (LaForce et al., 2017). PBL used in informal education programs also positively affected student self-efficacy and STEM career interest (Bicer & Lee, 2019; Halim et al., 2021; Rocker Yoel et al., 2020). The specific instructional practice in both in-school and out-of-school settings shows promise for future research.

Connections to self-efficacy exist in other research about STEM career exploration. An afterschool robotics program entitled For Inspiration and Recognition of Science and Technology showed an increase in STEM exposure and career choice in both current students and graduates of the program (Rocker Yoel & Dori, 2021). The For Inspiration and Recognition of Science and Technology program positively influenced student self-efficacy, increasing interest in STEM careers (Rocker Yoel & Dori, 2021). Findings of undergraduate student subjects also established a connection between using PBL in courses and increased student STEM self-efficacy and STEM career aspirations (Beier et al., 2019). This increase in self-efficacy and student perceptions of STEM skills indicates a possible benefit to using instructional practices that provide authentic experiences for students to enhance STEM career exploration and career choice. Although more research is needed on retention and career choice, PBL constitutes one type of instructional practice with a positive association with STEM career exploration. However, it is essential to note that using student-centered approaches to STEM education, such as PBL, is not the ultimate solution to the lack of STEM career interest. Although effective instructional practices such as dialogic discourse, design practices, and phenomenon-based units help to increase student access to STEM content, real-world links, and explicit career content is also needed to fully target STEM careers (Srikoom et al., 2018).

In addition to the specific instruction practice of PBL, other instructional practices that intentionally expose students to authentic learning opportunities encourage STEM career interest. These instructional practices include different student-centered approaches allowing full student participation, collaboration, and genuine exposure to STEM activities and careers (Blustein et al., 2020; Mitsopoulou & Pavlatou, 2021; Nachtigall et al., 2022; E. Şahin & Yildirim, 2020; Srikoom et al., 2018). Schriebl et al. (2022) included the need for both real-world and disciplinary authenticity in their model of authentic learning instruction. Activities that use industry-required equipment, that model career activity, and that provide a content-relevant perspective are crucial to developing authentic practices in the classroom (Schriebl et al., 2022). The key to authentic learning settings is the opportunity for students to contextualize the value and utility of the knowledge gained through lessons and activities related to STEM careers (Nachtigall et al., 2022). Even a mix of teacher-directed and student-centered approaches can increase the potential for developing positive student interest in STEM careers (Areepattamannil et al., 2020).

Other research points to specific additions to instructional practices that impact career exploration and positive self-efficacy related to STEM. A quantitative analysis of high school students enrolled in a High School Technology Academy in West Virginia determined specific practices, such as hands-on activities, field trips, and guest speakers, as having a significant influence on student STEM career interest for students Brigandi et al. (2020). Role-playing, a student-centered practice, can also increase student interest in STEM careers (Emembolu et al., 2020). Other instructional practices and intentional experiences that enrich students' STEM career interests include student-teacher-science partnerships, mentorships, and community collaborations with role models (Burrows et al., 2018; Godbey & Gordon, 2019; Taylor et al., 2021; Wu-Rorrer, 2019). Integrated STEM curricular units (Dare et al., 2018), utilizing career-based scenarios within lessons (Drymiotou et al., 2021), and incorporating culturally relevant science programs into instruction (Arif et al., 2021; Corneille et al., 2020; Gibbons et al., 2020; Rocha et al., 2022; Sparks et al., 2020; Stevens et al., 2016) also show promise. Virtual learning simulations are increasingly used in STEM education to increase STEM career exposure and career choice (Makransky et al., 2020; Spyropoulou et al., 2020; Thisgaard & Makransky, 2017; Walker et al., 2020). The myriad instruction practices available to STEM teachers should increase STEM career exploration. Current research, however, points to several barriers that inhibit this outcome.

Barriers to STEM Career Education

Although it is understood that teachers and their choice of instructional practices can positively influence STEM career exposure, students often miss this specific content in STEM courses (Archer et al., 2020; Rocha et al., 2022; A. Şahin & Waxman, 2021). A qualitative analysis of teachers' readiness to use science-related career exploration in the classroom highlighted the lack of focus on these career exploration practices (Soobard et al., 2021). A recent systemic review of STEM career integration in formal classrooms identified barriers such as curriculum challenges, assessment demands, and lack of teacher support (Margot & Kettler, 2019). Lack of support from the administration is a consistent theme when identifying obstacles to this practice in the formal classroom (Autenrieth et al., 2017; Knowles et al., 2018)

Teachers' limited knowledge due to a lack of training and ongoing PD related to the topic is a critical factor that reduces STEM career exploration. Although teachers are interested in integrating career exploration into the curriculum, many feel unprepared due to a lack of training (Shernoff et al., 2017). PD opportunities that model guidelines and practices show promise in helping increase teacher ability and confidence. (Autenrieth et al., 2017; Garcia et al., 2021; Gibbons et al., 2019; Knowles et al., 2018; Margot & Kettler, 2019; Schwartz et al., 2018; Stevens et al., 2016). District support, prior experiences with STEM instructional practices, and inflexible curriculum were also highlighted as limiting factors in career exploration use in the STEM classroom (Margot & Kettler, 2019).

Despite schools and educators playing an essential role in promoting STEM career exploration, formal STEM teachers found integrating multiple topics and disciplines to be a complex undertaking within the hours of the school day (Dare et al., 2018). In the same study, teachers also identified real-world, meaningful context inclusion as essential to promoting STEM career exploration in the classroom. Still, case-study participants acknowledged that the practice was difficult to maintain throughout the year (Dare et al., 2018). Similar constraints related to timing and limitation on implementation due to the scope and sequence of the current curriculum are possible (Autenrieth et al., 2017). Additional information related to the lack of STEM career exploration implementation in formal education points to a gap in understanding how and why this practice occurs and the barriers experienced by teachers before, during, and after implementation.

Summary and Conclusions

Current STEM education curricula focus on the use of science and engineering practices that promote scientific thinking. Although these practices are essential for raising STEM literacy, the explicit use of embedded STEM career experiences must be required in current curricula. If increasing exposure to STEM career information with methods like PBL (A. Şahin, 2019), career-based scenarios (Drymiotou et al., 2021), and the availability of role models (Emembolu et al., 2020) positively impacts student career choice, it is vital to understand the problem of why and how teachers are incorporating STEM career information into current curricula.

STEM career exploration has foundations in several education theories and instructional practices. Some theories of learning and transfer, including situated cognition, call for learning experiences that use authentic contexts and instructional practices that facilitate career exploration. These practices, including PBL, are relevant to both informal STEM education programs and formal STEM education within the classroom. Using methods that enhance STEM career exploration highlights the importance of teacher support as a contextual variable to increase student self-efficacy and, ultimately, affect student career interests. However, multiple barriers reduce the likelihood of explicitly including STEM career exploration versus the incorporation of science and engineering practices that may have a small, indirect influence on STEM career interest.

Current research also invites a more thorough study of why formal STEM teachers incorporate STEM career exploration into their curricula. There needs to be more understanding of how teachers make these choices and what specific practices they choose to provide STEM career exploration in the formal classroom. This qualitative, embedded case study examined the drivers for STEM career exploration and addressed some research gaps. The following chapter explains the research methodology used for this study.

Chapter 3: Research Methods

Qualitative research methodologies include case studies, longitudinal studies, and action research, allowing the researcher to interpret data differently (Burkholder et al., 2020; Gillani, 2021). The variety of methodologies present in qualitative research allows for more flexibility in studying the ever-changing perspectives of the people involved in the study. The purpose of this study was to understand how and why high school STEM teachers embed career exploration into STEM curricula. The following chapter offers an overview of the research methodology for this study by first identifying the research questions and the specific qualitative design method—an embedded case study approach. This chapter provides background on the embedded case study design and presents a detailed methodology, including procedures for participant recruitment, instrumentation, and data collection. The chapter continues with the data analysis procedure and the strategies used for trustworthiness and ethical approaches to qualitative research.

Research Design and Rationale

Research Questions

Since career exploration may not be an explicit instructional standard or district mandate, the research questions sought more information about the teacher's choice to include career exploration:

- RQ 1: What are teachers' experiences implementing classroom career exploration strategies?
  - SQ 1: How do STEM teachers embed career exploration in their curricula?

    - SQ 2: What instructional strategies related to career exploration do high school STEM teachers include in their lesson plans?
    - SQ 3: What barriers limit the inclusion of career exploration in STEM curricula?
- RQ 2: Why do STEM teachers embed career exploration in their curricula?

The research questions framed the focus of the study on the perceptions and experiences of a STEM educator that purposefully embeds career exploration in the current classroom curriculum. These research questions aligned with the present study's problem and purpose. These research questions also provided context to the development of the interview questions described later in this chapter.

Qualitative Research Design Approach

I used a qualitative embedded case study approach to address the research question. When qualitative researchers study people in their natural settings, they are challenged to interpret multiple perspectives within a single research project (Hong & Francis, 2020). As qualitative research has evolved, different methodologies or approaches to understanding the meaning of human thoughts and actions have developed (Erickson, 2011). Qualitative research methodologies include case studies, longitudinal studies, and action research, allowing the researcher to interpret data differently. Quantitative research, in contrast, uses structured, pre-determined analyses and designs to analyze data objectively (Burkholder et al., 2016; Gillani, 2021). The variety of methodologies present in qualitative research allows for more flexibility in studying the ever-changing perspectives of the people involved in the study.

As evidenced in Chapters 1 and 2, more needs to be understood about how STEM teachers embed career exploration into their practice. As a result of this gap in understanding, there is a need to ask "why" and "how" questions rather than making hypotheses about known variables like a quantitative study. Qualitative methods allow open-ended data analysis to identify trends in experiences, understandings, or perspectives (Ravitch & Carl, 2021; Saldaña, 2021). In this study, I analyzed how teachers embed career explorations into their practices (understandings) and their perspectives on why they do so. This type of inquiry is best associated with questioning participants using interview questions, a form of qualitative data collection (Creswell & Poth, 2018; Hamilton & Corbett-Whittier, 2013; Rubin & Rubin, 2012)

Additionally, the constructivist research paradigm provides another rationale for a qualitative study. Constructivist thinking includes the idea that people's reality is shaped by their experiences (Burkholder et al., 2016; Gillani, 2021; Ravitch & Carl, 2021). In other words, individuals understand their world and develop perceptions based on their involvement with the world around them. This thinking implies that the concrete truths or universal laws described by the positivism paradigm, generally studied using quantitative methodologies, are less influential in understanding events (Denzin & Lincoln, 2013). With the constructivist viewpoint as a foundation, qualitative research is used to understand the complex processes that shape understandings and influence behavior (Hong & Francis, 2020; Ravitch & Carl, 2021). Human feelings, behaviors, perceptions, and assessments are the primary focus of qualitative research. The focus on perspectives again links to the research problem as well as the research questions that attempt to understand how and why the participants carry out actions, in this case, related to STEM career exploration (Burkholder et al., 2020).

Embedded Case Study Research Design

Various qualitative research designs exist to establish patterns and themes related to a person's experiences and understandings (Burkholder et al., 2016; Creswell & Poth, 2018). The use of an embedded case study methodology combines the benefits of a case study design with the opportunity to compare the experiences and distinctiveness of each participant, or a subset of participants, who represent individual embedded units in the study (Hancock & Algozzine, 2021; Scholz & Tietje, 2002). A qualitative case study design allows for the detailed exploration of a specific topic (Hancock & Algozzine, 2021; Yin, 2017). Using a case study approach acknowledges real-world examples of a situation, which may present a clear understanding of the phenomenon of interest supported by the abstract nature of theories and principles (Hamilton & Corbett-Whittier, 2013). Once information from the case study is analyzed, the real-world examples are related to theoretical ideas to understand the phenomenon (Yin, 2017). The current study recognized the phenomenon or case of interest in embedding career exploration into established curricula. Within this context of analyzing the case phenomena, there may be a need to look at each teacher or subsample of teachers as embedded subunits within the larger case. The designation of each teacher as a subunit of the case required a more specific methodology referred to as an embedded case study.

Embedded case study research can be used in education to consider each case under the context of a specific phenomenon or case (Budiyanto et al., 2019). Though different definitions of a case exist, the current study follows the description developed by Merriam (1998), in which a case is “a unit around which there are boundaries” (p. 27). The current study defined the main case as embedding STEM career exploration into existing curricula. A boundary exists because the study includes STEM career exploration versus other content and subject areas. Within the boundaries of this case, individual teachers served as single units of analysis because each teacher’s situation is unique to the case being analyzed. Each teacher’s experience embedding career exploration in a STEM classroom qualified how they experienced the process and made sense of the actions (see Merriam, 1998; Yazan, 2015). Each embedded unit provided a rich description and an opportunity for in-depth analysis of data (Budiyanto et al., 2019; Scholz & Tietje, 2002). An additional advantage of an embedded case study methodology is that each unit could be analyzed as an individual situation or combined to allow for multiple means of analysis (Budiyanto et al., 2019; Scholz & Tietje, 2002). The multiple forms of analysis allowed for a deeper understanding of the common themes that relate to the overall case.

During the development of this study, I considered other qualitative research methodologies that were eventually eliminated from consideration. Phenomenology, for example, is a qualitative approach used to understand what and how participants experienced a universal phenomenon (Creswell & Poth, 2018; Ravitch & Carl, 2021). An analysis of phenomenology research then identifies the shared experiences of individuals. Within the current study context, there is no universal description for STEM career exploration; therefore, each participant's experiences may not be similar enough to warrant a phenomenological approach.

Grounded theory research was also rejected as a plausible methodology for this study. Grounded theory generally collects data that is then used to generate explanatory theories or models (Burkholder et al., 2020; Creswell & Poth, 2018; Ravitch & Carl, 2021). The current study was not intended to establish a new theory but instead seeks to understand the instructional choices made by STEM teachers as they relate to established theory. In addition, grounded theory is not appropriate because the data collection and analysis commonly used for grounded theory research involves constantly comparing data for an extended time (Creswell & Poth, 2018). Over time, multiple interviews and extensive observations are used to continuously compare data to shape and develop a new theoretical explanation for a process (Burkholder et al., 2020). This study focused on the perceptions and ideas of individual STEM teachers and did not require an ongoing evaluation of a process; therefore, grounded theory was eliminated as an option.

Role of the Researcher

Qualitative research is not relegated to controlled experiments in isolated conditions that are purposefully developed to exclude influence from outside variables, including the researcher. In this study, I was an observer and did not include my own experiences in data analysis. Though study participants were teachers like me, I am not engaged in a working relationship with any participant. As a recipient of an award for teaching, a personal connection to a participant was possible since all participants were award winners. This personal connection, however, did not involve power differentials that influenced data collection (Hamilton & Corbett-Whittier, 2013). To fully engage in the research process, I acknowledged my research bias and challenged myself to explore this personal bias concerning the research project and outcomes (Gillani, 2021; Ravitch & Carl, 2021).

Prior to working as a high school biology teacher, I was employed as a marine mammal field biologist. Whether working as a field-based researcher or classroom teacher, I highly valued science as a potential career opportunity. Because of these close connections to STEM careers and education, I used reflexivity to identify personal subjectivities and biases related to the research topic (Ravitch & Carl, 2021). In my classroom, I actively expose biology and zoology students to career scientists and explore other career roles supporting all STEM fields. My interest in and experience working in STEM careers could have acted as a bias toward this research study. When conducting this research project, I was aware of how my desire to enter a STEM career field and my deliberate emphasis on STEM career exploration in the biology curriculum used in my classroom influenced the lens through which I approached this study. Additionally, I acknowledged that only some STEM teachers might share my desire to include career exploration.

I built a system of safeguards to manage bias, such as a detailed literature review containing a diverse selection of current and peer-reviewed sources. The literature review provided a basis for theory development and research design and offered empirical evidence supporting the current research topic (Machi & McEvoy, 2016). In addition, I maintained a critical perspective of discovery and inductive exploration, ensuring that I did not seek the answers I wanted. Instead, I looked to understand the perspectives and practices available in participants' answers and artifacts (Rubin & Rubin, 2012). Identifying trustworthiness methods and including validity and reliability methods are ways to reduce bias in qualitative research (Creswell & Poth, 2018). I present a detailed methods of trustworthiness later in this chapter.

Methodology

Participant Selection

I used purposeful sampling to recruit nine teachers from the approximately 1,200 teachers participating in the National Network of State Teachers of the Year private Facebook group. These teachers are members of this group because they are either a teacher of the year, a finalist, or a semi-finalist from their respective states and choose to collaborate through the private Facebook group. The purposeful sampling technique recruited teachers who embedded STEM career exploration into their curriculum (Guest et al., 2006; Hamilton & Corbett-Whittier, 2013; Ravitch & Carl, 2021). Using a random sampling technique can yield a sample with individuals who cannot comment on the study particulars due to a lack of experience with the topic (Hamilton & Corbett-Whittier, 2013).

Interviews and other qualitative data collection methods utilize purposeful sampling to intentionally focus on a smaller sample size to gain information-rich understandings (Patton, 2015; Rubin & Rubin, 2012). I chose a sample size of nine to collect thick descriptions for data analysis and to reach saturation. Saturation in qualitative research describes the point at which no new perspectives or ideas or generated from interviews, observations, or other qualitative methodologies (Mason, 2010; Patton, 2015; Rubin & Rubin, 2012). Various factors could influence saturation levels for a qualitative study, but a number between six and 12 is a reliable means of reaching saturation (Guest et al., 2006).

Criteria for participation in this study were that the teacher was a current STEM teacher in a public school in the United States; had been recognized as a current or former teacher of the year, finalist, or semi-finalist in their respective state; and embedded some form of STEM career activity into their STEM curriculum. This study was not site-specific; therefore, participants were allowed to have a variety of locations. As the criteria for participation were restricted to specific teachers, participant recruitment included contact with volunteers through the Facebook social media platform. Inclusion in the private social media group was voluntary; therefore, members were not coerced to join or participate in any activities related to a specific organization. Social media can help recruit study participants from broad geographical ranges and diverse populations (Darko et al., 2022); therefore, recruitment was possible for award-winning teachers across the United States. Using a specific Facebook group available to award-winning teachers limited the recruitment scope and allowed me to target a specific population. Social media recruitment served as a means of advertisement for the study. All additional contact related to informed consent and scheduling used email for communicating with participants. Specific recruitment procedures are described in detail in future sections of this chapter.

Instrumentation

Semistructured Interviews

In-depth qualitative interviews have great value as a data collection tool because of the ability of the interviewer to explore perspectives in detail (Rubin & Rubin, 2012). Surveys, focus groups, document analysis, and other data collection methods may not be able to invoke the level of detail that you can get when you conduct a qualitative interview. Qualitative interviews provide rich detail beyond yes-or-no responses (Rubin & Rubin, 2012). This instrument allows the researcher to gather examples, experiences, and stories about how and why an individual perceives an action or idea (Creswell & Guetterman, 2019; Ravitch & Carl, 2021; Rubin & Rubin, 2012). This study focused on the experiences and perspectives of STEM educators to answer questions of how and why; therefore, qualitative interviews were a sufficient instrument.

I used a semistructured interview format to question participants. Participants were interviewed once using the researcher-developed interview protocol provided in Appendix B. The interview protocol consisted of open-ended questions and provided the likely order questioning. I used broad questions to reduce restrictions on how the interviewee approached the question (Rubin & Rubin, 2012). I chose a responsive interview style that allowed for flexibility such that additional questions were possible based on the participant's response (Rubin & Rubin, 2012).

The development of the interview questions involved identifying themes from both the conceptual framework and the literature review content. For example, the subquestion linked to the barriers to embedding career exploration was derived from research identifying a lack of teacher PD and training in career exploration practices (Garcia et al., 2021). The interview protocol included possible additional questions in anticipation of departure from the central questions of the interview. For example, one interview question asked participants to describe the current STEM curriculum used in their school or district. To help participants describe the curriculum in as much detail as possible, I included follow-up questions in the protocol, such as: What are the topics of emphasis in the curriculum? Moreover, does your curriculum discuss career exploration related to STEM fields? These follow-up questions targeted the main subject area of the study and ensured that information related to STEM career exploration was included in the interview.

Lesson Plan Sample

Document analysis of lesson plans served as the second form of data collection. Document analysis is often used with in-depth interviews to look for consistent or contradictory information that may need further exploration (Rubin & Rubin, 2012). Upon receipt of the participant's lesson plan or description, I reviewed the contents using the researcher-developed Lesson Plan Sample Analysis Protocol (see Appendix C). The protocol explicitly targeted the objectives and instructional practices used in the lesson. Identifying the objectives in the lesson plan provided additional information to inform the research question about why STEM teachers embed career exploration. The review of the instructional practices in each lesson offered additional evidence for analysis related to the research question of how STEM teachers embed career exploration. As stated in this study's conceptual framework and literature review, instructional practices such as PBL and phenomenon-based lessons and units effectively increase student access to and interest in STEM careers (Abe & Chikoko, 2020; Srikoom et al., 2018).

The semistructured interview and lesson plan analysis protocol were sufficient data collection instruments for this study as they were grounded in literature for construct and content validity (L. Cohen et al., 2017). The interview questions and lesson plan analysis captured the essential aspects of STEM career exploration presented in the literature review and aligned with the research questions and conceptual concepts developed in the framework. This content validity is evidenced by the alignment of interview questions to research questions in the Virtual Interview Protocol (Appendix B) as well as the specific instructional strategies identified in the Lesson Plan Sample Analysis Protocol (Appendix C) or Lesson Plan Information Collection Form (Appendix D).

Procedures for Recruitment, Participation, and Data Collection

The study participants were purposefully sampled from approximately 1,200 National Network of State Teachers of the Year private Facebook group members based on the criterion that they were teaching a high school STEM subject in a formal school setting. Participant criteria also included being recognized for their teaching ability through the state Teacher of the Year (STOY) award recipient, finalist, or semi-finalist designation, and finally, that they purposefully embedded career exploration into their STEM curriculum. For this study, I interviewed nine teachers to reach a level of data saturation. The commonality of the participant's experience implied a homogenous sample; therefore, a sample size between six and twelve participants ensured data saturation (Guest et al., 2006).

Recruiting subjects involved publishing information to a national pool of approximately 1,200 teachers awarded for accomplished teaching (State Teacher of the Year awardee, finalist, or semi-finalist). After I received approval from the Walden University Internal Review Board (IRB), I recruited participants for this study using the National Network of State Teachers of the Year private Facebook group, which potential participants join voluntarily after receiving a State Teacher of Year award or are recognized as a finalist or semi-finalist in their respective state. I posted the Participant Social Media Recruitment Graphic on the private Facebook group. This advertisement briefly overviewed the study and identified the criteria required to participate. Once prospective participants were interested in learning more about my study, I emailed the informed consent document for review. Participants were asked to send an email reply with the phrase I consent to verify their willingness to participate.

The informed consent contained information about the research study's purpose and goals, measures to protect privacy and confidentiality, and voluntary withdrawal rights and procedures. Presenting these elements to potential participants is vital to respect the rights of the individuals and their decision-making process (Creswell & Poth, 2018; Hamilton & Corbett-Whittier, 2013; Yin, 2017). The Ethical Procedures section of the consent form provided detailed information about participants' rights to privacy and confidentiality. All communications and scheduled events were entered into an audit trail document to ensure confirmability (Burkholder et al., 2020; Carcary, 2020). This process is described in more detail in the Trustworthiness section of this chapter.

Semistructured Interviews

I conducted semistructured virtual interviews using the Zoom video conferencing platform to ensure access to participants who would otherwise not be available to participate due to their locations across the country. Participants received a copy of the interview protocol four days before the scheduled interview. Each interview lasted between 30-120 minutes and occurred at a time convenient for the interviewee. Before scheduling an interview, I assigned each participant a code and used that code on corresponding written documents and electronic files instead of the participant's name. The participant's name and corresponding code were entered into an electronic spreadsheet saved on a private computer that only I could access. This protocol ensured that the participant's name was only in one confidential document. During the interview, I recorded audio components with permission from the participant. In addition, I recorded written notes on a separate copy of the interview protocol during the meeting. The audio file of each interview was transcribed using Zoom transcription capabilities. The audio and transcription files were renamed using the participant's code. All files were stored in a password-protected folder on a private computer. Printed transcriptions used for data analysis were accessible only to the interviewer. All data associated with the analysis will be stored for five years, as Walden University requires. The electronic files will be permanently deleted from the computer, and printed materials will be shredded after this period.

Following the interviews and the initial coding of responses, I contacted five participants to review my interpretation of their data. This process, known as member checking, was used to confirm that the information was accurate and representative of the thoughts and feelings of each participant (Birt et al., 2016; Rubin & Rubin, 2012; Stahl & King, 2020). All participants received a final email communication that included the overall study findings.

Lesson Plan Sample

Participants were asked to provide information related to the planning of STEM lessons using one of two lesson plan collection tools. Some participants submitted a detailed lesson plan that best represented their practice of embedding career exploration. These lesson plans were analyzed using the Lesson Plan Sample Analysis Protocol (see Appendix C). Other participants opted to complete a Google Form (Appendix D) that included prompts targeting the lesson objectives and the instructional practices for a lesson that embeds STEM career exploration. Either option provided details on the participant's goals for student learning and the instructional practices used in a lesson that embeds STEM career exploration. I requested that participants send the lesson plan document or complete the form at least five days before the scheduled interview. Upon receipt of the participant's lesson plan or form submission, I reviewed the document using the researcher-developed Lesson Plan Sample Analysis Protocol (see Appendix C). The protocol explicitly targeted the objectives and instructional practices used in the lesson. Identifying the objectives in the lesson plan provided additional information to inform the research question about why STEM teachers embed career exploration. The instructional practices used by each participant offered additional evidence for analysis related to the research question of how STEM teachers embed career exploration. As stated in this study's conceptual framework and literature review, instructional practices such as PBL and phenomenon-based lessons and units effectively increase student access to and interest in STEM careers (Abe & Chikoko, 2020; Srikoom et al., 2018). Analysis of both tools revealed similarities in responses that allowed for data from both tools to be grouped as one data set and collectively referred to as lesson plans for this study.

Each file was renamed with the participant's corresponding code assigned when the interview was scheduled (as described in the previous section). Participants had the opportunity to comment on the lesson plan during the interview. Clarifying questions from the researcher about the lesson plans were addressed during the interview, if applicable. No specific follow-up procedures were necessary for lesson plan submission. As with the interview files, all lesson plan files were stored in a password-protected folder on a private computer. Printed lesson plans used for data analysis were accessible only to the interviewer. All data associated with the analysis will be stored for five years, as Walden University requires. At that time, the electronic files will be permanently deleted from the computer, and printed materials will be shredded.

Data Analysis Plan

Qualitative analysis is challenging because researchers must take personal experiences, perspectives, and behaviors and determine how to proceed with interpretations and conclusions (Saldaña, 2021; Vaughn & Turner, 2016). Coding qualitative data is the first step in organizing data to look for patterns and discrepant cases related to a specific research question. (Linneberg & Korsgaard, 2019; Saldaña, 2021). The code can be a simple word or phrase that summarizes the response or viewed activity (Saldaña, 2021; Vaughn & Turner, 2016). Codes are generated multiple times to see different connections and patterns that allow the researcher to formulate ideas for analysis (Saldaña, 2021). Codes can then be grouped into categories to look for relationships between the numerous codes generated during the initial analysis (Hamilton & Corbett-Whittier, 2013; Rubin & Rubin, 2012; Saldaña, 2021). These categories can generate a theme, including a theory or narrative that establishes the connection between the research question and the data collected (Saldaña, 2021; Vaughn & Turner, 2016). The three-step analysis process for the current study is detailed below.

First Cycle Coding Process

For the first cycle coding step process, I used inductive and deductive coding to categorize statements from interviews and lesson plans. An electronic transcript of each interview and lesson plan was imported into the Quirkos qualitative analysis software (www.quirkos.com). Computer software for qualitative data analysis (CAQDAS) is effective when dealing with large quantities of data (Friese, 2012; Hamilton & Corbett-Whittier, 2013). With an interview sample size of nine participants, using a CAQDAS allowed me to systematically generate codes, patterns, and linkages (Friese, 2012; Hamilton & Corbett-Whittier, 2013). First cycle coding is the first step in organizing qualitative data to look for patterns and discrepant cases related to a specific research question (Saldaña, 2021). In this study, the first coding cycle looked for phrases containing either descriptive statements or value statements related to the research questions. In other words, the first coding cycle identified statements about concepts, ideas, and meanings related to teachers' experiences and actions related to STEM career exploration (Linneberg & Korsgaard, 2019; Saldaña, 2021; Vaughn & Turner, 2016). For example, if a participant described the curriculum or instructional practice used in the classroom, I identified this as a descriptive statement. This descriptive coding can identify overall meanings for segments of interviews or lesson plans to identify connections in a future review (Linneberg & Korsgaard, 2019). Phrases were labeled a value statement if they described a participant's beliefs, goals, or overall reasoning for an action (Saldaña, 2021). The current study sought to understand how and why a teacher may embed career exploration in a STEM curriculum. Therefore, the two categories of description and value related to experiences and beliefs aligned with the research purpose. In addition, identifying value statements in the initial coding process provided a basis for comparison to the conceptual framework. For example, if a participant believed their goals related to helping students achieve financial stability in the future, I included this statement in the value category for further theoretical connections to teacher intent.

Once descriptive and value statements were identified, I used inductive coding methods to look for relationships within the statements identified as descriptive or value statements to create first cycle codes (Saldaña, 2021). This analysis looked more specifically at the patterns and connections between each statement. I generated codes based on similar content or topics. These concepts were associated with the conceptual framework or previous studies related to STEM career exploration (Linneberg & Korsgaard, 2019). I also implemented deductive coding by identifying statements related to two a priori codes that targeted concepts from the conceptual framework. These two codes were SELF-EFFICACY and AUTHENTIC EXPERIENCES. Incorporating statements into the pre-determined a priori codes allowed for assessing how the data fit or did not fit with topics from the conceptual framework (Burkholder et al., 2020).

Second Cycle Coding Process

Second cycle coding developed a more concise list of concepts to review (Saldaña, 2021). I looked for specific instructional practices or perspectives related to the research questions and conceptual framework by breaking the large categories from the first coding round into more descriptive subcategories. For example, ACTIVITIES was divided into subcategories: DIRECT INSTRUCTION, PROJECTS, and VIDEOS. The first and second-round codes were then used to generate embedded cases.

Embedded Case Development

Following the coding process, I looked across all codes to generate interpretations of the findings (Linneberg & Korsgaard, 2019; Saldaña, 2021). Interpretations can identify emergent patterns in the data that provide additional explanations for a phenomenon or describe conceptual relationships (Linneberg & Korsgaard, 2019). Interpretations in this study looked for patterns across codes and subcategories to create embedded units of the case. I also looked for unique situations within the data representing an embedded case represented by a single participant. These unique embedded cases are equivalent to a discrepant case because the data is a distinctive perspective used for analysis (Saldaña, 2021). Any discrepant cases acknowledged in the study were used to identify areas for further research and to make claims about the transferability of findings (Butin, 2010).

Trustworthiness

Qualitative researchers must consider both the methodologies used to gather data and how to ensure levels of quality, trustworthiness, and credibility in the collection and analysis of the data. These characteristics of qualitative research are generally associated with the term rigor and speak to the ability to provide credible data analysis (Ravitch & Carl, 2021; Shenton, 2004; Stahl & King, 2020). Trustworthiness in qualitative research does not follow an exact set of guidelines. However, there are several research-based approaches to consider when dealing with credibility, transferability, dependability, and confirmability (Stahl & King, 2020).

Credibility

Presenting data that others deem trustworthy and credible is possible using strategies such as member checks and data triangulation. Member checks involve follow-up contact to allow study participants to review the researcher's interpretations of interview responses and lesson plans (Ravitch & Carl, 2021; Rubin & Rubin, 2012; Stahl & King, 2020). Asking participants to review these summaries confirms that the researcher's interpretation of information is accurate and adequately represents the thoughts and feelings of a participant. I contacted five participants for member checking. Each participant received a summary of my interpretations of the embedded cases. Using member checks validated the data from the research study and increased the trustworthiness and credibility of the research (Birt et al., 2016; Candela, 2019; Ravitch & Carl, 2021).

Reflexivity is another method to ensure the credibility of a study. By including a description of my role as the researcher, I recognized my pre-existing interest in the research topic and opinions related to the topics that could create bias in interview question development and other aspects of the data collection and analysis. Reflexivity is needed when developing interview questions, protocols, and analysis techniques to ensure the complexity needed for an ethical, unbiased process (Ravitch & Carl, 2021). The consistent use of reflexivity throughout the study allowed me to recognize my position and the biases that may help shape my interpretations.

Finally, data triangulation is recommended to guarantee qualitative research's credibility, transferability, and dependability. Triangulation involves using multiple data collection forms to understand the research outcomes (Ravitch & Carl, 2021; Shenton, 2004; Stahl & King, 2020). This study's interviews and lesson plan analysis provided evidence from different sources to examine a perspective or interpretation. The lesson plans were used to triangulate findings from interview statements and as an independent analysis of interview responses across participants. Multiple contributing sources provide corroboration and credibility to research interpretations (Creswell & Poth, 2018).

Transferability

Transferability involves creating descriptive, context-relevant interpretations that can be applied to broader contexts (Ravitch & Carl, 2021; Stahl & King, 2020; Yazan, 2015). Although this study did not aim for replicability, the patterns and conclusions drawn from the study apply to other circumstances. The different perspectives presented in this study could confirm the need to revise current curricula to include career exploration practices in schools nationwide. This transferability is possible when a detailed description expands on the interpretations and provides multiple examples to illustrate the findings (Yazan, 2015). This study used a rich description in the Data Analysis section of Chapter 4 that included perspectives and examples from multiple participants within each embedded case.

Dependability

Dependability involves consistency and a well-articulated rationale for each procedure (Ravitch & Carl, 2021). An audit trail provides a means to review the specific steps of the study and provide detailed reporting of the rationale behind each step (Ravitch & Carl, 2021; Shenton, 2004). This study's audit trail (see Appendix E) detailed the participant recruitment process, coding, and embedded case development steps.

Cloutier and Ravasi (2021) highlighted using detailed data tables to increase trustworthiness in qualitative research. Using various data tables increased trustworthiness by making the data collection process transparent and providing an accurate reconstruction (Cloutier & Ravasi, 2021). A coding scheme table was included in this study as one way to organize codes and themes generated by the researcher (Cloutier & Ravasi, 2021). Coding and theme development require a researcher to interpret information in one or more ways; therefore, providing the coding scheme can allow reviewers and readers the opportunity to see if the provided data accurately represents the codes and themes used in the analysis (Cloutier & Ravasi, 2021; Saldaña, 2021). The coding scheme and figures demonstrating the steps taken to create the embedded cases are presented in Chapter 4.

Confirmability

Audit trails and CAQDAS programs can serve as forms of research confirmability (Carcary, 2020). Using an audit trail allows a reader to review the events of the study and confirm findings (Carcary, 2020). CAQDAS programs also allow for increased data analysis and findings transparency to enhance confirmability (O'Kane et al., 2021). This study included an audit trail with a detailed overview of events (see Appendix E). The CAQDAS program Quirkos was used to analyze interview data.

Research reflexivity is an enhanced way to improve ethical confirmability by ensuring that the researcher consistently reviews the data and thinks about how the data is being used in the study, including any information that compromises participant privacy (Ravitch & Carl, 2021; Roth & von Unger, 2018). During data analysis, I questioned the data by reviewing statements and examples through a privacy lens and removed information I deemed compromising.

Ethical Procedures

Ethical considerations were made throughout the research study. Before data collection, Walden University's Internal Review Board approval (01-18-23-0994809) ensured adherence to required research and procedural protocol to limit ethical breaches. Qualitative research focuses on an individual's unique experiences and perspectives; therefore, it is crucial to consider the ethical responsibilities associated with this type of research. This research study's ethical considerations included protecting participant privacy and adequately managing and securing collected data. Using pseudonyms, limiting demographic information, and removing other personal information from published data is a straightforward way to ensure the privacy and anonymity of study participants (Ravitch & Carl, 2021). Upon receipt of a participant inquiry email, the individual received a code used as an identifier throughout the study. The code was included in the interview protocol, lesson plan analysis, and subsequent data analysis and write-up. Any use of the school, district, or state name provided during the interview or lesson plans was removed from publication descriptions.

Data collection privacy issues must also consider access to data and storage (Ravitch & Carl, 2021). In recent years, the collection and storage of digital data have challenged qualitative researchers to think about the issues associated with data accessible to others through digital means. Current guidelines consider ethical challenges related to data ownership, the confidentiality of metadata, and data sharing responsibilities (Clark et al., 2019). Data in digital form could be accessed by others if not protected. Therefore, each researcher must ensure that the saved data is secure and only used for purposes identified in the initial communications with study participants (Clark et al., 2019). For this study, all digital files were stored in a password-protected folder on a private computer. Printed transcriptions used for data analysis remained accessible only to the interviewer. All data associated with analysis will be stored for five years, as Walden University requires. The electronic files will be permanently deleted from the computer, and printed materials will be shredded. Any further use of the data must receive permission from the participants to minimize harm and maintain the ethical standards expected of professional researchers.

Summary

Qualitative research requires a researcher to develop a specific procedure for gathering, analyzing, and interpreting results. The information presented in Chapter 3 offered an extensive explanation of using an embedded case study to gather information about how and why STEM teachers embed career exploration into curricula. The embedded case study approach allowed for different perspectives, or embedded cases, to ultimately inform the comprehension of the case (Scholz & Tietje, 2002). In other words, analyzing the perspectives and experiences of each participant helped me understand more about embedding STEM career exploration into established curricula.

The data collected included teacher interviews and lesson plan analysis completed over two months. Data analysis focused on coding methods to identify participant descriptions of experiences and values related to STEM career exploration. These findings were used to develop interpretations of individual embedded cases and a holistic description of each case. Throughout the data collection and analysis process, I considered my role as the researcher and my potential biases to establish trustworthiness and ensure ethical procedures. This chapter described specific actions related to trustworthiness and ethics, including audit trails, data triangulation, participant privacy, and member checks.

Chapter 4: Results

The purpose of this study was to understand how and why high school STEM teachers embed career exploration into STEM curricula. Data from semistructured interviews and lesson plans from award-winning high school STEM teachers who currently embed career exploration into their curricula were analyzed to answer the research questions on teachers' experiences implementing classroom career exploration strategies, why they embed career exploration, and the barriers involved in this practice. The following chapter provides information on the study setting as well as information on the study participants. The chapter then details the collection, recording, and analysis of data from interviews and lesson plan submissions. The final section of Chapter 4 describes the findings and the evidence of the trustworthiness practices for the study.

Setting

Participants in this study were drawn from the pool of high school STEM teachers in the United States public schools who had been named a teacher of the year or were designated a finalist or a semi-finalist within the last 10 years. The participants' active inclusion of career exploration in their content curricula was also required for inclusion in the study setting. The participants were from nine separate school districts spread across eight different states in the United States. All represented schools are public schools and follow the guidelines and policies of the respective state's Department of Education.

The only demographic information contained in the descriptors for participants is the number of years teaching (reported in a range) and the school setting (rural, suburban, or urban) defined by each participant during the interview (see Table 1). Identifying individual participants was possible if these demographics were linked to participant responses or lessons.

Table 1

Range of Years Teaching and School Setting for Study Participants

Participant	Years Teaching	School setting
A	>15	Rural
B	5-10	Rural
C	10-15	Suburban
D	>15	Urban
E	>15	Urban
G	>15	Rural
J	>15	Rural
L	>15	Rural
M	10-15	Rural

Note. Due to the finite number of possible participants from the state teacher of the year pool, the study did not include identifiers such as state, town, and school district.

Social Media Recruitment Challenges

Social media was used in the successful recruitment of nine participants. During the recruitment proposal phase, I chose a private Facebook group due to the specific nature of my parameters for participation. As a member of this specific Facebook group, I believed more than 1,200 members would see the recruitment flyer. However, five participants saw the second posting of the recruitment flyer but never saw the initial posting on Facebook. The additional four found out about the study through word of mouth. The four participants had never seen the two postings of the recruitment flyer on Facebook, even though they were private group members. The lack of visibility of the recruitment flyer via social media made direct recruitment more difficult and necessitated snowball sampling to increase participant numbers (see Dusek et al., 2015; Zikar & Keith, 2023).

Data Collection

Participant recruitment and data collection took place over 2 months. Multiple posts to the Facebook private group did not yield responses quickly; therefore, participants were asked to help disseminate the recruitment information to the teacher of the year awardees, finalists, and semi-finalists they knew through personal or professional connections. Through purposefully sampling to social media and snowball recruitment, 13 teachers contacted me and requested informed consent. Upon receiving an email from a potential candidate, I assigned a letter to the participant. I began recording details about the data collection for the candidate on the audit trail document (see Appendix E). Nine participants consented to participate. The original letters assigned to these nine participants were used for the remainder of the study. This gap means some letters given to other inquiring teachers were not used; therefore, the participants' codes for my research are not consecutive. Once participants replied with consent, the participant received a calendar poll for scheduling the virtual interview with potential dates and times for the next week and a half. When I received the participants' preferences for scheduling, I replied with the chosen appointment and a copy of the Interview Protocol (see Appendix B) for participants to review, if desired. Participants were asked to complete the Lesson Plan Information Collection Form (see Appendix D) or send a digital lesson plan before the interview.

I conducted and transcribed interviews using the Zoom conferencing platform. The interview lengths varied between 32 minutes for the shortest time to 1 hour and 20 minutes for the longest. I recorded written notes during each discussion to capture specific phrases and added any additional notes that would help with future data analysis.

Five participants chose to complete the Lesson Plan Information Collection Form. One of these participants also sent an example of student work via email as a demonstration of the outcomes of the lesson. The participant answers were extracted to a Google Sheet for review. The remaining four participants emailed their lesson plans and other digital documents related to the lessons before their scheduled interview. The lesson plan information was reviewed and annotated for future coding and analysis using the lesson plan sample analysis protocol (Appendix C). Lesson plans were used to triangulate statements made by individual participants, when applicable, and as an independent form of data for analysis. Additional information related to the analysis of lesson plans is described later in the chapter.

Data Analysis

Semistructured Interviews

Upon completing all semistructured interviews, I printed each transcript to assist with analysis and uploaded each transcript to the Quirkos qualitative analysis software. The first-round coding process involved reviewing all transcripts and lesson plans for meaningful data segments related to descriptive statements and value statements mentioned by the participants. Using the Quirkos software, I highlighted and applied a code for statements related to the appropriate category. Table 2 provides examples of descriptive and value statements produced in the first-round coding process.

Table 2

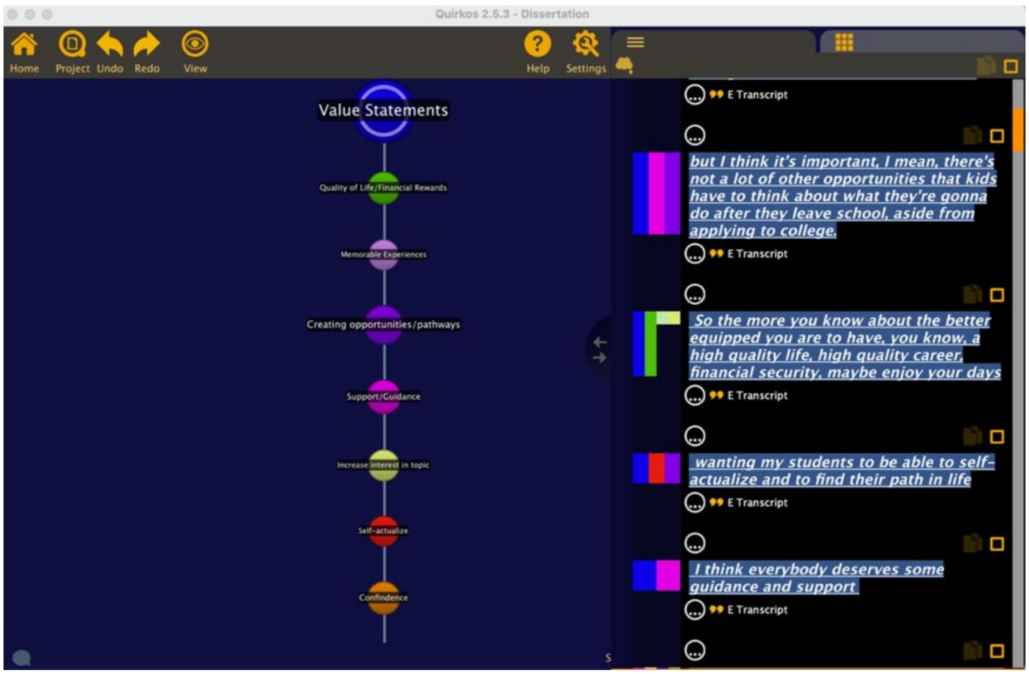
Examples of Descriptive and Value Statements from First-Round Coding

Statement Type	Examples From Coded Text
Descriptive	"But in chemistry, I start the year usually with like a couple of days on career exploration. Sometimes I end the year with it, too." "…in my classes and in other classes too in our school, come do service projects with them and just get out and see what it's like to grow food."
Value	"So, we have gone on some field trips to local businesses, and that, I think, is the most memorable and valuable experience that kids have." "I think everybody deserves some guidance and support in looking at what future possibilities exist and what, and then choosing."

I continued the first coding round with a more thorough review of the descriptive and value statements. Using Quirkos to show just the segments identified as value statements, for example, I started assigning emergent codes to address specific details about the statement. The Quirkos software maintained the statement as a value statement and created a new bubble for each new segment I highlighted and named. The initial code for value statements and each subsequent code were assigned a color. For example, statements made by Participant E that were initially identified as value statements (royal blue) were further identified as statements related to SUPPORT/GUIDANCE (pink), QUALITY OF LIFE/FINANCIAL REWARDS (lime green), SELF-ACTUALIZE (red), and INCREASED INTEREST IN THE TOPIC (yellow; see Figure 3).

Figure 3

Computer Screenshot of Value Codes Following First-Round Coding



In addition to the inductive coding described in the previous section, I used deductive coding to identify descriptive and value statements associated with two a priori codes: AUTHENTIC EXPERIENCES and SELF-EFFICACY. As stated in the Methodology section, these two pre-determined codes related directly to this study's conceptual framework. I continued to add value and descriptive statements to the associated codes in Quirkos. As more statements were assigned to a particular code, the size of the Quirkos bubble increased to demonstrate the relative quantity of responses.

At the end of the first coding round, I returned to the categories containing many statements to see if additional codes were needed to help identify other emergent codes to separate collective or discrepant ideas. This second coding round further segregated the intital codes' content into categories based on specific identifying words or descriptions.

One code, with many corresponding statements, was the emergent code within the Value Statements labeled BARRIER. This code contained multiple participant comments that could be further divided into codes of PD, TIME, SCHOOL SETTING, CURRICULUM REQUIREMENTS, and PRIOR EXPERIENCE (see Figure 4). A complete coding scheme is provided in Table 3.

Figure 4

Computer Screenshot of the First-Round Barrier Code with Second-Round Codes

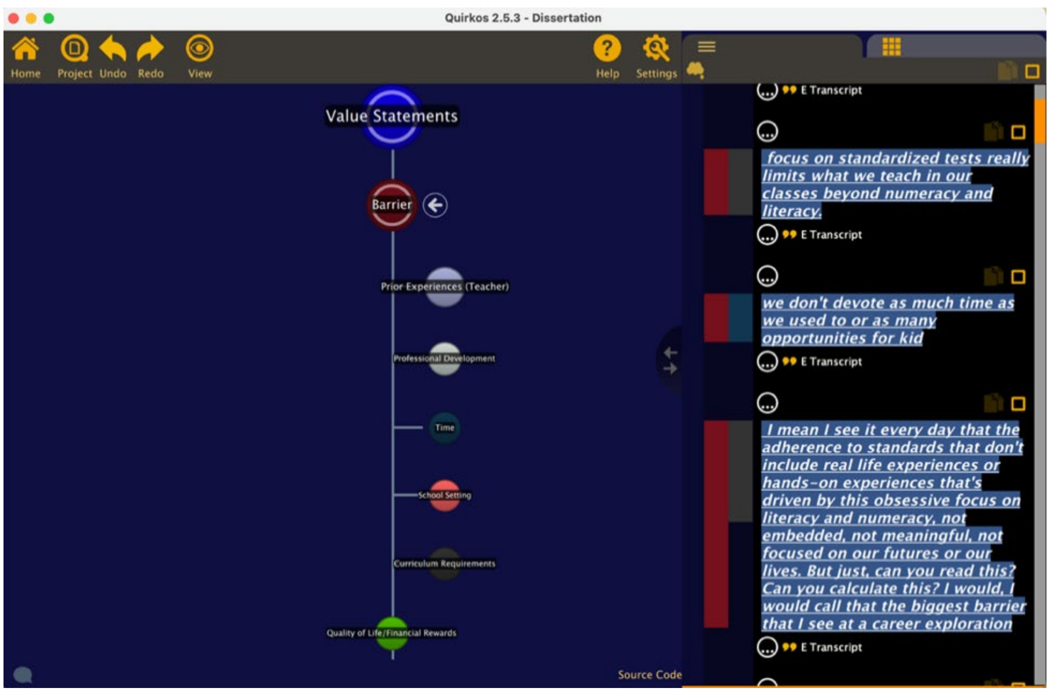


Table 3

First and Second Round Codes for Semistructured Interviews

	First Cycle Coding	Second Cycle Coding
Descriptive Codes	Activities	Career inventory/career survey Direct instruction Guest speakers Interviews Projects Social media/videos/readings Visuals
	Authentic Experiences	Field trips Inquiry-based lessons Modeling/role play PBL STEM/science fair
	Career Exploration Definition	
	Community connections or collaboration	
	Curriculum	Curriculum-required career exploration Self-created career exploration Standards
	School Demographics	Rural Suburban/urban
	Teacher Experiences	
Value Codes	Barriers	PD School setting Time
	Creating Opportunities/Pathways	
	Increase Interest in Topic	
	Memorable Experiences	
	Quality of Life/Financial Reward	
	Self-efficacy	Confidence Envisioning future Exposure Self-actualization
	Societal Contributions	
	Student Interest	
	Support/Guidance	

Note. Authentic experiences and self-efficacy are bolded and highlighted because they are a priori codes described in the Methodology section.

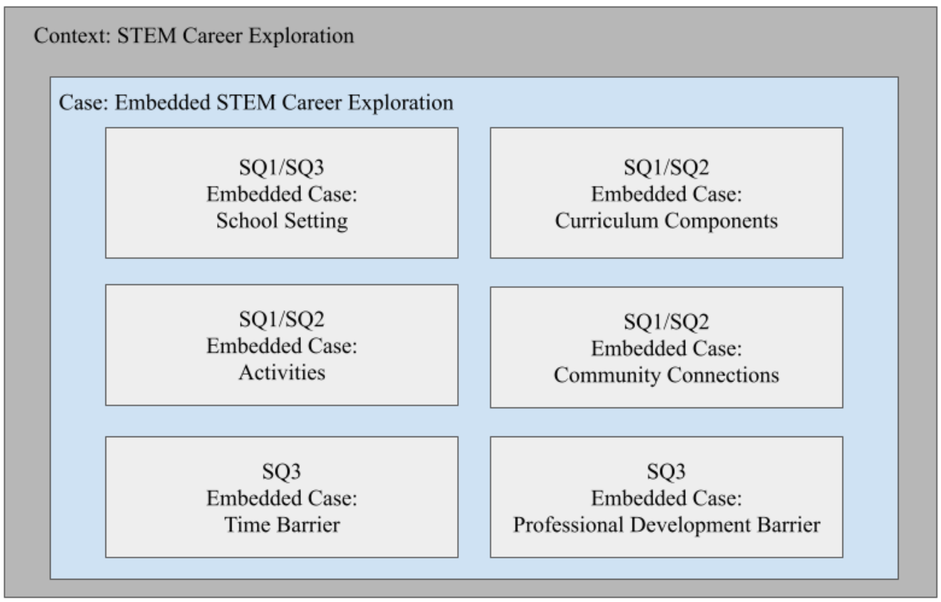
Lesson Plans

I used the same first and second round coding methods described for interview transcripts to analyze the lesson plans. Lesson descriptions and specific details, such as lesson objectives, were assigned emergent codes. I also looked for statements associated with the a priori codes of AUTHENTIC EXPERIENCES and SELF-EFFICACY. Analysis of the lesson plans triangulated data related to the value codes: EXPOSURE, ENVISIONING FUTURE, and INCREASE INTEREST IN TOPIC. All activities described in the lesson plans triangulated to previous descriptive codes, including AUTHENTIC EXPERIENCES, INTERVIEWS, PROJECTS, VIDEOS/READING, and VISUALS/MODELING/ROLE PLAY. This separate analysis was open to generating additional codes; however, no additional patterns were discovered across all nine lesson plans.

As stated in the last chapter, I examined interview and lesson plan data under the embedded case study design. Instead of using the first and second cycle coding to develop common themes across participant data, I looked at the relationships between the codes. I uncovered specific overlapping examples (or embedded cases) noteworthy of considering as separate units of analysis. Codes representing a unique practice or perspective were also identified as an embedded case for separate analysis. These embedded cases were aligned with the appropriate research question or subquestion and reported using thick descriptions. The embedded cases for RQ 1, related to teachers' experiences implementing career exploration, included school setting, curriculum components, activities, community connections, and barriers to time and PD. Figure 5 shows each embedded case and identifies the corresponding subquestion associated with RQ 1.

Figure 5

Embedded Cases Associated with the First Research Question.

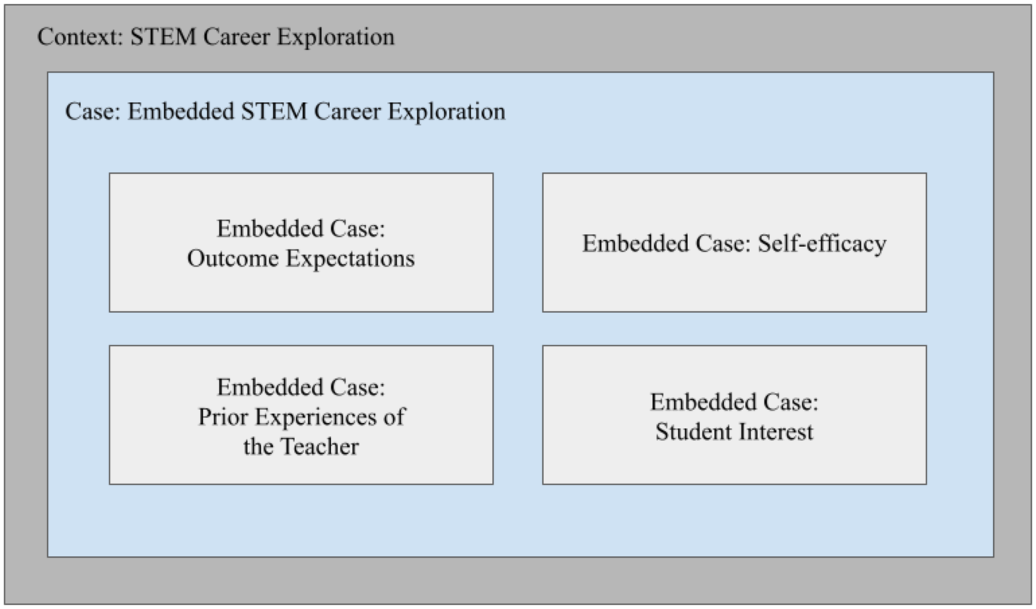


Note. Associated subquestions are also included in the figure. These connections will be explained in more detail in the Data Analysis section.

Embedded cases related to why teachers embed STEM career exploration corresponded to RQ 2. These cases included self-efficacy and outcome expectation reasoning, prior experiences, and student interest (see Figure 6).

Figure 6

Embedded Cases Associated with the Second Research Question



Discrepant Case

Embedded case studies offer an opportunity to use cases as a standalone situation to consider within the realm of embedding STEM career exploration or to look across embedded cases to compare each case's challenges and benefits (Yin, 2017). The nature of the embedded case study methodology eliminated the designation of a discrepant case because a unique situation becomes an embedded case related to a single participant. In this study, only one of the embedded cases represented the experiences of a single participant. This embedded case, Prior Experiences of the Teacher, used only data from one interview and the corresponding lesson plan. This unique case is factored into the analysis in the same way an embedded case with multiple participant exemplars was analyzed. All other embedded cases included responses or summation of responses from five or more participants.

Results

Analysis of nine participants' semistructured interviews and lesson plans generated 10 embedded cases within the main case of embedded STEM career exploration in the curriculum. Six embedded cases related to RQ 1, including the three associated subquestions, whereas the remaining four related to RQ 2. The following section describes the embedded cases related to each research question.

Embedded Cases for RQ 1

The first research question addressed teachers' experiences implementing STEM career exploration strategies in the classroom. The embedded cases for this research question were further distinguished from each other according to the relationship to three subquestions for RQ 1. During my review of the data for RQ 1, I noticed, for example, how teachers in rural schools embedded STEM career exploration differently from those in urban schools. A difference was also seen when participants described how career exploration occurred based on whether it was part of a required curriculum or something they had to self-create. I noticed a third within case difference when participants spoke about the types of activities used to facilitate STEM career exploration. Authentic and non-authentic tasks, such as active learning and direct instruction, were also identified during the independent analysis of each participant's lesson plan. For these three instances of cross-case comparisons, I created one embedded case that encompassed both opposing ideas. For example, the embedded case about school settings explored participants' opinions about how rural and urban settings impact STEM career exploration in the classroom instead of reviewing each school setting separately.

Embedded Case: School Setting

An embedded case that emerged was the participant's experiences with the practice of career exploration based on the school setting. Six of the nine participants identified the setting for their school as rural. The school's rural setting played a role in several aspects related to embedding STEM career exploration. Participants described how the rural location of their school determined the resources for career exploration that were available to the school. For example, participant B said rural communities receive few resources because "resources are not as plentiful as some of our other city schools." These resources could be in the form of physical equipment used to model career practices, access to various companies or businesses in the area, or in the form of funding. Participants with rural settings taught at schools with populations as low as 20 to 25 students per grade level compared to participants who identified their teaching setting as suburban or urban with over 200 students per grade. Funding may be limited due to school enrollment in these more remote locations. From an urban school setting, Participant E explained how funding through agreements with large brand companies provided funding for classroom projects. These companies are all considered local because of the school's urban setting. Schools farther away from these significant donors could receive different types of funding or no funding at all.

The responses related to the school setting mainly focused on the type of topics and activities teachers used to explore careers in STEM. This content was directly related to SQ 1 and how teachers embed STEM career exploration. Participant B rationalized the need to include STEM career exploration based on students' limited exposure to many occupations. "So, my catalyst was recognizing and realizing that unless a kid has a parent driving that far every day, which some do to go to work, we needed, I needed to do something different." The lack of diversity in the types of STEM careers in rural areas became the impetus for that action.

Five participants discussed how their rural setting often dictated the careers presented to students within lessons and curriculum. Participant J described how the lack of diversity in career opportunities and access to professionals in industry and academia in a rural location made it difficult to provide various examples for students. This challenge was especially true when students were allowed to explore a career of interest. Participant J stated, "It (limited career examples) forms how and what I teach because that is what my kids know." These same limitations were expressed by Participant L when they talked about how students who grow up in rural locations are exposed to only a few different types of STEM careers. Participant L took this one step further when they described how teachers living in these areas might also need to learn what other jobs exist because they have limited exposure to diverse STEM career opportunities. This limitation shaped the way Participant L chose careers to include in lessons related to career explorations because they did not want to limit student exploration to the fields found locally. Participant L stated, "I want them to see there are a lot of other really fun, cool, important things that they can do with science." Although Participant L felt it was important to expand to other career topics, they maintained the practice of place-based issues for many of their career-focused lessons because “it relates to things they (students) are interested in.”

Rural locations also created challenges for teachers when using a provided curriculum. These descriptions are associated with SQ 3 and focus on the barriers that limit the inclusion of STEM career exploration. Participant G noted, "The companies (textbook or curriculum) do not look to make examples for us (rural schools), so I think it has become more difficult as an instructor because I have to create the textbook now." Participants mentioned that their textbooks and curricula often use examples that are more specific to urban areas, which places the examples out of context for students. Examples related to local ranching, livestock rearing, and mining were given as examples of careers that are not found in provided resources. Participant G then described how this lack of examples representative of the students and their community could challenge engagement and motivation.

Participants from self-described suburban or urban schools did not express limitations in the topics or practices. Participant C teaches in a large district offering multiple high schools. Some of these high schools offer STEM pathways, while others are high schools without a content focus. Participant C stressed that proximity and the suburban location of the school allowed for direct partnerships, field trips, guest speakers, internships with government organizations, large engineering and manufacturing companies, colleges and universities, athletic franchises, established non-profits, and outstanding medical and biotechnology facilities. Students in this suburban location received instruction related to a large variety of potential careers because of the accessibility of these careers to the school. Though Participants D and E did not directly discuss how location impacted instructional practices related to career exploration, both participants identified proximity to urban areas as an opportunity to enhance lessons with field trips and guest speakers who may not be available in other districts in their state.

Embedded Case: Curriculum Components

One way in which teachers experience the practice of career exploration is through the curriculum used in each STEM course. Responses in the following section are related to both SQ 1 and SQ 2. All nine participants answered questions about their curriculum with information related to curriculum type, expectations, and whether the curriculum included career exploration. I noted a difference when the required curriculum included career exploration versus cases in which the individual teacher developed and embedded the career exploration into the current curriculum.

Two of the participants discussed a specific curriculum that intentionally included career exploration. Participant B used a nationally available STEM curriculum that included career exploration within the curriculum. Participant B explained that career exploration was always a part of this curriculum. However, a recent update focused more on embedding career exploration within the curriculum so that it coincides with the content and helps support the learning of content and careers simultaneously. Participant B stated, "Because then you can kind of be more authentic, and it is not just like another thing that you are trying to fit in." The presence of career exploration within the expected curriculum was a positive aspect of Participant B's work. With the opportunities for career exploration already present in the scope and sequence of the course, Participant B did not have to worry about where and when to add these concepts. Participant B noted that the consistent inclusion of careers in the curriculum made it easy to remember to include careers and offered various examples of how to include additional careers in the lessons and activities. Participant B's curriculum was unique in that career exploration was also included in the course assessment. Participant B explained that three of the four courses had an end-of-course assessment that included career questions." Therefore, the curriculum used by Participant B included the expectation of career exploration and offered specific information on when and how to explore careers and assess understanding of these career paths.

Participant C also used a STEM curriculum that specifically included career exploration as one of the significant components of the course. The curriculum was created by Participant C with the directive to have career exploration within the final product. Participant C also needed to center the course around career and technical education requirements and principles grounded in a national program focused on supporting underrepresented youth. This program creates partnerships with school systems to provide students with opportunities and resources to prepare for their future. Participant C, therefore, included a quarter long unit on STEM career exploration when designing the course. Students in this course spend multiple weeks conducting STEM field and STEM job research and exploring connections between these careers and the local needs of the community. Participant C stated, “One (component) is a careers unit, which also includes professional skills, such as resumes and mock interviews.” Students in the course also explore multiple careers and collaborate with peers to learn about the connections between fields. Although the STEM careers and community links explored each year are different, the foundational activities are expected annually and written into the curriculum that any teacher can follow in the school or district. In the case of Participant C, the curriculum that includes an entire unit on career exploration is used not only at their school but in the other two STEM highs school in the district.

The remaining seven participants described how their class curriculum does not include career exploration. Therefore, they deliberately embed STEM career exploration into the course curriculum provided by their district or aligned with state standards. Participant D described their current curriculum and how they identified the content when they stated,

> There are lots of opportunities through the curriculum for students to discuss, offer their own ideas, work together in small groups, and apply their knowledge to different real-world situations. In terms of being very specific about career exploration, the curriculum itself, I would say, does not do that.

Participant D added, "There are lots of real-world contexts, but I would not say that they explicitly, through the curriculum, try to teach students about specific careers."
The seven participants in this section acknowledged the need for more explicit information related to career exploration. Participants who discussed their curriculum development identified themselves as teachers of courses including, but not limited to, biology, chemistry, Algebra, physics, agriculture, research, and Earth science. Some studies, such as an Advanced Placement class, have a curriculum designated by The

College Board (www.collegeboard.org). Other courses incorporate a college curriculum through a collaborative dual enrollment program with local colleges and universities. Finally, some classes have a general curriculum that aligns with state standards but may have a flexible scope and sequence because they are not associated with Advanced Placement exams or college credit acquisition. Regardless of the class type, participants explained that the curriculum lacked career exploration and required additional information to meet this objective. Participant L, for example, stated that their undertaking of a dual enrollment course involved "a mix of things that you have developed in the curriculum plus the dual enrollment requirements." Participant A also spoke of their practice of modifying the curriculum by adding to the content information. Participant A stated, "It (career exploration) really has to be woven onto something else or enriching something else. For example, what we did was truly about air pollution, but I just threw in that little piece so that they got some career exploration." All other participants identified their respective state standards as the basis for their curriculum and acknowledged their commitment to adding career exploration to the content.

The experiences of Participants A and E were unique in that career exploration was an expectation for the class but was not included in the curriculum. Participant A's expectation of career readiness and exploration came as a state standard. However, the incorporation of the standard is left to the teacher to devise for the class. Participant E did not have a state standard to follow but did have the expectation of career exploration from the district. Participant E noted, "… there is a district expectation that we do a unit on careers. There is nothing provided. We just have to create it ourselves."

Participant D also used a unique curriculum development method that embedded STEM career exploration. In this example, the District Department of Equity and Diversity encouraged incorporating cultural and equitable practices and examples into all curricula. Participant D combined the required cultural components with career exploration. These examples were not part of the curriculum and needed to be created and added to the district-provided curriculum. Participant D stated, "I try to bring in career exploration through those cultural celebrations." They then provided an example of learning about black mathematicians and scientists during Black History Month, both those who are a part of the history of the mathematics field and those currently contributing to the field.

The remaining four participants (G, J, L, and M) had yet to have an expectation of career exploration from administration or state entities. I explored the reasons for including career exploration in these curricula in a future section of Chapter 4. The data relevant to this embedded case considered how the curriculum developed by participants in this category involved student interest and local career opportunities as the driver of the lessons and activities. Student interest was identified as a tool to develop and modify career exploration activities for six of the seven participants in this category. Participant E noted that one of the main components they considered when determining career exploration additions to the curriculum is the amount of interest in the career. To accomplish this, Participant E has students complete a career inventory survey as coursework. The results of this survey lead to a lesson where students research careers and present findings to the class. One of the learning targets/objectives for this lesson stated, "I can explore career options that fit my interests." The outcomes of these survey responses can shape the future lesson examples and activities used in this course. Participant E elaborated, "When I see the student passion emerge, that is when I activate." Three other participants also provided lessons based on objectives related to student interest. Participant A’s lesson plan objectives included the goal of students finding a chemistry career that interested them for use with future research in the class. Participant C also used STEM career interest as the foundation of a major project that included learning about the career and then collaboratively integrating this career with a partner’s career choice. Additional comments related to curriculum development focused on the need for flexibility in response to changes in interest. Participant J discussed how student interest required flexibility in curriculum and lesson development when they stated, "I think the market changes, I guess, like what careers they (students) are going to be interested in, what careers there are, what they hear about. So, I try to be just kind of responsive to what they are into". Participant M mentioned how student interest could reveal itself at any time, which can require modifications to the curriculum in an "on the spot" manner.

Local career opportunities were another subject used to modify the current curriculum to create opportunities for STEM career exploration. Participant G stated,

> But the textbook was the skeleton upon which it was my job to build the flesh of the lessons of the units… you have to match how you teach and what you teach to what the kids have around them. You need local

> examples. You need to explore locally, and all the curricular markets are built for California and Texas.

Participant G shared a lesson plan that included exploring a fisheries biologist job currently in place at a local ecosystem. Participant M described incorporating the activities of local caving groups and bat mist netters because this scientific field is active locally. Participant J includes local career opportunities by thinking about problems affecting the local environment and designing the curriculum around solving these issues. For example, instead of a genetics unit that might involve models from textbooks or a standard curriculum around human traits, Participant J embedded local content and careers into the curriculum by creating a livestock genetics unit. Ranching and raising livestock are prominent career opportunities in the local area. Therefore, Participant J wove these careers and the practices of the trade into the standard curriculum on genetics. Participant J explained, "We did a lot of genetic questions and problems, but then we also looked at the Expected Progeny Differences, which are measures of the probability of how good a bull is going to be (the value of the bull's progeny)." Participant E also identified the use of local careers, such as landscape design and chemistry jobs related to food science, at a local candy factory.

Although teachers developing their content within the curriculum described the flexibility to adjust and change content as positive, there were also limitations based on the career experiences of the educator. Participants said their lack of knowledge of different STEM careers created a challenge when developing curriculum and lesson content. Participant L mentioned they only knew about STEM careers based on their experiences growing up in a small town and the popular careers in the town where they teach. It is, therefore, necessary to find resources to help bolster STEM career exploration lessons to explore opportunities outside their limited knowledge bubble.

Embedded Case: Activities Used to Embed Career Exploration

The activities used by educators to embed career exploration were vast. Participants often described the instructional strategy and its use in the classroom. The two factors provide evidence for SQ 1 and SQ 2. The coding of interview and lesson plan data identified two main categories of activities labeled authentic or situation-based activities and teacher-directed activities such as concept-based learning or direct instruction about careers. All nine participants described the use of authentic activities related to career exploration, such as inquiry-based lessons and other student-driven real-world application activities. Participant G described inquiry activities where students worked in local ecosystems to measure fish as part of a long-term study. Students also developed small-scale honeybee entrepreneurial ventures and collaborated on a three-year bird research project that included field experience with data collection. Participant J told of an activity where students extracted phages (viruses that infect bacteria) from soil and collected samples from a local lake to analyze water quality after residents were swimming in the lake and became sick. Participant M told of an inquiry-based engineering activity that required students to solve a problem for teachers in the school. The design project asked students to create dry-erase marker holders for teachers. The process involved meeting with a teacher and listening to the teacher describe a need, and then the student began the iterative process of designing the marker holder. Participant M referred to the activity as a chance to practice real-world skills and "show them that this can be a career." Participants often commented that they chose activities that covered the required subject content and provided students an opportunity to do the work of the professionals. Participant L is responsible for their district's authentic high school research program. The entire course is designed as an authentic learning experience. Students use inquiry skills to solve problems while exploring STEM careers through collaboration with professionals in their fields of study.

One common practice mentioned by six of the nine participants was the use of PBL to embed STEM career exploration. Participant B used PBL activities to explore careers in biomedical research. Participant C explained how PBL in the curriculum allows students to explore careers through research and data analysis and work to solve community problems. Participant M stated, "For the last two years, I have really tried to embrace the problem and project-based learning." These projects included design challenges and STEM fair projects that required students to demonstrate proficiency with state standards while learning about associated careers. Many of the PBL descriptions focused on students modeling jobs and experiencing the challenges of these careers through PBL assignments. Participant A explained how using these PBL activities challenged students because "they have to find someone who knows more about it than they do and reach out to them. They are modeling real-world skills."

All nine participants also discussed activities that do not meet this study's definition of authentic activities. These activities included more teacher-led, direct instruction or concept-based activities where students learn about STEM careers through interviews, guest speakers, career exploration presentations, reading assignments, and viewing videos. These activities gave students access to careers for understanding. However, they did not focus on the application of the career or on student-driven questions, real-world experiences, or an opportunity to make connections related to the careers. Nearly all the participants described activities that asked students to learn about STEM careers through interviews. Some of these were interactions through phone calls, virtual meetings, and social media interactions between students and professionals. Some interviews were pre-recorded, and others were viewed as a webinar or virtual experience. Participant B emphasized the role of technology in making it easier to include interviews in the class when they stated, "Everyone has Zoom now, so the ability to chat with professionals has gotten so much easier." Participants D & E described using websites to access interviews of people with different careers that students could view as a class.

All the participants mentioned the inclusion of guest speakers to embed career exploration into the curriculum. Participant C spoke about a career panel provided by a local non-profit research organization, and Participant J described a monthly career exploration presentation for students that was conducted in the years prior to the COVID-19 pandemic. Guest speakers visited participant classrooms for careers in chemistry, physics, biomedical sciences, and biology. Speakers gave information on their educational backgrounds, job descriptions, and, when applicable, their current research endeavors. Participants noted the importance of virtual programs, like Skype a Scientist (www.skypeascientist.com), that allow teachers access to more career examples and the scientists who represent diverse individuals. These types of programs were also named as a way participants were able to continue guest speaker activities during the COVID-19 pandemic. Other virtual options discussed included using pre-recorded vignettes of mathematicians, biologists, farmers, and biomedical professionals whom students viewed in conjunction with the subject content. The visits and videos allowed students to learn about and understand the applications of the career. However, they did not include students actively engaged in modeling or projects related to career applications in the real world.

Lesson plans submitted by each participant demonstrated the use of authentic and non-authentic tasks for career explorations. Five of the nine lesson plans included activities where students were tasked with researching and presenting an analysis of specific STEM careers. In all cases, the projects were teacher-led activities with specific requirements for content. These expectations are related to education requirements, salaries, the national demand for the job, and the job descriptions. In the lesson from Participant C, the objective stated, "Students will be able to work independently to research a STEM interest career focusing on education needed to enter chosen career, skills, work environment, growth rate, and other relevant information." Other objectives for research and presentation-style activities included gaining background knowledge and learning about the contributions of individuals in a particular field. These projects did not include student-led activities or situated learning experiences.

The remaining lessons were either identified by the participant as using PBL instructional practices or were project-based. These projects included independent research projects, design challenges, and lessons with objectives that asked students to collect data like the professional or to model activities representative of the professional's daily work. Participant M identified learning applications of STEM in the real world as one of the objectives of the PBL lesson submitted. Participant B provided a lesson that was a mix of direct instruction about a STEM career and an opportunity for students to apply their understanding of a career by simulating the job of a genetic counselor. When referring to the lesson and its content, Participant B stated, "It is like the story that makes all the other information relatable." The lessons revealed a few of the instructional practices that teachers utilized to embed STEM career exploration.

Embedded Case: Community Connections or Collaboration

SQ 1 and SQ 2 are addressed by describing how community connections or collaboration affected teachers' experiences with STEM career exploration. All nine participants described some collaborative relationship associated with the experience of embedding STEM career exploration into the current curriculum. Each participant found members of the school, the district, the local community, and beyond for interactions related to STEM career exploration. There is a sense that all teachers looked for collaborative opportunities and utilized what they knew was available (see Table 4).

Table 4

Participant Responses Related to Collaboration

Participant	Response
A	"I put that in some of my projects where I found this like team of experts; it is kind of like asking a scientist. And when they are doing their science project, they can call and ask different people in the field different questions about what they are doing."
B	"We work with our local community college, and every year, we actually take our kids to the college, and they experience all the different biomedical certificate and nursing programs they offer."
C	"You know we have partnered with NASA to have them have guest instructors, who are astronauts, for our Earth and space kids."
D	"They (Equity and Diversity Department) often share resources with us, and so they pull these resources and vet them, and then send them out to us, and I sometimes use those to help me to decide on what people I want to focus on (for career exploration)."
E	"It is a community organization in our neighborhood that runs summer camps and after-school programming. And they will have students, in my classes and other classes too in our school, come do service projects with them and just get out and see what it is like to grow food."
G	"You build those connections, and you call in some people, and suddenly, it becomes a yearly thing, and so he brings his boat in and sets the nets in the lagoon. And then the next day, the kids are sorting fish species, weighing, you know, length, and then we have an opportunity where he meets with the kids for about 20 min. And this is a question-and-answer session."
J	"So, I try to be kind of responsive to what they are (students) into and bring that in. Whenever they (students) say, 'This relates to what so and so does,' I am like, 'Oh my gosh! Bring them in!'"
L	"So, we collaborate with many people. My kids work with the Fairchild Botanical Gardens in Florida. They have a NASA growth chamber where the students grow whatever the scientists are growing on the International Space Station, and this is 20 to 30 schools across the country. We, our students, contribute their data to NASA for that research project."
M	"You know, tons of collaboration almost on a daily basis. Checking in with each other and asking: What are you doing? What is cool? Stealing ideas from each other."

Whether the collaboration efforts were already in place, or a teacher wanted more collaboration to enhance the practice of STEM career exploration, each participant understood the need for collaboration beyond the classroom walls to bolster the career exploration opportunities available to their STEM students. The chance to collaborate also allowed participants to modify the curriculum as different types of collaborative opportunities became available.

There was also a sense that all participants sought more collaboration, guidance, and resources from local and state education policymakers, textbook writers and curriculum developers, PD creators, local businesses and community organizations, and higher education institutes. Participant A desired an approach to career exploration that utilized current relationships with local colleges to create a top-down approach to career exploration. Colleges share practices and guidance for career exploration with local high schools to establish a more cohesive transition between high school and college. Participant M also spoke of how collaboration with colleges would positively impact STEM career exploration practices and how having relationships and access to colleges with science degrees would allow students to work directly with college professors to learn more about careers. Participant L also sees a need for collaboration that includes multiple grade levels and industries. Participant L stated, "I have been trying to work on building a kindergarten through industry STEM pipeline so that we are connecting industry and those researchers and scientists better with students earlier on."

Embedded Case: Time Barrier

Time was a barrier that all educators shared when asked about the challenges associated with embedding STEM career exploration in their curriculum (SQ 3). Participants responded almost immediately with the response of time, and answers included phrases like "obviously" and "of course" to emphasize the general belief that time was a significant barrier. The topic of time took two paths. One path discussed the time as it related to the scope and sequence of the curriculum. Many participants expressed frustration with meeting the numerous required benchmarks for state standards. Participant M said,

> Time is the biggest barrier that I have. I try hard to bundle standards together to give students more time. But even the way I do it, I find myself at some point in the year. I have got to squish.

The need to meet many standards and learning objectives made it easy for participants to leave career exploration out of their practice. "It is easy for six weeks to go by and me not do a career type of a thing just because I am focused on how to get the content out," added Participant G. This is especially true when students struggled with content. Participant A asked, "How am I going to put one more thing in here when students are struggling just to get the concepts you are trying to teach?" The time to focus on career exploration was often lost due to the demands of the content. Lack of time either limited the length of the opportunities to explore careers or limited the number of options provided to students. In some cases, participants only included career exploration activities once per term or unit, usually at the beginning to ensure they fit into the course schedule. Participant E added, “When we look at school scheduling and how much time students have for experiences beyond numeracy and literacy, we do not devote as much time as we used to or as many opportunities for kids.” Participant D also noted that more time is needed because students may not get to explore STEM careers as in-depth due to the need for so many other requirements within the curriculum. They added,

> As teachers, there is never enough time. There is never enough time for all the things that we want to teach and all the planning. In a perfect world, I would absolutely have more time for career exploration. I would like to do even more extensive projects and really get kids to consider specific jobs.

The second theme related to time was how the lack of time impacted the opportunities teachers had to collaborate with staff to discuss options for career exploration. Participant D stated, "We do have professional learning weekly. We have a meeting almost every week with math teachers from our department. Still, most of the time, we are focused on what is in the curriculum and making sure we know students are learning standards and how we can get them there, so we do not often talk about career exploration." The lack of opportunity to share ideas and develop rich career exploration opportunities for students was shared by several other participants. None of the teachers shared that they had regular opportunities to collaborate with co-workers about STEM career exploration.

Embedded Case: PD Barrier

Eight participants described limited PD opportunities related to STEM career exploration. These limitations created another barrier example to address SQ 3. For many participants, recalling the last time they received PD specific to career exploration was difficult. When asked about PD related to STEM career exploration practices, Participant L, a veteran teacher of more than 15 years, stated, "If there was, I missed it, and I go to a lot of PD." Participant B received over 80 hours of PD specific to a nationally known curriculum and spoke positively about the experience. They mentioned that the PD was detailed but needed to be more focused on the career exploration aspect of the curriculum. PD for career and technical education STEM courses, like agriculture, biomedical sciences, and food sciences, were also mentioned as opportunities to receive training for the provided curriculum. This training may have included components related to the career highlights of the curriculum, but it did not emphasize training in practices associated with STEM career exploration.

Other participants spoke of PD that was not directly related to STEM career exploration but offered opportunities to think about instructional practices that incorporated real-world examples and situations. Participant D experienced a PD opportunity that focused on starting lessons with real-world situations. Examples from the PD included life events like holidays. Careers were not specific examples provided; however, Participant D built on the idea of these situational inquiries and began to create situations to explore mathematicians and scientists involved in their respective careers. Participant L also spoke of how they used a PD opportunity that asked teachers to include the current research of engineers as the foundation for a chance to explore careers. They explained that during the PD, "it was an eye-opening experience to see engineering skills applied." Regardless of the PD opportunities experienced by each participant, most expressed a need for more training in embedding STEM career exploration on both the school and district levels and with PD offered through outside sources.

Embedded Cases for RQ 2

The next set of embedded cases corresponded to RQ 2 and described why STEM teachers embed career exploration in their curricula. The section includes a summary of participant definitions of STEM career exploration. The section then describes participants' responses to expected outcomes or self-efficacy as reasons for intentionally including STEM career exploration. In addition, one participant described previous experiences from their education that influenced their decision to incorporate career exploration. Interview answers from participants are included here as they represent a personal motivation for the practice of embedding career exploration. In some instances, I used examples from the participant’s provided lesson plan to triangulate their interview responses. Some cases in this section also include a separate analysis of all lesson plans beyond the scope of the interview answers.

Definition of Career Exploration

All nine participants were asked to define STEM career exploration. Responses are provided in Table 5. I created a synopsis for each participant from their answer to the specific question and other descriptions they may have given while responding to other questions in the interview protocol.

Table 5

Definitions of STEM Career Exploration Provided by Participants

Participant	Definition
A	Opening students' minds to the diversity of people and opportunities associated with science.
B	Providing career knowledge related to current topics and showing skills' interrelated nature.
C	Opening kids to things they did not know about and encouraging them to discover linked interests.
D	Providing a gateway to opportunities.
E	Embedding a lens or perspective into the curriculum allows students to think strategically about their future.
G	Providing opportunities that get kids thinking about the endgame and what contribution or purpose they will serve in the future.
J	Giving information to students to provide exposure and relevance to why they need to know specific topics and content.
L	Letting students be the driver of their exploration.
M	Providing students with as much exposure to opportunities as possible.

Although none of the participants defined STEM career exploration in the same way, the prominent topic expressed by many was the desire to create opportunities for exposure to careers. These definitions did not directly correlate with participant responses concerning why each participant included STEM career exploration. Nevertheless, the description can provide context for how a participant understands career exploration concepts and how it might influence their motives for such practices.

Embedded Case: Outcome Expectations

All participants presented reasons for embedding career exploration related to a goal or outcome expectation for students. In most cases, participants included STEM career exploration in the curriculum because it allowed students to see what careers were possible (exposure) and what they could expect from these career pathways. These expectations included understanding the opportunities within the careers, the potential benefits to the individual student, and the potential benefit to society. Participant E explained that their reasoning was so critical to them that they extended the career exploration into a complete unit of learning for students and added,

> I was not told that it had to be a unit, but I just decided to make it a unit… there are not a lot of other opportunities that kids have to think about what they are going to do after they leave school, aside from applying to college.

This desire to expose students to careers was also held by Participant D. "It dawned on me that these kids are very close to deciding what they are going to do with their lives after high school. So, I wanted them to understand that they had options," they said. Participant B also focused on exposure as their reason and added, "I think it is more about just giving students exposure to see what is out there." Exposure to careers can help students know what they want to do when they grow up and not be forced into something because it is the only option available. Participant M referred to their own experience with deciding on a future career and how challenging it was because of the few jobs they had been exposed to during high school. Embedding career exploration allowed many participants to help students think strategically about their future outcomes.

Participants described other outcome expectations related to the future success of the student. Five of the nine participants referred to achievement as one of their reasons for embedding career exploration. Participant M spoke generally about success and stated, “I want students to know what they want to do when they grow up. I want kids to have opportunities. I want kids to really be successful." Success in financial stability or quality of life drove the curriculum modifications for other participants. Participant E stated, "My ultimate goal is for kids, when they grow up into adults, to have a profession that they enjoy and is financially rewarding enough to have a comfortable life." Participant C also mentioned having a job that allowed students to "provide the basics for yourself and your family" in the future. The lesson plan provided by Participant C supported this statement through objectives related to student understanding of job growth rate, income, and other relevant information. Exploring these elements allowed students to understand how their chosen career might impact their futures. Another lesson plan from Participant A included a learning objective that asked students to research a career and be able to explain the job outlook, including demand, salary, and earning potential. Participants who thought about each student's quality of life used this as a spark for deliberately embedding STEM career exploration. Participant D summed up the sentiment when they said,

> Learning this content is a gateway for a lot of students to have a fulfilling life, to come out of poverty, to be able to do something in their lives, and to really change the trajectory of their families.

A third idea linked to teachers' decisions to include career exploration was relevant to how the outcome would benefit society. Participant E described how they challenged students to explore careers in high demand worldwide. Participant J expressed the need to teach about jobs so that "students can come back and serve their community." Participant G added, "It is just getting kids thinking about the endgame of what contribution and purpose are you going to serve in the future?" These three participants focused on a general contribution that students could make to society. Participant B narrowed the scope of the reasoning to include a particular skill set that benefits the workforce. They added, "We want you (the student) to leave here being able to think critically and be a member of the workforce." There were no specific lesson objectives that correlated to this reasoning.

Embedded Case: Self-efficacy

No participant used the phrase self-efficacy to describe their reasonings for embedding career exploration. Descriptions from each participant, however, did point to a desire to increase student confidence, present representative examples, encourage self-actualization, and provide opportunities for students to envision themselves in these careers. These actions relate to self-efficacy because they increase a student's belief in their ability to be successful in a chosen STEM career. Three participants specifically answered with a response that wanted students to believe they could do the job. Participant D stated, " And so that is what I really want them to walk away with the recognition that they can do. They can do this." Participant G echoed this response when they said, "You see the opportunities growing for these kids and the light bulbs turning on like, yeah, I could do this, you know." The same sentiment is found in Participant M's response when they said,

> It is just allowing students just to figure it out. We have this, you know, kind of sandbox when they are in high school to hopefully, you know, build a little, you know, structure that they see themselves doing it.

Two participants specifically spoke about representation when they described their reasons for career exploration practices. This representation, including race, gender, and physical ability, was essential to these participants and motivated each to not only include career exploration but to do so with a lens of equity and diversity in mind. Participant A stated, "I do believe that if you see someone who looks like you are doing that role, it encourages you to think you can do it." Although only two participants specifically spoke to representation as a reason, other participants mentioned the diverse demographic of students as a reason to ensure that students are exposed to STEM careers.

A review of lesson plan objectives and activities did not relate to self-efficacy. Most of the learning objectives focused on specific actions such as knowledge acquisition. Submitted goals did not include criteria such as increasing exposure, diversifying representation, or growing student confidence. Participant L elaborated on the independent research project lesson plan they submitted and explained that the outcome for students related to confidence and exposure is not a written goal. Instead, the goal is to encourage students to direct the results. Exposure to different professions can increase student interest and confidence. Participant L responded, "So each student gets something different, and they are determining what they want from it. That is probably the most important part to me".

Embedded Case: Prior Experiences of Teacher

Participant E was the only participant with prior experience directly contributing to why they currently embed career exploration into curricula. During their time in college, Participant E decided their projected career was not what they wanted to pursue anymore. They visited a career counselor and were allowed to complete a career interest inventory. There were additional opportunities to meet with the counselor and discuss career options. The counselor ultimately asked Participant E if they had ever thought about a career as an educator. Participant E reflected,

> I have been in education for a long time now, and it has been a great career for me, and I would not have considered it if I had not had that counseling and that inventory combination.

Participant E uses the career interest inventory yearly to guide career exploration in STEM classes. Including completion of the interest inventory multiple times each year is a deliberate way to provide as much exposure to careers as possible. Participant E added,

> I encourage them, you know, if it is at all interesting to you, do it again and look at five new careers and five new careers and five new careers because who knows what is going to spark your interest.

The lesson plan provided by Participant E supported this work. The lesson was a research project that included an opening activity where students completed a five-minute inventory to identify five careers of interest to explore further. There were no other prior experiences identified by participants who appeared to be the origin of their current practice related to STEM career exploration.

Embedded Case: Student Interest

Student interest was already discussed in how teachers developed curricular and lesson components. In other words, student interest influenced how participants embedded STEM career exploration. Participants also spoke about student interest related to why they chose to embed career exploration into the curriculum. Participant A offered an example from a chemistry class. Students seemed unsure how chemistry was relevant to a career interest in cosmetology. Participant A wanted students to see the connections between content and their future. They explained, "I had many girls for a long time who are like, well, I just want to be a cosmetologist. I do not need chemistry. So, I brought in cosmetologists to talk about the chemistry they learned". Participant A also used a project related to the first African American millionaire and products for African American hair to increase chemistry connections. Participant A described one reason for including these projects as "trying to bring STEM to the students wherever they are." Peaking and sustaining student interest in subject content became a reason for continuing to embed STEM career exploration. Four other participants commented on wanting to increase or maintain student interest as a reason for including career exploration. Participant E stated, “So, I am always on the lookout for when a student enjoys something that we do in class and to try to connect it to a possible future activity.”

Evidence of Trustworthiness

The methodology for this project included a detailed coding scheme that used both a priori and emergent codes. The methodology and data analysis sections of the current chapter included a detailed description of the coding process. The coded content was then used to create a detailed description and context-rich interpretations of the findings.

Triangulation of data increased credibility, transferability, and dependability. Lesson plan data supported interview responses and allowed for a separate analysis of data to enrich the descriptions of each embedded case. The use of two different forms of data offered multiple levels of perspective and corroboration of my interpretations.

I regularly updated an audit trail (see Appendix E) for confirmability and dependability. My audit trail described the process of recruitment as well as the data description and analysis process. The audit trail helped me organize codes and outlined the continuous revisions during the coding process. I included images to verify that I completed the data analysis according to the proposed methodology.

Member checking was used following the creation of descriptions for each embedded code. After using an online number generator to select participants, I sent five participants a summary of the results section of Chapter 4. I asked each to review the section to provide constructive feedback on the rich detail used to explain interview responses and lesson plan submissions. I requested that each participant acknowledge their perspective and when applicable, the intent of their respective lesson plan was represented by the written descriptions of the embedded cases. I received responses from four of the five participants. There were no recommendations for additions or changes to the interpretations I provided.

Summary

The purpose of this study was to understand how and why high school STEM teachers embed career exploration into STEM curricula. I identified two research questions, one related to how and the other to why teachers embed STEM career exploration, to guide the analysis of semistructured interview responses and lesson plan data from nine participants. Inductive and a priori coding of data resulted in 10 embedded case studies for analysis. Six of the 10 embedded cases in this study related to the experiences of STEM teachers purposefully embedding career exploration (RQ 1). These six embedded cases provided details on how teachers embed career exploration into the curriculum (SQ 1), the instructional strategies that teachers use (SQ 2), and the barriers experienced by teachers as they implement these practices (SQ 3). Teachers in this study embedded career exploration into STEM curriculum using opportunities that reflect the school setting (rural or suburban/urban) and in response to the type of curriculum provided or not provided by the school/district. The instructional practices used to embed STEM careers into the curriculum included authentic or situated learning opportunities and teacher led activities. All nine of the participants used a combination of the two types. However, the implementation of these practices is often restricted by time and PD opportunities. School setting was a factor in how teachers embed career exploration and represented a barrier for most rural teachers.

All nine participants gave multiple reasons for embedded career exploration (RQ 2). The most prominent reasons focused on outcome expectations, including financial rewards, quality of life, societal contributions, and success. Teachers also expressed a desire to increase student self-efficacy by helping students envision their future, exposing them to various careers, and building confidence in themselves as STEM students and future workforce members. Only one participant was influenced by a previous experience with career exploration during their education.

In the next chapter, I will use the data collected in this study to substantiate the current understanding of STEM career exploration practices and contribute additional ideas to existing research. I will also interpret the findings of this study as they relate to the conceptual framework offered in Chapter 2.

Chapter 5: Discussion, Conclusions, and Recommendations

The purpose of this study was to determine how and why high school STEM teachers embed career exploration in curricula. This qualitative embedded case study was grounded by a conceptual framework using aspects of SCCT (Lent et al., 1994) and situated cognition (Brown et al., 1989). A study based on these two theories allowed for an examination of the connections between instructional practices and teacher perceptions about STEM career exploration. These theories also provided a basis for developing the research questions for this study.

Nine high school STEM teachers provided interview and lesson plan data for analysis. The results identified 10 embedded cases that offered views on the practices used and the reasonings for embedding STEM career exploration. Embedded cases included examples of how teachers embed STEM career exploration and the types of instructional practices used in these examples. Additional embedded cases provided unique perspectives on barriers such as time and minimal training related to embedding STEM career exploration. The remaining embedded cases identified the various reasons a teacher chooses to do so. When considering all 10 embedded cases, the results of this study point to a need to expand on the amount of time students spend exploring STEM careers, the types of hands-on, applicable experiences used in the classroom, and the amount of support teachers receive to make this possible. This study also showed that teachers are thinking about their students' self-efficacy and future successful outcomes when they purposefully take the time to embed STEM career exploration in curricula.

Interpretation of the Findings

Experiences of Rural Teachers

The results of this study indicated that teachers have varied experiences and reasons for implementing STEM career exploration in the classroom. One circumstance that created different experiences for high school STEM teachers in the school setting was whether the school was in a rural or suburban/urban area. This topic was not explored in the literature review. However, in a quantitative study based on national high school longitudinal data, rural, or small-town schools were shown to offer fewer STEM career exploration opportunities compared to suburban or urban schools (Saw & Agger, 2021). The current study provides evidence that rural teachers are providing diverse opportunities for rural students to explore STEM careers. The current study only focused on opportunities provided through different instructional practices, however, and did not include variables such as course offerings, teaching capacity, and extracurricular programs described previously (Saw & Agger, 2021). The current study also offered a rich description of experiences that are not available in the previous quantitative analysis (Saw & Agger, 2021).

Participants from rural locations found that distance from businesses and higher education institutes created a challenge for collaborative efforts and opportunities for real-world experiences and applications. Even when collaboration was possible, the rural settings offered a limited pool of examples related to STEM careers. These results reflected earlier research identifying the narrow range of visible career options in rural communities as challenging STEM career exploration (Gibbons et al., 2019). Teachers in suburban or urban areas spoke of the many opportunities for students to attend field trips, internships, and other on-site programs because of their proximity to these entities.

Additional constraints related to rural areas included limited resources and curricula that needed to be culturally relevant to the school setting. These limitations challenged rural teachers to take time to seek out resources and, in most cases, to re-write the curriculum to highlight more relevant content for students. Previous work described how rural teachers were required to adapt curriculum components to enhance the interests and experiences of students from rural populations (Gibbons et al., 2019; Gibbons et al., 2020). All the participants from rural locations spoke about the need for curriculum changes. Therefore, it is possible that location or school setting significantly influences how rural teachers embed STEM career exploration into the curriculum versus suburban or urban teachers.

Experiences With Standards and Curricula

Increasing the cultural relevancy of curriculum for rural or other under-represented students has been shown to increase STEM career interest and student self-efficacy (Arif et al., 2021; Corneille et al., 2020; Kier & Blanchard, 2021; Lee et al., 2022; Gibbons et al., 2020; Rocha et al., 2022; Sparks et al., 2020). Though participants in this study did not expressly point to student self-efficacy as the reason for changing the curriculum, the teachers' time and effort used to make these changes may influence these outcomes beyond the teacher's initial intention of cultural relevancy.

The literature review indicated that national standards emphasize science and engineering practices but do not explicitly mention learning expectations for STEM careers (NGSS Lead States, 2013). Peterson (2020), however, indicated the need for explicit career content within the STEM curriculum. In this study, eight participants had no formal requirement for STEM career exploration at the state or district level. The one participant who worked in a state with a learning standard related to career exploration still lacked specific directives on how and when to embed the content. The lack of specific criteria for career exploration described by participants in this study shows a possible lack of consideration for the findings from current research that recommend the inclusion of purposeful integration of career components to increase STEM career interest (Li et al., 2021; Peterson, 2020; Virtič & Šorgo, 2022). Some states appear motivated to transform STEM education into a more student-centered, career-centered practice. In 2019, for example, Indiana embarked on a 6-year strategic plan to improve STEM instruction and increase interest in STEM careers through changes to curriculum and instructional practices (STEM Six-Year Strategic Plan, 2018).

The lack of specific standards for STEM career exploration did not deter participants from including these practices. It did, however, create situations in which teachers who were expected to or wanted to include STEM career exploration had to develop the content and activities on their own or modify existing activities to include some form of career exploration. In this study, many participants used student interest to guide the choices for instructional practices and activities. Career interest is one dimension to consider when developing STEM career exploration activities (Dorph et al., 2018). Building on student interest through coursework and proactive career exploration in undergraduate education ultimately added to student interest in these STEM pathways

(Quinlan & Renninger, 2022). Though more research is needed at the high school level, any opportunity to include a student's interests in a lesson can help encourage and sustain their aspirations for future careers (Rocha et al., 2022). Teachers can use career interest surveys to identify focus areas when developing lessons and curriculum updates (Kier & Blanchard, 2021; Mau et al., 2019). One participant in this study utilized a formal career interest survey. However, it is not clear how other participants identified students' career interests other than through student comments or classroom discussions.

It should be noted that there were teachers in this study with experience using a curriculum with components of STEM career exploration in place. One such curriculum is the nationally known curriculum called Project Lead the Way. Participants in this study who used Project Lead the Way noted that careers and career exploration were included in the scope and sequence of the curriculum. However, the depth of exploration needed to be improved, and there needed to be more opportunities to add additional activities to the curriculum. This experience reflected the limitations on the breadth and depth of career exploration content in the targeted curriculum (Margot & Kettler, 2019). Project Lead the Way is a purposeful curriculum, but not necessarily accessible due to costs (Stebbins & Goris, 2019). So, although curriculum options incorporating some degree of STEM career exploration are known, they may only be available to some teachers. This limited access creates a situation where the desire for such practices requires teachers to create their curriculum or modify existing options. The type of content in the curriculum used by teachers, therefore, directly impacted their choice of activities and instructional practices related to career exploration.

Another factor noted in this study was the impact of a teacher's knowledge of STEM careers. Participants noted they are often limited to examples based on their knowledge of STEM careers. This lack of knowledge was especially noted with the teacher in rural areas where, as previously noted, they encounter fewer career examples in their setting. If the curriculum already needs more information related to STEM careers, teachers may be limited in how they modify and supplement the curriculum. This limited knowledge has been described as having a negative impact on STEM career exploration (Navy et al., 2021; Srikoom et al., 2018). If participants feel their limited knowledge of STEM careers can negatively impact their ability to embed STEM career exploration, they may be less likely to focus on STEM career exploration.

Authentic Instructional Practices

Despite differences in the school setting and the curriculum type used by study participants, commonalities existed in the classroom activities and the instructional strategies used to promote STEM career exploration. All participants in this study described authentic practices as an important way to embed career exploration with content standards. Authentic practices have previously been shown to increase STEM career interest, self-efficacy, and career goals in students (Beier et al., 2019; Bradley et al., 2021; Nachtigall et al., 2022; Schriebl et al., 2022; Wang et al., 2021). Participants in this study described practices such as PBL, engineering design, and inquiry-based activities to describe their examples of authentic experiences. Though the terminology for these practices is sometimes used interchangeably, the study participants described these activities as student-driven, open-ended, meaningful, and applicable to the real world.

Participants noted that adding career information to these activities seemed a successful way to embed STEM career exploration. Researchers have shown the benefits of using PBL to support STEM career interests (Abe & Chikoko, 2020; Birzina et al., 2021; Çevik, 2018; Wyatt & Nunn, 2019). Specifically, engaging in PBL activities increased student interest in novel STEM careers (Drymiotou et al., 2021). Engineering design lessons showed promise in increasing engineering skills and influencing students' tendency to pursue STEM careers (Özkul & Ozden, 2020). Inquiry-based learning approaches also allowed students to participate in contextualized learning that increased STEM career interest (Hiğde & Aktamış, 2022).

Other authentic learning opportunities described by participants supported previous evidence on the topic. These activities included career-based scenarios (Drymiotou et al., 2021), role-playing (Emembolu et al., 2020), and off-site field trips (Brigandi et al., 2020). Though participants in this study acknowledged using authentic instruction to embed STEM career exploration, the amount of time spent using this instructional practice was not addressed in this study. If participants used authentic experiences minimally throughout the year, there may still be the need for additional exposure to these types of experiences through other opportunities. Previous research provided examples of authentic experiences through informal science education programs outside of regular school hours (D. Cohen et al., 2019; Habig & Gupta, 2021; McDavid et al., 2020). The current study did not address other STEM career exploration opportunities available in the school or district of each participant. Though the annual quantity of authentic experiences cannot be factored into the results of this study, participant responses offered additional evidence for the continued use of authentic activities as an instructional practice that can be used to embed STEM career exploration.

Community Connections and Collaboration

One important factor identified by this study was the importance of community connections and collaboration necessary to include authentic experiences. It is not a specific instructional practice, but partnerships and community collaborations can support the instructional practices of STEM educators (Burrow et al., 2018; Godbey & Gordon, 2019; Scott-Parker & Barone-Nugent, 2019; Taylor et al., 2021; Wu-Rorrer, 2019). Participants spoke of partnerships with local businesses, museums, industry and medical professionals, and colleges and universities. These relationships often started as short career presentations but grew to annual collaborations incorporating student participation in real-world experiences. These results show that more emphasis from curriculum developers, district administration, and STEM teacher preparation programs should emphasize and encourage community outreach to help students engage in career exploration and understand the relevance of the career within the community.

Other Instructional Practices

Although the literature review for this study focused on the research related to authentic experiences as having the greatest influence on students' STEM careers exploration, all the participants described using non-authentic or teacher-led practices that were also used in their practice. These practices offer students fewer student-centered opportunities, but some, like guest speakers, positively impact STEM career exploration outcomes (Brigandi et al., 2020). The participants in this study perceived the use of activities such as direct instruction, interviews, guest speakers, and research projects as valuable ways to embed STEM career exploration and increase understanding of these careers. Often participants identified goals related to students learning more about the careers and background information linked to salaries, education requirements, and job descriptions. No participant spoke of these non-authentic activities as the only instructional practice used for STEM career exploration. Findings from this study proposed a close interplay between the use of authentic experiences and more teacher-led instructional strategies to embed STEM careers in curricula. Participants combined use of opposing instructional strategies expanded the proposed conceptual framework for this study and will be explained in a future section.

Barriers to Embedding STEM Career Exploration

The primary barrier identified by participants was time. Some participants described the time constraints concerning the scope and sequence of state standards or class curriculum. In other words, participants found little opportunity to include STEM career exploration, especially when it was outside the scope of a lesson, unit, or curriculum. Prior research has also noted teachers' inability to include STEM career exploration due to time (Archer et al., 2020; Navy et al., 2021; Margot & Kettler, 2019; Rocha et al., 2022; Şahin & Waxman, 2021). Participants expressed difficulty due to the amount of information to cover within the school year, and the rigorous pace of courses as the main constraints. Teachers labeled grade-level standards as inflexible and noted that assessment demands, such as standardized testing, allowed little time to expand the curriculum to include career exploration (Margo & Kettler, 2019). Participants in this study focused on the amount of material they were expected to cover but did not highlight standardized testing when discussing the time barrier. Teachers in this study demonstrated that when standards and curriculum offer little opportunity to add career exploration, it is possible to embed the practice with current content using different instructional practices. Even with these adjustments to practice, participants wanted more time to focus on STEM career exploration in class and more time to collaborate with other educators on the topic. When teachers are responsible for developing their forms of STEM career exploration, the lack of time to do so may decrease the likelihood of the frequency and extent of the practice.

The lack of formal PD related to STEM career exploration was also mentioned as a barrier to participants' practice. Researchers have shown that teacher self-efficacy increased after participation in STEM PD (Garcia et al., 2021; Kelley et al., 2020). Teachers in this study did not discuss self-efficacy related to their practice; however, as veteran educators, they may feel more confident in all areas of their practice. Instead, they discussed the desire for PD related to STEM career exploration. When this topic is explored in PD, teachers have increased awareness of types of careers and knowledge of best practices (Knowles et al., 2018; Shernoff et al., 2017). Participants also reflected on the lack of training in the early years of their teaching experiences and how difficult it was to figure out these practices on their own. These findings suggest that limited training opportunities provided to teachers do not deter the practice of embedding STEM career exploration in the curriculum but increase the difficulty in doing so.

Reasons for Embedding STEM Career Exploration

Teachers described different reasons for purposefully embedding STEM career exploration into the curriculum. One category found during the analysis was student self-efficacy as a reason. Self-efficacy is crucial in developing interest in STEM careers (Mohtar et al., 2019). SCCT also emphasized the importance of self-efficacy when working to increase career interest (Lent et al., 1994). Participants in this study identified the desire to help students visualize themselves doing specific careers, but none explicitly mentioned increasing a student's belief in themselves as a reason. Analysis of participants' definitions of STEM career exploration showed a focus on student learning goals but did not include wanting to support student beliefs. The absence of the terminology does not mean that a teacher's choice of instructional practice for content knowledge or skill training does not affect student self-efficacy. Previous studies have shown that instructional practices like PBL increased student self-efficacy (Drymiotou et al., 2021; Nariman, 2021). The current study did not explore the direct connection between a teacher's chosen career embedding practices, such as PBL, and student self-efficacy. It is possible, however, that teachers may be (possibly unknowingly) supporting students' sense of self-efficacy through their choice of instructional practice.

Another reason participants gave was increasing student awareness and expectations associated with STEM careers. These reasons, such as financial stability, quality of life, and societal contributions directly related to the outcome expectations described in SCCT (Lent et al., 1994). Teachers were not asked which was the fundamental reason for embedding STEM career exploration, so one of these factors may play a more prominent role. However, current research does not explore this possibility.

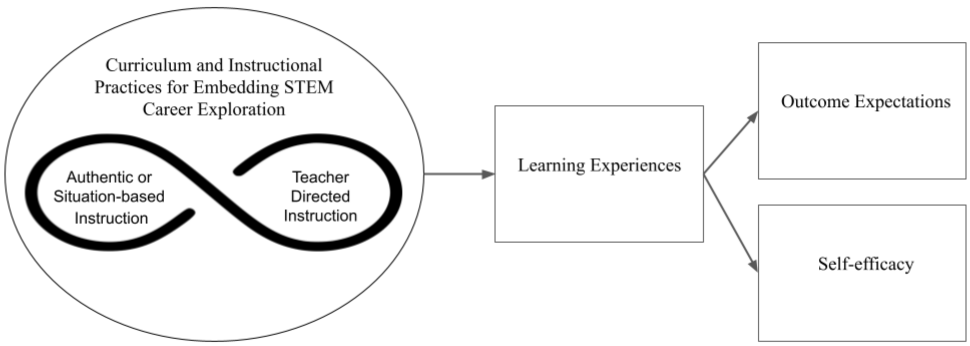
One participant described reasons outside the scope of this study's literature review. This participant acknowledged a personal experience with career exploration that influenced their reasoning for including the practice in their current position. Although it is unnecessary for teachers to engage in STEM career exploration to be able to lead career exploration practices, this example adds a unique perspective to current research on teacher reasoning.

Reimagining the Conceptual Framework

This study's results demonstrated that the conceptual framework's scope needed to be widened to account for the multiple forms of instruction and teacher intentions that shaped the process of embedding STEM career exploration in high school curricula. To account for these findings, I reimagined the conceptual framework to show the connections between various instructional practices and how these learning experiences could affect self-efficacy and outcome expectations (see Figure 7).

Figure 7

Updated Conceptual Framework Accounting for Study Findings



The new framework imagines a continuous connection between authentic and teacher-led practices. When used and embedded into the curriculum, these practices create learning experiences that could positively affect student self-efficacy and outcome expectations. The conceptual framework still uses situated cognition (Brown et al., 1989) as a foundation. However, the new framework considers the constraints of time and curriculum requirements that may require a more varied level of instructional practices. The updated framework also maintains components of the SCCT model (Lent et al., 1994). However, it is no longer limited to the idea that focusing on student self-efficacy is the only way teachers can increase interest in STEM careers. Teachers in this study also focused their efforts on embedding STEM career exploration on student outcome expectations. Both reasons are now included in the conceptual framework.

Limitations of the Study

Chapter 1 detailed the predicted limitations of this study. I recognized the possibility of a limited pool of participants because the Teacher of the Year recognition criteria allowed for recruiting a finite number of teachers. Additionally, only a limited number of these award-winning STEM teachers might have embedded career exploration in their curriculum. I did not acknowledge that using social media for recruitment could limit participant numbers. First, the voluntary nature of participation in social media meant that not all Teacher of the Year awardees, finalists, and semi-finalists were part of the private Facebook group. As explained in Chapter 4, each participant's social media engagement level might have varied. The responses from participants describing when they saw the post containing the study recruitment flyer led me to believe that all potential participants did not see the post if they used social media platforms. Although I initially hoped to recruit 12 participants for this study, I ultimately completed the study with nine participants. The similarity of participant responses, however, indicated that saturation was achieved in this study.

The study is also limited to teachers of only two of the four categories of STEM courses; this study interviewed eight science teachers and one math teacher. Teachers overseeing classes in technology and engineering were not included in this study. Therefore, the transferability is limited because the results may only apply to some STEM educators' experiences.

I previously identified my personal bias as a limitation of this study. The detailed descriptions in the results section and the triangulation of interview and lesson plan data reduced the chances that my experiences with STEM education affected the data. I also used member checking to ensure that my interpretations of the results reflected the participants' thoughts and not my own.

Recommendations

This study provided new perspectives on STEM career exploration by analyzing the experiences of veteran, award-winning teachers. The findings presented here are useful to multiple stakeholders who contribute to STEM education. Curriculum designers, either at the level of large corporations or individual teachers, can use the results of this study as evidence that STEM career exploration is possible within the scope of current curricula. These entities could use this information to create embedded content in current curricula or develop new curricula that enhance student exposure to STEM careers and authentic experiences related to STEM careers. The need for PD and training on embedding career exploration is evidenced in this study. Therefore, PD facilitators can also refer to the results of this study as they develop new training programs for STEM teachers. These PD programs might focus on STEM career exploration but may also include some of the instructional practices highlighted by teachers in this study. Administrators at the district and school level can also use the findings of this study as they plan and create goals for the school year. The teachers in this study provided examples of the types of goals to work towards and the possible methods required. Administrators use these examples to think strategically about the types of instructional practices and content to support. Finally, STEM teachers can use the discoveries from this study as a form of support for their practice. Although they may be physically alone in their classrooms, it is apparent that other teachers use the same practices, have the same goals, and experience the same setbacks and struggles. Learning about the teachers' perspectives in this study can lessen the feelings of isolation for other STEM teachers who want the same outcomes for their students and are attempting the same practices in their classrooms.

Although this study does help to expand the understanding of how and why high school STEM teachers embed career exploration in curriculum, the small participant pool and inclusion of participants with only science and math course assignments reduced transferability. I recommend expanding the participant pool to learn more about how and why a more diverse group of teachers embeds STEM career exploration. Eliminating restrictive criteria, such as teachers with specific awards, may allow comparisons across grades, curriculum types, geographic locations, and content areas. There is also a possibility of expanding the analysis of experiences of rural and suburban/urban teachers to identify other differences that may impact STEM career exploration.

Further research is also needed at the level of teacher training. Pre-service teachers' knowledge of practice related to STEM career exploration can provide insight into the differences in teacher training programs nationwide. A study of teacher training programs may also identify best practices that can be used in all training programs to increase the level of STEM career exploration in high school.

The recruitment of teachers from different states in this study did not allow for a comparison of practices related to specific content standards. A study within a state might provide insight into best practices used by teachers for a specific learning standard. This study could also compare teachers' practices to other states that may use the same national standards, such as the NGSS (NGSS Lead States, 2013).

I also recommend conducting quantitative research examining factors that contribute to teachers embedding STEM career exploration, such as exploring whether teachers who have embedded career exploration in previously taught non-STEM courses are more likely to embed it even in courses without a district or set curriculum.

It is also vital to incorporate student data to support and expand on the findings of this study. I suggest a study that gathers data on student perspectives in classes where STEM career exploration is included. Asking students about their experiences could help support teachers' work and provide insight into the practices most beneficial to students. Research using student data can also help understand if these practices change students' beliefs and expectations.

Finally, there is a need to look at how teachers embed STEM career exploration through the lens of student identities and demographics. I would like to know if the teachers' practices and the reasons for these practices differ based on the student population they teach. Hopefully, results from these studies could identify practices that increase student interest in STEM careers, particularly for students currently under-represented in STEM industries.

Implications

The results of this study demonstrated a need to expand on current practices in STEM career exploration in public high school curricula. The lack of standards and the diverse ways teachers implement STEM career exploration supports previous calls for more permanence in these practices so they can be used across schools throughout the United States (Kurban & Cabrera, 2020). Creating standards or curriculum objectives does not imply that every teacher must do the same lessons but that teachers should have access to examples and training to help them build a foundation of practice. So many teachers have years of knowledge and practice in various instructional strategies that are shown to improve STEM career interest and student self-efficacy. Unfortunately, the lack of continuity in these practices may make developing and encouraging similar practices in others challenging. The best practices used by exemplary teachers, such as those in this study, can help guide curriculum modifications, provide topics for professional collaboration, and create the foundation for PD that targets training in STEM career exploration practices.

Suppose teachers, administrators, and curriculum content developers are exposed to more information about current practices in STEM career exploration. In that case, there is a chance that these practices will increase in high schools. Research has already demonstrated that including career exploration increases the likelihood of a student pursuing a STEM career (Birzina et al., 2021; Blustein et al., 2020). If best practices and research-based objectives are widely available to STEM teachers, we will see a positive change in STEM career interests. It could alter the projected decline in STEM career candidates discussed in Chapter 1 of this study. Increased access to these practices may be incredibly impactful for teachers of marginalized youth who are historically less likely to pursue STEM careers. Including these practices means that students are more likely to learn about various opportunities, experience what it might be like to enter this career, and believe they can be in these roles. Equitable access to STEM career exploration may be possible if the practices are shared and promoted.

Teachers in this study pointed to the lack of curricula that embed STEM career exploration and the lack of leeway in the current curriculum to embed this work. Teachers who build off student interest and design their curriculum accordingly can step into a leadership role and design a curriculum that highlights STEM career exploration. These teachers may also pave the way in designing PD to support colleagues in acquiring or honing these skills in their classrooms.

Conclusion

STEM career opportunities for students are vast, but entering a STEM career is outside the goal of many high school students. Most STEM curricula do not include explicit opportunities to explore STEM careers. Therefore, students need more access to knowledge about STEM careers to help them build confidence in their abilities related to succeeding in these career pathways. Participants in this study embed STEM career exploration in their curriculum. However, it is mainly due to their interests and inclination rather than because of a national effort to influence change in the current outlook.

Teachers are providing lessons and activities for their students to be able to explore STEM career exploration. We should value the pedagogical knowledge of these teachers and use their experiences to shape the future of STEM education. Changes in STEM curricula that purposefully embed opportunities for student-led, authentic practices benefit student outcomes and indirectly increase contributions to society through continued advancement in STEM fields.

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Appendix A: Use of Figure Permission Letter

Re: permission to use figure

Cara Pekarcik [redacted]>
Wed 10/12/2022 9:43 PM
To: Dake Zhang [redacted]

Dr. Zhang -
Thank you for the quick reply and for the permission to use.

Be well,
Cara

From: Dake Zhang [redacted]
Sent: Wednesday, October 12, 2022 9:22 PM
To: Cara Pekarcik [redacted]
Subject: Re: permission to use figure

HI Cara

Of course yes. Just cite it appropriately. Thanks for checking and best luck with your dissertation!

Dake

From: Cara Pekarcik <[redacted]>
Sent: Wednesday, October 12, 2022 9:07 PM
To: Dake Zhang <[redacted]
Subject: permission to use figure

Hello Dr. Zhang,

My name is Cara Pekarcik and I am an EdD candidate at Walden University. I am finishing the proposal for my dissertation titled 'An Exploration of Exemplary High School Teachers' Practice of Embedding Career Exploration in STEM Curricula' and am interested in using a figure from one of your publications to support my work. My conceptual framework includes aspects of both Social Cognitive Career Theory and Situated Cognition. Figure 1 of your paper entitled An Examination of Preservice Teachers' Intentions to Pursue Careers in Special Education (2014) highlights key features of SCCT that I want to focus on in my study. I am writing to ask if you would give permission for me to use this figure in my dissertation, with proper acknowledgment of its use. I appreciate your response on this matter and hope that you enjoy the rest of your week. If you need any additional information, please feel free to contact me at cara.pekarcik@waldenu.edu or 978-239-6306.

Thank you,

Appendix B: Virtual Interview Protocol

Participant Code:
Interview #
Date:
Time:

Introduction:

Hello, my name is Cara Pekarcik, and I am a Doctor of Education (EdD) candidate in the Richard W. Wiley College of Education and Human Science program at Walden University. My degree specialization is Curriculum, Instruction, and Assessment. I am conducting a qualitative research study for my dissertation to learn more about how and why high school STEM teachers embed career exploration into the curriculum. This interview aims to learn more about your perspectives and behaviors related to your instruction. The goal is to obtain a detailed description of your thoughts and ideas, so feel free to elaborate on your responses.

This interview should last about 45-60 minutes. I will not identify you by name in any documents to maintain your privacy. Instead, you will be assigned a participant code. As stated in our email, I am recording this meeting to transcribe your answers for later analysis accurately. I will also maintain written notes during the interview.

I received an email confirmation of your informed consent. This document described the purpose of the study and provided background information about your rights as a participant. The consent form also informed you that I am a mandated reporter and any information provided related to potential child abuse or neglect must be reported to law enforcement. Before we begin, do you have any questions regarding this document? Can you verbally reaffirm your consent as a participant? Can you verbally reaffirm your consent for this recording?

Please remember that you may choose to stop this interview at any time. Do you have any questions before we begin?

Questions:

Background Questions	Can you describe your role in STEM education? • Which subjects do you teach? • What grade levels do you teach?

	How long have you been in your role as a STEM educator? What types of recognitions have you received during your time as a STEM educator? Have you worked in a STEM-related job other than education? Can you tell me about your current school system? Can you provide me with some details about the current STEM curriculum that you use? • What are the topics of emphasis? • Does your curriculum discuss career exploration related to STEM fields?
RQ 1: What are teachers' experiences implementing classroom career exploration strategies? SQ 1: How do STEM teachers embed career exploration in their curricula? SQ 2: What instructional strategies related to career exploration do high school STEM teachers include in their lesson plans? SQ 3: What barriers limit the inclusion of career exploration in STEM curricula?	Can you describe what STEM career exploration means to you? Can you think back to when you first started using STEM career exploration in your classroom and tell me about that? • Was there a catalyst that caused you to begin including career exploration? In what ways, if any, do teachers in your department or school embed career exploration in their classroom? • If yes, do you collaborate with these teachers? • If no, can you explain why you do not collaborate with

	the other teachers regarding career exploration? Please describe any other type of collaboration that influences your practice of embedding career exploration. Does your school or district play a role in your decision to embed career exploration? • If yes, can you elaborate on the influence? • If no, can you explain why you feel the school or district play a limited role? Can you describe ways in which you embed career exploration in the classroom? • Please tell me more about what this might look like in your classroom. In what ways, if any, do you determine the amount of time, or the amount of STEM career exploration to include in some aspect of your instruction? How and where did you learn the strategies that you use to embed career exploration? What resources do you use to enhance these practices related to career exploration?

	Can you describe the barriers that limit the inclusion of career exploration in STEM curricula? • If yes, can you think of any other barriers that might exist to limit this type of practice? • If no barriers exist, can you describe what qualities of your school, curriculum, etc. reduce those barriers?
RQ 2: Why do STEM teachers embed career exploration in their curriculum?	Why do you (and continue to) embed career exploration in into your curriculum? What do you believe are the benefits of embedding career exploration in the curriculum? • Can you expand on direct impacts for students?
Lesson Plan Analysis Questions:	Thank you again for submitting a lesson plan for review. I was wondering if you had anything that you would like to tell me about the lesson before we conclude our interview. (If applicable) I have a specific question regarding…

Conclusion:

Thank you for taking the time to meet with me today. In the coming weeks, I will be in touch with you should I require clarification on your answers or your lesson plan. I will contact you after my initial analysis to provide you an opportunity to review my interpretations of your responses. Please contact me at any time if you have any questions or choose to no longer be a part of this study.

Appendix C: Lesson Plan Sample Analysis Protocol

Participant Code:
Lesson Plan #
Date:
Time:

Lesson Title:

STEM Topic Area: **Grade**: **Course Level (if available)**:	Science ☐ Biology ☐ Chemistry ☐ Physics ☐ Other ________________ ☐ Technology ☐ Engineering ☐ Mathematics

Lesson Objectives:	

Instructional Practices: Example: Inquiry-based lesson, case-study, PBL, phenomenon-based lesson, active-learning instructional models, etc.	
Additional Observations:	

Appendix D: Lesson Plan Information Collection Form

Lesson Plan Information Collection Form

Please fill out the following form based on a lesson used in your classroom that embeds STEM career exploration

[redacted] (not shared) Switch account

* Required

Name (will be changed to participant code after submission) *

Your answer

Lesson Title *

Your answer

STEM Topic Area *

- [ ] Biology
- [ ] Chemistry
- [ ] Physics
- [ ] Technology
- [ ] Engineering
- [ ] Mathematics
- [ ] Other: ____________________

Grade *

- [ ] 9
- [ ] 10
- [ ] 11
- [ ] 12

Course Level (if applicable)

Your answer

Lesson Learning Objectives *

Your answer

Instructional Practices *

Example: Inquiry-based lesson, case-study, PBL, phenomenon-based lesson, active-learning instructional models, etc.

Your answer

Any additional information you would like to provide about the lesson?

Your answer

Submit

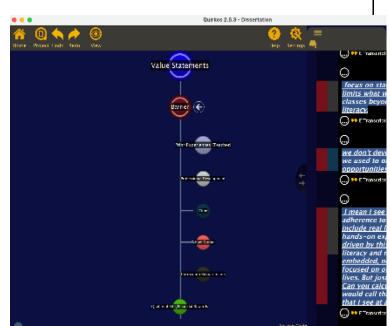
Clear form

Appendix E: Audit Trail

Date	Action	Notes
1/21/23	Social Media Recruitment Flyer posted to National Network of State Teachers of the Year private Facebook group	
1/22/23	Email received from potential candidate - informed consent mailed (A)	
1/23/23	Consent received from Participant A	
1/28/23	Social Media Recruitment Flyer posted to National Network of State Teachers of the Year private Facebook group	Repost
2/1/23	Email received from potential candidate - informed consent mailed (B)	
2/1/23	Scheduling poll and lesson plan request sent to Participant A	
2/3/23	Email received from potential candidate - informed consent mailed 2/4/23 (C)	
2/3/23	Email received from Participant A to confirm interview on 2/18/23	
2/6/23	Consent received from Participant B	
2/6/23	Consent received from Participant C	
2/6/23	Scheduling poll and lesson plan request sent to Participant B	
2/6/22	Lesson plan information received from Participant A	
2/8/23	Email received from potential candidate - informed consent mailed (D)	
2/8/23	Scheduling poll and lesson plan request sent to Participant C	
2/8/23	Email received from Participant B to confirm interview on 2/15/23	
2/9/23	Email received from Participant C to confirm interview on 2/16/23	
2/9/23	Email received from potential candidate - informed consent mailed (E)	
2/8/23	Lesson plan information received from Participant C	
2/8/23	Consent received from Participant E	
2/9/23	Scheduling poll and lesson plan request sent to Participant E	
2/13/23	Lesson plan information received from Participant B	
2/14/23	Email received from Participant D to confirm interview on 2/21/23	
2/14/23	Lesson plan information received from Participant D	
2/15/23	Interview conducted with Participant B	transcribed 2/15/23
2/15/23	Follow up interview sent to potential candidate (E) regarding informed consent	
2/15/23	Email received from potential candidate - informed consent mailed (F)	
2/16/23	Email received from potential candidate (E) with additional questions - reply sent	
2/16/23	Interview conducted with Participant C	transcribed 2/16/23

2/18/23	Interview conducted with Participant A	transcribed 2/18/23
2/21/23	Interview conducted with Participant D	transcribed 2/21/23
2/21/23	Email received from potential candidate - informed consent mailed (G)	
2/23/23	Email received from potential candidate - informed consent mailed (H)	followed up on 3/7/23 - candidate is at conference and will look early next week
2/27/23	Consent received from Participant G	
2/27/23	Scheduling poll and lesson plan request sent to Participant G	
3/5/23	Email received from potential candidate - informed consent mailed (I)	
3/5/23	Email received from potential candidate - informed consent mailed (J)	
3/6/23	Email received from potential candidate - informed consent mailed (K)	
3/6/23	Consent received from Participant J	
3/6/23	Scheduling poll and lesson plan request sent to Participant j	
3/7/23	Email received from Participant J to confirm interview on 3/12/23 @ 10AM	
3/7/23	Email received from Participant G to confirm interview on 3/12/23 @ 4PM	
3/7/23	Lesson plan information received from Participant J	
3/8/23	Email received from potential candidate - (L)	asked for informed consent to be emailed next week after conference
3/9/23	Lesson plan information received from Participant G	
3/10/23	Email received from potential candidate (M) - informed consent mailed 3/11/23	
3/12/23	Interview conducted with Participant G	transcribed 3/12/23
3/12/23	Interview conducted with Participant J	transcribed 3/12/23
3/13/23	Informed consent sent to candidate L	
3/13/23	Consent received from Participant M	
3/13/23	Scheduling poll and lesson plan request sent to Participant M	
3/14/23	Consent received from Participant L	
3/14/23	Scheduling poll and lesson plan request sent to Participant L	
3/15/23	Email received from Participant L to confirm interview on 3/20/23	
3/16/23	Lesson plan information received from Participant L	
3/17/23	Lesson plan information received from Participant M	
3/20/23	Interview conducted with Participant L	transcribed 3/20/23
3/23/23	Email received from Participant M to confirm interview on 3/26/23	
3/24/23	Consent received from Participant E	
3/25/23	Scheduling poll and lesson plan request sent to Participant E	
3/25/23	Email received from Participant E to confirm interview on 3/28/23	

3/25/23	Lesson plan information received from Participant A	
3/26/23	Interview conducted with Participant M	transcribed 3/26/23
3/28/23	Interview conducted with Participant E	transcribed 3/28/23
3/30/23	All 9 transcripts printed for coding	
4/2/23	Descriptive coding and values coding started on all transcripts	Completed with Quirkos software
4/16/23	Started first round coding by looking through both the values statements and the descriptive statements and assigning a code to address specific details of the statements. In the example shown below, the participant's response was initially coded as a VALUE STATEMENT. Second round coding specified the values such as EXPOSURE, CREATING OPPORTUNITIES/PATHWAY, and SOCIETAL CONTRIBUTIONS (see example below). 	Completed with Quirkos software
4/16/23 cont.	Completed with Quirkos software SOCIETAL CONTRIBUTIONS statements from multiple transcripts are coded with yellow (as shown on the right-side bar) 	

4/18/23	First-round coding generated the following data: Descriptive Statements Activities Authentic Experiences Career Exploration Definition Curriculum School Demographics Teacher Experiences Value Statements Barriers Creating Opportunities/Pathways Increase Interest in Topic Memorable Experiences Quality of Life/Financial Reward Self-efficacy Societal Contributions Student Interest Support/Guidance	
4/18/23	Second-round codes were created to allow for a more descriptive analysis of data. Activities Career Inventory/Career Survey Direct Instruction Interviews Projects Social Media/Videos/Readings Visuals/Modeling/Role Play Authentic Experiences* Community Connections or Collaboration Field Trips Inquiry-based lessons STEM/Science Fair Curriculum Curriculum-required career Exploration Self- created Career Exploration Standards Barriers PD School Setting Time	Image shows the descriptive hierarchy of codes: Value Statement, Barriers (first round), and second round codes 
4/18/23 cont.	Self-efficacy* Confidence Envisioning Future Exposure Self-actualization School Demographics Rural Suburban/Urban	

	* denotes a priori codes	
4/24/23	Lesson plan coding started. Lesson descriptions were used as Descriptive Statements while lesson objectives were used as Value Statements. Codes from the lesson plans corresponded to those from interviews and are highlighted above.	
4/26/23	Met with committee chair to discuss possible embedded cases: The connections I have thought of so far:- Rural location and the need to expose students to a variety of fields- Using projects as a way to demonstrate the value of careers for increasing quality of life/financial stability- The role of standards and curriculum in limiting the time spent on career exploration- The differences in a pre-packaged/purchased curriculum vs. a self-created curriculum- The use of authentic instruction in a self-created curriculum- The outcome expectations vs. self-efficacy-based reasons for embedding career exploration	
May	Continued working with the codes to outline a draft of Chapter 4 Decided to group goal-based Value Statements under the umbrella of Outcome Expectations to link data to SCCT	
5/31/23	Met with committee chair and decided to set some non-binding deadlines to ensure I am working towards my goal; goals submitted via Discussion on Blackboard; continued working on components of Chapter 4	
6/20/23	Emailed an early draft of Chapter 4 to committee chair that included the introduction, setting, data collection, data analysis and one embedded case study description	Response received on 6/22/23 with positive comments and some suggestions for data analysis section
6/26/23	Finalized embedded cases to describe. Six related to RQ 1 and four related to RQ 2. One case uses only one participant for description; Figures 5 & 6 create to illustrate embedded cases in Chapter 4	
6/26-6/28/23	Committed days to working on Chapter 4. Organized and wrote descriptive content for all embedded cases	
6/30/23	Completed draft of Chapter 4; Emailed committee chair with question regarding procedure for member checking	
7/1/23	Draft 4 submitted for review Drafted member checking summary for each embedded case	
7/3/23	Drafted member checking summary for each embedded case; member check sent to four participants (used random number generator) Updated tenses to Chapter 3 Reread Chapter 2 and annotated content that aligned with data	
7/7/23	Participants D and J replied to member check email with no additional comments	