CHAPTER III: METHOD

The purpose of this chapter is to introduce the research methodology for this qualitative grounded theory study regarding what motivates women to stay in or return to STEM professions long-term. This approach allowed for a deeper understanding of women's experiences working within STEM and provided a way to develop theory from the data in order to understand what motivates women to work within STEM professions long-term.

The applicability of grounded theory and a constructivist approach for this study are discussed in-depth in this chapter. The research plan, including the methodology, study participants, procedures, analysis method, and ethical concerns are also primary components of this chapter.

Research Questions

This study sought to build a theory in answer to the following research questions:

RQ1: What motivates women in STEM professions to stay in their profession long term?

RQ2: What motivates women with non-linear careers in STEM professions to return to their profession after at least a 6 month break from their profession?

Methodology Selected

A qualitative study is appropriate when the goal of research is to explain a phenomenon by relying on the perception of a person's experience in a given situation (Stake, 2010). As outlined by Creswell (2003), a quantitative approach is appropriate when a researcher seeks to understand relationships between variables. Because the purpose of this study was to examine the experiences and perceptions of women working in STEM, a qualitative approach was the most appropriate choice.

Grounded Theory Methodology

This qualitative study was performed using grounded theory methodology. "Grounded theory is a respected qualitative way of moving from individual knowledge to collective knowledge" (Stake, 2010, p. 17). Introduced to the research community in the 1960s, grounded theory is "the discovery of theory from data" (Glaser & Strauss, 1967, p. 1). Glaser and Straus (1967) created this methodology where theory could emerge by methodically coding interviews with terms that succinctly and conceptually summarize each phrase, line, or even word.

Charmaz (2006) explained that "grounded theory contains both positivist and constructivist inclinations" (p. 127). Birks and Mills (2011) and Charmaz described the positivist philosophical position as a view that comes from the human experience with complete objectivity, understanding a human's perception is imperfect. Birks and Mills and Charmaz described the constructivist philosophical position as a view that comes from the human experience relative to their paradigm, influenced by society, culture, or other external influences.

This study was conducted using grounded theory with a constructivist approach. Interpretive grounded theory, which the constructivist tradition is a part of, aims to: "conceptualize the studied phenomenon to understand it in abstract terms, articulate theoretical claims, acknowledge subjectivity in theorizing, and offer an imaginative interpretation" (Charmaz, 2006, p. 127). This research study sought to conceptualize the phenomenon of each participant's experience, to understand in abstract terms built through coding the data from interviews, and build a theory based on the interpretation of the their shared experiences.

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In this study using constructive grounded theory, emphasis was placed on a phenomenon and the reflective nature of the research as the theory evolved (Charmaz, 2006). Reflecting on the evolving theory throughout the research study was important in guiding changes in interview questions during the study to uncover more details of the theories that emerged. The researcher needed to be keenly aware of the subtleties in the data to uncover the distinct differences and similarities (Charmaz, 2006). The resulting theory is the researcher's interpretation of the data, consistent with constructivist grounded theory (Charmaz, 2006).

The Sage Handbook of Grounded Theory by Bryant and Charmaz (2007) formed the basis for this study, outlining the tenets of grounded theory methodology used in this research study. Bryant and Charmaz (2007) outlined tenets such as coding, generating memos, analyzing data as it is generated to build theory, selecting core categories from coding, and generating theory. Together, the procedural steps used in applied grounded theory methodology aided the researcher in continually seeing the data through a fresh lens to foster the potential for new theory to emerge from the data (Charmaz, 2006).

The Researcher

The researcher worked in engineering for 18 years and holds a Bachelor of Science in Civil Engineering and a Master of Science in Geotechnical Engineering. No participant had a direct relationship with the researcher that represented a conflict of interest, such as a reporting relationship, contract, or any relationship with the researcher that may have imparted bias on the research study.

The researcher has been trained in the skills necessary to carry out the designed study. The researcher has interviewed multiple people with intent to hire during her career. The

researcher's skills include training in listening skills as a part of corporate training and a qualitative research course at the University of the Rockies. Since 2008, she has been responsible for corporate communications and supporting internal engagement and external awareness of key initiatives.

Study Participants

> Describe specific criteria used to select participants.

The sample was drawn from a population of women who studied a STEM field and have worked in science, technology, engineering, and math professions for at least 10 years in the United States. Women could be working full- or part-time and there was no age limitation. All participants had to be fluent in the English language, but English did not have to be their native language. Female professionals with a college level degree in science, computer science, engineering, math or related subject, who continued their careers in a related profession, were the target population to participate. Career examples included, but were not limited to, research, engineering, computer programming, physical sciences, life sciences and design.

> Describe specific strategies for recruiting participants.

Participants were recruited through the researcher's existing professional networks, the Association for Women in Computing (AWC), the Association for Women in Science (AWIS), the Association for Women in Mathematics (AWM), and the Society of Women Engineers (SWE). The researcher emailed contacts in her professional network using the Email to Potential Participants in Appendix A and asked for leads to women that fit the criteria. The researcher also contacted the AWC, the AWIS, AWM, and SWE via phone to request assistance from these organizations and permission to post the Email to Potential Participants in Appendix A on their website, within a blog, or other suggested mechanism for communication to the association's members. AWC, AWIS, AWM and SWE all have long

standing associations with women in STEM profession. SWE was founded in 1950 and AWC, AWIS and AWM were all founded in the 1970s. The researcher is not a member of nor actively involved in any of these associations.

The women were asked to respond to a brief demographic questionnaire, as shown in Appendix B, via email to help the researcher select participants and document the level of candidate diversity in the study. For the first group of interviews, four participants were selected based on the first three questions only. One of these four participants was a woman with a non-linear career. The participant sampling pool was limited to those participants solicited for this research as defined in this study. An informed consent form, as shown in Appendix C, was required for each participant prior to participating. The researcher anticipated approximately 12-20 participants for this study. The final number of participants was 20, as determined by saturation.

> **Tip**: Include detailed protocols in the Appendix.

Data Collection

This study used an interviewing method, found in Appendix D, where both the interviewer and the interview questions were the instrumentation used. Memos were used to capture any research thoughts during and after each interview. The interviews were recorded electronically using a conference recording service and an Olympus WS-803 Voice Recorder™. The interviews began with open-ended questions about the participants' initial interest in STEM professions and their initial career interests in general. More intensive questions followed, with the intent to gather data with more depth on motivation (Charmaz, 2006). The interview concluded with more open-ended questions, framed to invite more depth regarding motivation of the participants to stay in a STEM profession.

Interviews were conducted over the telephone only. The interviews were recorded electronically using a conference recording service and an Olympus WS-803 Voice

Recorder™. The conference recording service signed a non-disclosure form, found in

Appendix E, prior to recording any interviews. No interview was conducted without

confirming the written and verbal informed consent of the participants. Each participant

interview took place in a single interview session. Each interview was transcribed by a

professional transcriptionist, who signed a non-disclosure form, found in Appendix E, prior

to transcribing the interviews.

Procedures Followed

Approval from the Institutional Review Board (IRB) was sought from the University

of the Rockies. Once approval was given, the researcher emailed individuals within her

professional contacts, using the Email to Potential Participants (see Appendix A). The

researcher also contacted the AWC, the AWIS, AWM, and SWE via phone to request

assistance from these organizations and permission to post the Email to Potential Participants

in Appendix A on their website, within a blog, or other suggested mechanism for

communication to the association's members. Potential participants were screened using a

demographic survey (see Appendix B) to be sure they met the selection criteria. Based on the

responses to the demographic survey, four participants were selected for the first group of

interviews. An informed consent form, as shown in Appendix C, was required for each

participant prior to participating.

Participants were interviewed over the telephone only. Both the researcher and the

participant were in a separate, private room. As part of the interview introduction, the

researcher confirmed that the participant was in a room with a closed door. The interviews

were recorded electronically using a conference recording service and an Olympus WS-803

Voice Recorder™. The conference recording service signed a non-disclosure form, found in

Appendix E, prior to recording any interviews. No interview was conducted without confirming the written and verbal informed consent of the participant. Each participant interview took place in a single interview session. Each interview was transcribed by a professional transcriptionist. The transcriptionist signed a non-disclosure form, found in Appendix E, prior to transcribing the interviews

Grounded theory allows for discovering the phenomenon during the research process (Charmaz, 2006). Because the theory or phenomenon emerges from the data, it is possible that some interview questions may be added, or that the proposed interview questions will be modified during the research study (Birks & Mills, 2011; Charmaz, 2006; Urquhart, 2013). As some initial themes surfaced during the first four interviews, or subsequent interviews, the researcher added clarifying questions or points to subsequent interviews in an effort to explore more on the topic or gap that emerged. Appendix B includes the additional questions added. Previous interviews were not re-conducted using the new clarifying questions or points.

The transcribed interviews were sent to the interviewees for review once. While each interviewee had the right to strike any interview content, this practice was not encouraged. The interviewee was also asked if there was anything she would like to add upon reflection. Following the endorsement of the participant, edits were made as necessary to the transcription, including capturing any reflective thoughts following the interview. Participants were not part of the writing or editing of the actual analysis and results, as no one participant had access to any other interview. The participants were not equipped to provide any insight into how the group of individuals collectively may have similar or different perspectives.

In their seminal work, Glaser and Strauss (1967) discussed the concept of saturation, where the researcher starts to realize that for a given subject, no new categories emerge from the code; therefore nothing more can be added to the emerging theories. It was possible that saturation could be reached during the interview process conducted as part of this research. Once saturation is reached, the theory or phenomenon is said to be grounded in the data (Charmaz, 2006; Urquhart, 2013). Saturation was reached in this study after the 20th interview.

Discuss how you minimized potential bias.

Memo writing happened regularly throughout the study (Birks & Mills, 2011; Charmaz, 2006; Glaser & Strauss, 1967; Urquhart, 2013). Both memo writing and constant comparative analysis help minimize bias, because both activities are reflective, which aids objectivity throughout the study (Birks & Mills). Memos in particular serve to remind the researcher of his or her thoughts and help the researcher separate thoughts that the researcher might impose on the theory versus theory that emerges from the data (Birks & Mills, 2011). Memos included topics such as thoughts or concerns related to the study, interpretation of relevant books and papers, reflections on the quality of the process, and thoughts on emerging codes, categories, and the theories.

Data Analysis

Coding of transcripts was completed in the order of the interviews conducted, in batches of four at a time, allowing the researcher to reflect and edit the interview questions as theories began to emerge from the data. Coding was used to aid the researcher in understanding the perspectives of the participants and in analyzing their combined experiences. Codes were created during the research process, based on the data, for the

Discuss when the analysis took place.

purposes of analyzing the data (Urquhart, 2013). Coding was conducted both manually and

using computer assisted qualitative data analysis software.

Coding the transcriptions, or breaking them down into meaningful and manageable

chunks of data, was a critical part of the data analysis. Coding used in grounded theory was

instrumental in focusing the interview analysis on the experience of the participants in a

structured way. Coding helped to prevent the interviewer overemphasizing the importance of

any one aspect early in the study and helped ensure a thorough analysis of the entire

interview (Charmaz, 2006; Stake, 2010).

Align analysis with the specific research design.

The process of analyzing, reanalyzing, and comparing new data to existing data is

known as constant comparison (Birks & Mills, 2011; Urquhart, 2013). As each phase of

coding began, it was important to continue reviewing the data in previous phases so that

connections were constantly being made until saturation occurred. Coding terminology used

for this dissertation was adopted from Urquhart (2013) who termed the three phases of

coding as open, selective, and theoretical.

Open Coding

Within this section give details about the coding procedure and how themes were developed.

Open coding is the phase when each line of transcribed interview text is coded line by

line (Urquhart, 2013). Line-by-line coding is a critical part of grounded theory methods

(Birks & Mills, 2011; Charmaz, 2006; Glaser & Strauss, 1967; Urquhart, 2013). It is what its

name reflects, where coding each line of the transcribed interviews by using a few words to

describe the data, as suggested by Urquhart (2013), Birks and Mills (2011) and Charmaz

(2006). This method of coding helped the researcher focus in-depth on every interview.

This method also helped instill the discipline of grounded theory where the theory the

emerged from the data itself. Coding line by line in open coding typically results in many codes (Birks & Mills, 2011; Urquhart, 2013).

Selective Coding

Selective coding begins to occur when there are no new open codes, or when codes relate only to the core categories that begin to emerge (Urquhart, 2013). In general, the terms *categories* and *constructs* are interchangeable across the grounded theory methods (Birks & Mills, 2011; Urquhart, 2013). Some selective codes may emerge more often than others. Sometimes a single selective code becomes a prominent theme, or a theoretical code (Birks & Mills, 2011; Urquhart, 2013).

In selective coding, the researcher strives to find categories emerging, but will hopefully not have as many selective codes as open codes. Urguhart (2013) suggested revisiting the selective code categories if too many selective codes emerged from the original coding. Reinforcing that coding is an iterative process, Urguhart suggested that the researcher review selective codes to see if selective code names best represent the open codes or selective codes identified. Urguhart also suggested that looking at the selective code attributes and potential relationships can help the researcher distinguish between open, selective, and theoretical codes.

Theoretical Coding

Division among grounded theorists exists regarding when exactly theoretical sampling begins. Charmaz (2006) asserted that theoretical sampling begins after categories emerge. Birks and Mills (2011) argued that theoretical sampling can begin during open coding, as the initial data starts to reveal concepts that begin to signal potential theories or explanations of phenomenon. Theoretical coding occurs when the codes and categories that

emerged during open coding and selective coding are compared, and relationships are found between the codes or categories (Urquhart, 2013). The theory or phenomenon emerges from these relationships. All of the coding is iterative. New codes should be constantly compared to existing data to determine if new categories emerge and whether or not these new categories are densifying. Memos are important to the theoretical coding process and should be included in constant comparative analysis.

NVivo Use

A computer assisted qualitative data analysis software, NVivo 10, was used to aid in the data management and analysis process. The software was also used to query key words for comparison with manually coded categories and themes. NVivo 10 was not used as a primary coding source and was only used in the context of solidifying data analysis. The research process was led by the researcher, not by supporting software (Bryant & Charmaz, 2010). Software was useful as a repository and for sorting through data (Bryant & Charmaz, 2010).

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Trustworthiness

</div>

> In this section, address credibility, transferability, dependability, and confirmability.

The trustworthiness and validity of qualitative research depends on what the researcher sees and hears. Lincoln and Guba (1985) noted that credibility, transferability, dependability, and confirmability are important in establishing trustworthiness. One of the ways to ensure credibility and transferability is to ensure that those interviewed have the experience to discuss the phenomenon the researcher seeks to explore (Lincoln & Guba, 1985). Vignettes from the interviews were used to illustrate key themes for this study, which also served as support for the results of the study (Leedy & Ormrod, 2013). One way to establish confirmability is to ensure no researcher bias. It is important to interpret what the data tells the researcher in an unbiased way. Transcribing entire interviews and manually

coding them helped ensure a deep understanding of the interview content and participant intent.

The use of constant comparative analysis ensured that systematic comparisons were made and that this research demonstrates the links between the analysis and resulting theories (Charmaz, 2006). Constant comparative analysis was also critical in lending credibility to the theories that emerge from the data as the researcher will be able to specifically highlight those codes and categories that had the analytical weight to be used in developing the theory (Charmaz, 2006). Demonstrating saturation was also a factor in ensuring that the data gathered includes data sufficient to provide credibility to the theory claimed (Charmaz, 2006). Transferability was limited in this research study as this study sought to explore a unique topic.

The research must be accessible to aid trustworthiness (Yin, 2011). While the data for this research will be accessible for 5 years following the study, all transcripts and recordings will thereafter be disposed of. The unavailability of the data after 5 years, causes a potential limitation to the trustworthiness and credibility of this study in the future.

Another potential limitation of this study was conducting the interviews by phone versus in person. Birks and Mills (2011) noted that the researcher should increase attention to verbal communication to try to overcome the impact of missing non-verbal cues. To maintain consistency among all interviews, the interviews were all conducted the same way, on the telephone, even if proximity to the interviewee allowed for an in-person interview.

Introducing bias to the phenomenon or theory that emerges from this study was minimized in several ways. Yin (2011) suggested to set clear rules and follow them to help minimize bias in research. This researcher had a set of clear rules and several controls to

[Margin note: Show evidence of how you assured the accuracy of data.]

[Margin note: Explain how you lessened the impact of potential researcher bias.]

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help ensure following of the rules took place. Using conference call recordings and a digital

audio recorder to capture the interviews prevented the researcher from adding to or excluding

any data from the participants' interviews. Manually coding the interviews using grounded

theory methodology helped ensure objective interpretation of the data, which also helped to

minimize bias. The use of memos also helped the researcher stay accountable to the theory

that emerged by aiding reflection and helping during the research process (Birks & Mills,

2011).

Ethical Concerns

The researcher ensured ethics remained a top priority throughout the study.

Following the methods as outlined in this chapter was paramount in ensuring the validity and

reliability of the study. The informed consent form, read to each participant prior to the

interview, is shown in Appendix C. The letter of Informed Consent follows U.S. federal

guidelines, as outlined by Frankfort-Nachmias and Nachmias (2008) including, "a fair

explanation of procedures, description of risks reasonably to be expected, a description of

benefits reasonably to be expected, an offer of inquiry regarding the procedures, and an

instruction that the person is free to withdraw" (p. 75). The risks to human subjects

associated with this study were minimal. All participants were over 18 years of age, and did

not demonstrate any impaired mental capacity, as determined by their ability to perform the

positions that they hold in the workplace. Meeting these criteria qualified them as

participants in this study. Additionally, all recorded materials will be erased after 5 years,

following final approval by the research committee, minimizing any future risks related to

confidentiality.

Explain how informed consent was obtained.

Summarize
key points of
the chapter.

Summary

The goal of this chapter was to outline the research method used to answer the

research questions. A discussion of the procedure, study participants, data collection, and

interview questions outlined the specifics of how the study was conducted and who

participated in the study. A constructivist grounded theory methodology was used to develop

theory on what motivates women to stay in STEM professions, leading to a motivation

model. All study participants contributed to this theory by sharing their experiences in the

STEM workplace and their perspectives of what helped them stay motivated to stay long-

term. The goal of Chapter IV is to provide the study results and demonstrate that the

methodology described in Chapter III was followed.

Bridge to Chapter IV.

Tip: Chapter III is expected to be 10-25 pages long.

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