

An Introduction to Grounded Theory: Choosing and Implementing an Emergent Method

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Introduction

Over the past 40 years, grounded theory (GT) has slowly emerged as a prominent methodology in social research for qualitatively exploring dynamic and unexplored phenomena. While this methodology provides researchers with systematic, yet flexible guidelines that promote and streamline theory development, it is this same open-ended and loosely-structured characteristic that convolutes the practice of GT research. Therefore, it can be particularly difficult for novice researchers to recognize and employ the multiple versions of this methodology in practice. To provide these individuals with a starting point for conducting grounded theory research, we organize this paper into three overarching sections: 1) introduction to the methodology; 2) a comparison between two types of grounded theory traditions; and 3) strategies for implementation. First, we establish an initial understanding of this methodology by providing a brief introduction of the GT methodology. Second, we compare and contrast two approaches of GT: classic GT developed by Glaser and Strauss [1], and constructivist GT developed by Charmaz [2]. Lastly, we provide strategies for methodological implementation as situated within a current GT study exploring professional identity formation in undergraduate civil engineering students. Strategies for data collection, organization, and analysis, model development, and theory abstraction are discussed.

An Overview of the Grounded Theory Methodology

Grounded theory (GT) is a qualitative research methodology that was initially developed by Barney Glaser and Anselm Strauss in 1967 as a way to merge quantitative and qualitative research approaches in social research [1-3]. In particular, GT provides researchers with a systematic and flexible constant comparative approach for theory-constructing inquiry [2, 3], and is typically used when a theory is not available to understand or explain a process that occurs over time [2, 4]. For example, Groen utilized GT in order to expound the processes of professional identity formation [5-7], and Simmons used GT to explore family influence on decision-making processes in first generation college students [8]. In the event that a model applicable to the process under study does exist within prior literature, a researcher will utilize GT in an attempt to further develop the theory for a particular sample population that possesses potentially valuable variables and characteristics of interest [4]. While models of identity formation (e.g., [9-11]) and decision-making (e.g., [12]) exist, these GT studies explore the experiences of particular groups of civil engineering students and first generation college students, respectively, to gain a more nuanced insight of that process. These studies were conducted in these contexts to examine valuable factors that may influence these processes (e.g., engineering stereotypes, the mathematically-orientated nature of engineering work, and the traditionally masculine culture of engineering) specifically for civil engineering and first generation engineering students. From this perspective, these grounded theory studies can aid in operationalizing abstract social processes within specific contexts.

This approach, unlike other research traditions, explicitly encourages persistent interaction and continuous involvement with emergent findings via simultaneously-performed data collection

and analyses. Data within GT studies may be collected in a variety of ways that include pre-existing documents (e.g., historical articles), observations, and/or transcribed interviews. From this process, the researcher moves back and forth between data collection and analysis as a means to perform analytical checks and streamline the process of theory development. For example, a grounded theorist may collect a series of interviews while simultaneously analyzing and adjusting interview protocols that further explore emergent observations and findings. Throughout this constant comparative process, researchers are urged to consider all possible explanations emerging from the data as the analysis evolves from a concrete state to one of theoretically-informed abstraction. As one of the most popular and widely-used qualitative research traditions, GT has been applied in multiple disciplines and to a variety of subjects [3]. From this broad application, GT has slowly evolved from its traditional form, introduced by Glaser and Strauss [1], into other forms presented by Strauss and Corbin [13, 14] and Charmaz [2, 15].

Paradigmatic Influences of Grounded Theory Approaches

While GT maintains a number of defining methodological characteristics, the various versions of grounded theory are separated by paradigmatic nuances reflective of its originators. In this section we delineate the philosophical assumptions underpinning the classic form of GT created by Glaser and Strauss [1] and Constructivist GT developed by Charmaz [2]. A paradigm, or philosophical worldview, is a basic belief system that a researcher holds to describe his or her ontological (i.e. the nature of reality and what can be known about it), epistemological (i.e. the nature of learning and what can be known), and methodological (i.e. the methods employed to inquire about what is to known) assumptions [16, 17]. These paradigmatic views vary by researcher and are influenced by his or her past research experiences, disciplinary background, and personal beliefs [16]. From this set of beliefs, researchers may then make decisions regarding the questions and methods to investigate and employ throughout their research, often incorporating qualitative, quantitative, or mixed methods approaches into those endeavors [16]. When considering the paradigms influencing GT, two main philosophies emerge that capture the perspectives of the primary developing researcher’s methodologies: 1) the objectivist/positivist perspective of classic GT [1], and 2) the relativist/constructivist perspective of constructivist GT [2, 3, 15, 17]. A summary of each perspective and its influences on GT are shown in Table 1, followed by an in-depth discussion of each paradigm.

Table 1: Paradigmatic Assumptions and Characteristics of Grounded Theory Methodologies [2]

	Objective/Positivist (Glaser & Strauss, 1967)	Relative/Constructivist (Charmaz, 2014)
Ontology	Realist	Relativist
Epistemology	Objective	Subjective/Interpretivist
Impact on Methods	Promotes strict adherence to steps embedded within the research approach	Highlights flexibility; resists mechanical application
Product of Grounded Theory Research	Generalized, explanatory theory of a process, action, or interaction that transcends time and context	Subjective, descriptive theory of a process, action, or interaction dependent on time and context

Classic Grounded Theory: The Objectivist/Positivist Perspective

The classic approach to GT by Glaser and Strauss primarily reflects the objectivist/positivist worldview of Glaser merged with the pragmatist worldview of Strauss [2, 3, 15]. Classically trained as a quantitative researcher, Glaser heavily influenced the objective, systematic processes embedded within grounded theory research. Glaser's primary aim was to identify key strategies or "codify" (p.9) the methods to demystify and conduct rigorous qualitative research [2]. Glaser's research partner, Strauss, impacted the development of GT by bringing a symbolic interactionist perspective to the methodology. Symbolic interactionism assumes that reality is constructed through language, symbols, and social interactions that are utilized by individuals to construct, make, and enact meaning and action [2, 18]. It was Strauss's perspective that gave grounded theory its qualitative-based approach of utilizing individual stories and accounts for the purpose of studying and understanding social processes [2].

An ontology describes the researcher's view of reality, while an epistemology describes how researchers come to know that reality [17]. In the classic form of GT introduced by Glaser and Strauss [1], they maintain a positivist worldview [3] with a realist ontology and an objectivist epistemology [17]. In other words, the positivist form of GT considers that reality is an external, unyielding "Truth" that is to be explored, determined, and understood through objective, value-free means of the researcher [17]. The ontology and epistemology of a positivist grounded theory are enacted through an objective methodology. The positivist perspective emphasizes the importance of maintaining strict, systematic adherence to the methodological process embedded within the GT approach, regardless of context [2]. As a result, a researcher employing this form of GT will produce a generalized, explanatory theory of a process, action, or interaction that intends to transcend time and context [2].

Constructivist Grounded Theory: The Relativist/Constructivist Perspective

The constructivist approach to grounded theory presented by Charmaz [2] reflects her constructivist/relativist worldview. Trained as a student under Strauss, Charmaz was influenced by his symbolic interactionist perspective and iterative research approaches. Hence, she developed another form of grounded theory that maintained the basic components of Glaser and Strauss's "emergent, comparative, inductive, open-ended" (p. 12) approach but was departed from the societal emphasis of social constructionism [2]. The social constructionist perspective views individuals as products of society; who we are is based on socially and culturally-generated categorizations and ideologies [19]. Constructivism, on the other hand, acknowledges individual agency in making meaning and maintains the interpretivist, relativist view of both the researcher and participants.

This form of GT developed by Charmaz [2] maintains a relativist ontology with a subjective and interpretivist epistemology [17]. From this perspective, reality is perceived as constructed by individuals and exists in multiple forms [2, 17]. Unlike the objective, external epistemology of positivism; knowledge about reality in the constructivist paradigm is co-constructed and context-dependent; individuals make-meaning of and interpret their interactions and the actions of others [2, 17]. From the constructivist worldview, the lines between ontology and epistemology become somewhat blurred; what is to be known is highly dependent on the way in which it is come to be

known [17]. Research methods employed to enact the relativist ontology and subjective epistemology are highly *dialectic* [17] and dependent on the interactions between the researcher and the participants (i.e. the co-construction of knowledge through symbolic interactionism). Due to the dynamic nature of the interpretivist epistemology, the researcher acknowledges that meaning may change throughout the research process due to participant interactions and contexts, warranting a flexible, iterative use of GT that is applied when relevant. From this view, the mechanical application of GT research methods is highly inappropriate [2]. The result of this form of GT is a theory that sophisticatedly describes an explanation of a process, action, or interaction as situated within time and context [2].

Choosing a Grounded Theory Approach: Comparing Methodological Implications

Provided these different forms of GT, it can be particularly difficult as a novice researcher or aspiring grounded theorist to choose and implement either approach. One way to determine which form of GT is appropriate for you and your research aims is to review and understand the key methodological components underpinning each approach. In this section, we compare and contrast the methodological constituents of classic and constructivist GT. As you read this section and determine the most appropriate GT tradition for your research, ask yourself the following questions:

- Which grounded theory approach supports my research aims?
- How do I see myself interacting with my participants and my data?
- What are my values as a researcher, and how do they influence my work?

Despite the paradigmatic differences among GT traditions, multiple steps within the GT method remain constant across paradigms and often distinguish this methodology from other qualitative research approaches. These steps include: 1) inquiring about process-oriented phenomena; 2) beginning with inductive logic; 3) conducting rigorous, comparative analyses with the data; 3) continuously developing an increasingly theoretical analysis; and 4) creating a theory about a process-oriented phenomenon [2]. Grounded theorists, regardless of paradigmatic influence or worldview, investigate the process of a phenomenon [20]. In addition to learning and gaining an understanding of the phenomenon itself, GT seeks to show potential explanations and underlying mechanisms to identify why the phenomenon may be occurring. As a result, the GT inquiry is designed for the researcher to produce a data-influenced theory describing the process of a phenomenon. For example, in the professional identity study described in the following sections, Groen examined the ways in which civil engineering students develop a professional identity over time, rather than examining ways in which participants negotiate dimensions such as gender and profession [6]. Another defining characteristic of GT is the inductive logic that drives the method. That is, rather than imposing codes and utilizing deductive research approaches, grounded theorists allow patterns and themes to emerge from the data, which influence further data analysis and collection using a method called constant comparison [21]. For example, rather than utilizing Gee's Four Ways to View Identity [22] to create a coding structure based on institutional, discourse, affinity, and nature identities, open coding was used to allow for participant constructions of identity to emerge. Constant comparative methods is a process in which a researcher continuously compares categories and themes from previously collected data to those of recently collected data (e.g., iteratively sampling interview transcripts during

analysis) [2]. Through this process, a researcher develops a theory that is “grounded” in data derived from the process-oriented phenomenon under study.

While the different forms of GT share characteristics across paradigms, they also differ in many ways. In this section, we compare and contrast the various characteristics across GT methodologies as influenced by their paradigmatic assumptions. In particular, we discuss the following steps within the GT process: bracketing, sensitizing concepts, theoretical sampling, quality criteria, causality assumptions, role of researcher values, reflexivity, and the role of researcher interpretation. A summary of these characteristics and their definitions corresponding to each paradigm are presented in Table 2. To further compare these characteristics, we also indicate the *high* and *low* levels of agreement between the two versions of GT. *Partially congruent* characteristics are generally defined in similar ways; however, they are utilized for different purposes and yield different meanings for researchers. *Incongruent* characteristics indicate that the researchers maintain opposite views on the topic, which drastically influences how it is utilized throughout the GT process.

Table 2: Grounded Theory Methodological Characteristics in High Agreement

	Characteristic	Classic GT Glaser & Strauss (1967)	Constructivist GT Charmaz (2006; 2014)
Partially Congruent	Bracketing	Awareness of preconceptions at the beginning of a study [23]	Iterative process of identifying preconceptions and assumptions during the research process [23]
	Sensitizing Concepts	Concepts that serve as departure points and to guide inquiry [2, 21]	Background ideas that inform the overall research problem and guide inquiry [21]
	Theoretical Sampling	Intentional form of data collection to further develop emergent theory [2, 3]	Intentional form of data collection to further explore and develop categories of the emergent theory [2, 3]
	Quality Criteria	Generated generalizable theories that are modifiable explanations of process, actions, and interactions [4, 16]	Generated suggestive, sophisticated, and informed theories that explain process, actions, and interactions [2, 4, 17]
	Causality Assumptions	Based on causal processes in which some events influence others [24]	Causal mechanisms and their effects are not fixed, but contingent [24]
Incongruent	Role of Values	Maintains a neutral, expert, and passive researcher perspective [2]	Maintains a “non-neutral” researcher perspective and acknowledges personal priorities, positions, and values [2]
	Reflexivity	Rejects reflexivity as it is considered to be “paralyzing and self-destructive”; researcher experiences may be used as an initiation point of analysis [2, 25]	Researcher engages in reflexivity throughout the entire process; used as a means to further analysis [2]
	Role of Interpretation	Researcher does not take an interpretive stance; interpretation remains at descriptions of categories [2]	Interpretation occurs throughout analytical process; acknowledges that the resulting theory is an interpretation [2]

The following methodological characteristics maintain a partial congruency between the classic and constructivist approaches to grounded theory.

Bracketing

Throughout the literature, there are multiple definitions for the process known as *bracketing* [23]. Nevertheless, bracketing is still maintained as an important step in the GT research process across paradigmatic worldviews; however, its perceived necessity and benefits vary depending on the paradigmatic assumption underpinning your chosen GT approach. In general, bracketing occurs when a researcher acknowledges his or her own preconceived notions, biases, and beliefs so that readers may understand the researcher's position (i.e. reflexivity), and the researcher may bracket or suspend those biases as the research continues [23, 26]. In classic GT, Glaser and Strauss maintain that bracketing is necessary for researchers to identify their preconceptions and biases at the beginning of the study [23]. Constructivist GT maintains the importance of the researcher's background throughout the entire study and perceives bracketing as an iterative process that may appear at any time [23]. From Charmaz's perspective, if this bias is not captured when it appears, it may impact the results of the entire study. While these definitions and uses of bracketing align with Creswell and Miller [26] and Tufford and Newman [23], they are reflective of their respective paradigmatic assumptions. Glaser and Strauss, who maintain a positivist perspective in their GT, use bracketing almost as a form of normalizing researchers at the beginning of a study, much like normalizing an instrument in a quantitative study. Also, the fact that bracketing only occurs at one time maintains a strict adherence to the research procedure, which is characteristic of positivist, quantitative research traditions [16]. Charmaz, on the other hand, acknowledges that the researcher is dynamic and his or her views may change throughout the research process and potentially impact the research in different ways. This change may be accounted for through an iterative bracketing process, which is reflective of a constructivist and interpretivist worldview [17]. Also aligning with a constructivist worldview is the flexible, iterative nature of the bracketing process, which is more characteristic of qualitative traditions [16].

Sensitizing Concepts

The use of sensitizing concepts is another characteristic of GT methods that are similar yet different depending on the form of GT in which it is considered. Within the classic and constructivist forms of GT, sensitizing concepts serve not as theories to prescribe inquiry, but as guides throughout the research process and provide a general sense of reference for the researcher [21]. While the perceptions of sensitizing concepts are very similar, one distinction may be made between classic and constructivist GT: the point at which these concepts are considered throughout the research process. While Glaser perceives these concepts to be starting points for further inquiry, Charmaz goes one step further to state that these concepts may impact the overall research problem [21]. From this distinction, it is emphasized that, through Charmaz's constructivist point of view, she perceives sensitizing concepts as an interpretive device for the researcher; within classic GT, Glaser perceives them as a means to begin inquiry [21].

Theoretical Sampling

A distinguishing characteristic of GT, theoretical sampling serves as a thread that connects both forms of GT. *Theoretical sampling* is a sampling process in which a researcher intentionally and purposively collects more data from sources that will further develop specific, previously-observed themes for the refinement of the emergent theory [2, 3]. However, the point at which a researcher ceases to collect data through theoretical sampling varies among GT researchers [2] and is known as *theoretical saturation*. In general, theoretical saturation occurs when, upon collecting new data, no new categories or properties emerge [2, 13]. Researchers such as Glaser and others maintain that “this logic supersedes sample size” [2, p. 214] – even if the sample size is quite small. From this positivist perspective, theoretical saturation focuses more on generalizability across participants, whereas Charmaz agrees with Bowen’s [21] interpretation of saturation which focuses on “sampling adequacy” [27, p. 140] and redundancy in categories. In this constructivist view, sampling should continue until no new knowledge is to be constructed or interpreted from collected data. However, this logic may provide the researcher with issues if the sample size becomes too unruly [28]. To balance these issues, researchers have come to a consensus as a general “rule of thumb” for a GT sample size. In general, a sample size should consist of 20-30 participants, or other units of analysis [2, 16, 28]; however, this should not be the sole indicator for ceasing data collection.

Quality Criteria

One characteristic that is heavily influenced by paradigmatic assumptions is the quality criteria used to evaluate a grounded theory. Classic GT [1] utilizes the following criteria: a close fit with the data (i.e. credibility), usefulness, conceptual density, durability over time, modifiability, and explanatory power [2]. From these criteria, classic GT emphasizes the development of grounded theories that align with positivist perspectives; theories that can transcend time through meaningful, “accurate” explanations. Classic GT also maintains that a grounded theory is a theory that resolves a main concern that can be theoretically coded in many ways while still coming to the same conclusion, emphasizing the “apprehendable reality” [17, p. 106] of a positivist ontological view [2]. In contrast, constructivist GT utilizes the following quality criteria to evaluate grounded theory: credibility, originality, resonance, and usefulness. While some of these quality criteria overlap with those presented in classic GT, they focus on the constructivist emphasis of relativist ontology. These criteria assume that any conclusions developed by a grounded theory are suggestive and context-dependent [4]; therefore, these criteria are dependent on the researcher’s context and situation to which they would employ the grounded theory. However, this is not to say that constructivist grounded theories cannot be transferred to other contexts; the transfer and application of these theories are left to the discretion of researchers who wish to employ them based on their own areas of inquiry.

Causality Assumptions

One key identifier of grounded theory is the ability to determine *causal conditions* that “influence or cause a phenomenon to occur” [29, p. 18]. While many qualitative traditions do not attempt to determine causality [16], Maxwell [24] presents his argument that aligns with scientific aims of causality through a realist perspective of qualitative research. This perspective

aligns with that of Glaser and Strauss [1], who perceive processes as variables and, in essence, merge the quantitative and qualitative traditions together [24]. Rather than conducting a quantitative measure of causality through variance theory and statistics, grounded theorists utilize process theory in which observed processes can influence others [24]. This perspective maintains positivist assumptions and has been compared to behaviorist principles and scientific observations of participants in their natural environments [24]. Due to a realist view of causality, the resulting theory should become generalizable over time [2]. However, Maxwell [24] also presents a view that contrasts the realist views of causality in qualitative research and aligns more with the constructivist views of Charmaz. From this perspective, causal conditions are seen as contextualized and contingent [24]. This supports Charmaz's view that resulting constructivist grounded theories are sophisticated explanations of the phenomena under study [2, 4]. Rather than assuming that casual mechanisms transcend time, they are only relevant provided a given context.

The following methodological characteristics are incongruent between the classic and constructivist approaches to grounded theory.

Role of Values

Depending on the type of GT a researcher is employing, the role of researcher values throughout the study will drastically vary. From Glaser and Strauss's [1] positivist perspective, they assume that the researcher maintains objective and neutral to the topic as a passive, expert observer [2]. In this form of GT, the values of the researcher are not relevant nor have any bearing on the study, similar to a scientific-based inquiry. However, Charmaz [2] takes a much different perspective on the values of the researcher. Her constructivist perspective "loosens grounded theory from its objectivist foundations and brings the grounded theorist into the research situation and process of inquiry" [2, p.321]. The researcher's positions, prior experience, and values are maintained throughout the duration of the research process and are considered as the researcher interprets themes from observations and interview data and decides which research avenues to pursue during theory development.

Reflexivity

Similar to the role of researcher values within a GT study, the worldview assumed by the GT will also influence the importance of researcher *reflexivity* throughout the process. This is a point of contention between Glaser and Strauss [2, 25]. As they developed the classic form of GT together, personal paradigmatic views separated them. While this is not the only point at which Strauss departs from Glaser's positivist view, it is one that is most easily identifiable. Glaser perceives reflexivity as "paralyzing" and "self-destructive" [25, p. 518]. Strauss, on the other hand, views reflexivity as a necessary characteristic of GT similar to Charmaz [2, 13, 25]. From this debate, it appears that this disagreement may have been partially negotiated in the traditional GT model where reflexivity may be used as a single data point [2]. Charmaz, from the constructivist viewpoint, also perceives reflexivity as a necessary facet of GT that may be used throughout the entire research process to enhance and further data analysis while the researcher is in dynamic, continuous dialogue with themselves and their data [2]. From this perspective, Charmaz acknowledges that the researcher's viewpoints may – and probably will – change

throughout the research process. Continuous reflexivity is a way to capture that change and enhance research quality.

Role of Interpretation

A final characteristic that greatly distinguishes classic GT from constructivist GT is the role of interpretation in the research process. From Glaser and Strauss's [1] positivist perspective, the research should maintain a non-interpretivist, objective stance throughout the research process [2]. The only time the researcher may make any interpretation is during the development of categories in which the researcher segregates the codes into categories [2]. Charmaz views the role of interpretation very differently. From a constructivist perspective, the research process in itself is an interpretation constructed by the researcher. The researcher interprets what is happening during data analysis and collection; hence the theory produced from those processes is also an interpretation [2].

Grounded Theory in Practice: Strategies for Implementation

While grounded theorists such as Charmaz and others [1, 2, 14] provide general guidelines for conducting GT research, they do not necessarily explicate the operationalized approaches for implementing GT. Charmaz, in particular, describes GT using the term *methodological eclecticism*, meaning that researchers may pragmatically employ research tools most appropriate for achieving their research purpose [2]. From this perspective, grounded theorists may utilize multiple approaches for data collection and analysis and even combine other qualitative traditions with GT such as ethnography. As a beginning researcher, this methodological freedom may be slightly overwhelming as you embark on your GT journey, as it can be difficult to anticipate which data collection and analytical strategies will prove as useful and contribute to theory development. To facilitate the implementation of the GT research process, we provide examples of ways in which you can engage in this methodology in the context of your own research. In particular, we discuss strategies of implementation for memo-writing, data collection, and data analysis using examples from an on-going GT study exploring the process of professional identity formation in undergraduate civil engineering students.

Overview of Present Study

The examples presented in this section are derived from an on-going study that is utilizing GT to explore the professional identity development of undergraduate civil engineering students [6]. Drawing from sensitizing concepts (i.e., Gee's four identity constructs [22] and social identity theory [30, 31]), this study sought to examine the variety of events, relationships, values, and experiences that influence students' formation as emerging professionals within the disciplinary context of civil engineering. From this study, a grounded theory of professional identity negotiation emerged from 32 interviews with undergraduate students in civil engineering. As depicted in Groen's GT model, students begin to perceive and position themselves as professionals within the civil engineering discipline through a process of definition negotiation [6]. During this process, students negotiate their constructed definitions of self (e.g., gender, disability, family background, etc.) with those of the profession (e.g., nature of engineering work, roles of civil engineering in society, ethics, etc.). As this iterative negotiation process

continues, students form a professional identity and advance from an outsider (i.e., one not belonging to the civil engineering profession) to an insider (i.e., an individual belonging to the civil engineering profession). A full description of this GT study is presented in [6].

Memo-Writing

Memo-writing is an integral component to GT research that is continuously conducted throughout the data collection and analytical processes. Memos serve as an informal place for grounded theorists to make comparisons among data, codes, and categories as well as provide an interactive space for a researcher to engage in conversation with themselves [2, 32]. Within GT, memos exist in three primary forms: 1) initial memos, 2) advanced memos, and 3) integrated memos [2]. The definition, purpose of its use, and form in which each memo was recorded are summarized in Table 3.

Table 3: Summary of Memo-Writing Techniques and Uses

Memo Type	Definition [2]	Purpose	Approach
Initial Memos	Memos that capture the exploration and development of qualitative codes and provide direction for future data collection	To capture thoughts and ideas during the exploration of participant perspectives	<ul style="list-style-type: none"> • Participant summary sheets • Hand-written notes in research notebook
Advanced Memos	Memos that identify, trace, and describe the supporting assumptions, emerging changes, and practical applications of categories throughout analysis	To provide a space to freely write reflective thoughts, ask and answer questions, and identify gaps in the data	<ul style="list-style-type: none"> • Electronic notes recorded in Microsoft Word with comments
Integrated Memos	Memos in which the researcher begins to integrate codes, categories, and prior memos to enhance theory development	To provide a space for theory abstraction and integration through drawings and discussion	<ul style="list-style-type: none"> • Hand-written notes attached to participant interview transcripts • Audio recordings

Notably, the participant summary sheets served as a form of initial memos that were completed during initial phases of coding as a means to summarize participants’ key experiences and identity shifts. These sheets, presented in Appendix A, were intentionally designed to align with the study’s research questions and prompted us to ask questions of the data and make comparisons across participants [2]. Spoken memos were transcribed and stored with other memos. Memos were stored in two forms: 1) an electronic “memo bank” [2] that included electronic files and multiple revisions of each memo, and 2) a research notebook that contained hand-written memos from interviews and spontaneous ideas.

Data Collection

As previously discussed, GT data is typically collected in the form of 20-30 interviews [4, 28, 33] although other forms of data may be considered such as pre-existing documents and

observational notes [2, 4]. In this particular study, we conducted 32 semi-structured interviews each lasting 60-90 minutes. These interviews were conducted using a combination of constructivist interviewing [2], intensive interviewing [2], and critical incident techniques [34-36] to tailor the interviews toward the exploration of participants' specific experiences. For the purpose of my study, a critical incident was defined as any incident, relationship, activity, event, or experience that a participant perceived as influencing, either positively or negatively, their professional identity formation.

While the interview strategies for exploring participants' professional identity formation were fairly logical decisions based on the personal nature of the research topic, the interview protocol, on the other hand, was rather difficult to develop. Acknowledging that an interview was an identity intervention in itself, we needed to develop a protocol that was semi-structured and indirectly prompted participant discussion about identity formation. To accomplish this, we created a participant worksheet (Appendix B) in which participants defined civil engineering throughout three periods of their lives. As participants wrote down their definitions of civil engineering, we would ask them the follow-up questions using the protocol are as follows:

1. To get started, picture yourself at any time before you came to college. What were the skills, events, activities, interests, and people that helped you determine why you wanted to go into engineering? Please list these skills and activities in the "Prior to College" column.
2. So think about yourself in the present day. What skills, events, activities, events, and people do you feel are important while you are in college, specifically within civil engineering? Please list these skills and activities in the "Now" column.
3. Now I'm going to ask you to speculate a little bit. Think about yourself after graduation. What skills, events, activities, interests, and people do you feel you will need to have and do in your pictured role? Please list these skills and activities in the "After Graduation" column.
4. Where do your insights come from?
5. As you review what you've entered into the table, how are the items you listed in the "After Graduation" column consistent or inconsistent with how you see yourself?
6. Would you be willing to participate in another interview at a later date?

Further probing questions were influenced from the sensitizing concepts underlying this study, as discussed above. Maintaining such a flexible and encompassing interview structure allowed us to tailor participant interviews to their individual experiences while also providing the university institutional review board (IRB) with enough information for protocol approval. All interviews were transcribed and field notes were taken to preserve the context and subtle implications of topics discussed by participants. Interview field notes were also used to supplement memo-writing and analysis in later phases of the study.

Data Analysis

The constant comparative nature of GT analysis is flexible and non-discrete, thus making it difficult to identify when one coding strategy ends and another begins. However, throughout the GT process, a grounded theorist should embark on at least two phases of coding: initial coding

and focused coding [2]. The later coding phases, those beyond focused coding, are less articulated and are implemented at the discretion of the researcher [2]. All six coding techniques as outlined by Charmaz [2] are shown in Figure 1. These coding techniques include both emergent and a priori approaches and grow increasingly abstract throughout the research process.

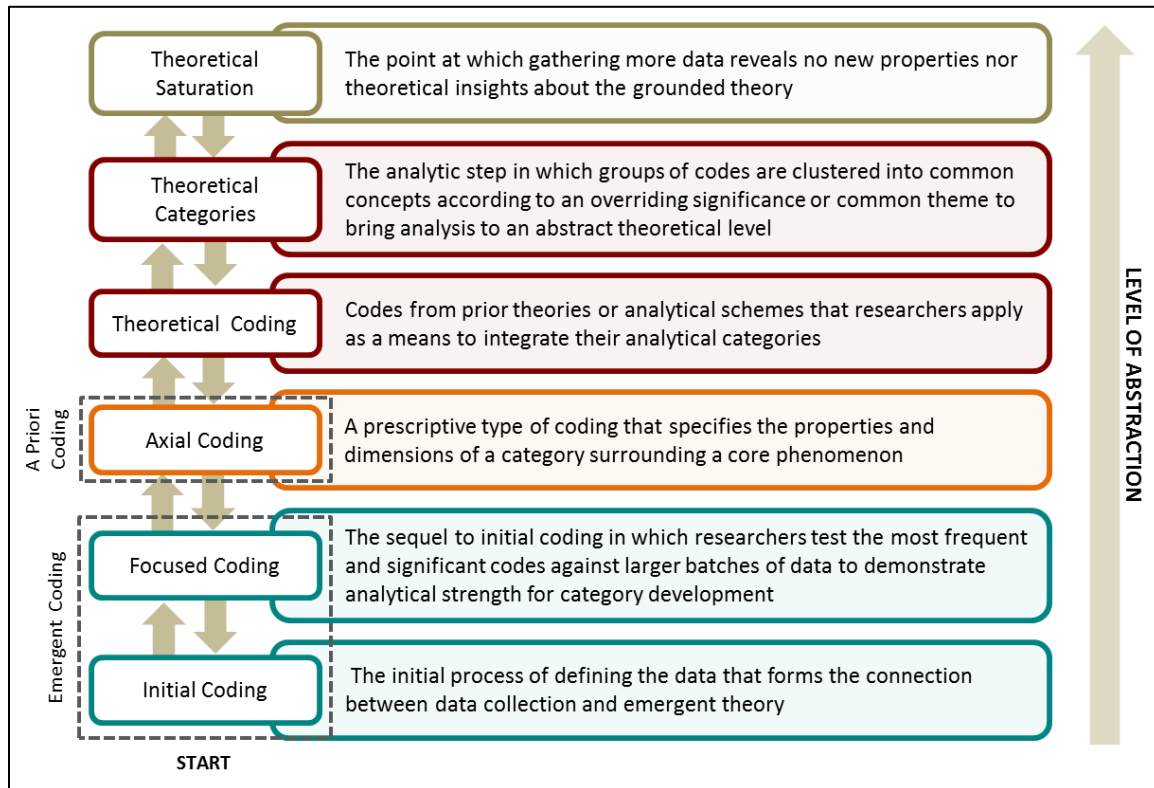


Figure 1: Summary of GT Coding Strategies

As summarized in

Table 4, a combination of electronic and traditional coding approaches was used to implement each coding strategy. MaxQDA™ coding software was used to conduct line-by-line coding of participant interviews. By using the MaxQDA™ software, we were able to capture a variety of participant experiences and the frequency at which they occurred. To organize and visualize the relationships among our initial codes, we printed each code on a strip of paper and clustered them into themes based on action type (i.e., the act performed by the code). This process was repeated until distinct themes could be identified within the data. Focused coding was then conducted incident-by-incident on printed copies of the interview transcripts to determine the characteristics of each theme. Prominent theme characteristics were then applied a priori across documents using axial coding. During this process, GT components were also used to structure the data into *causal conditions* (i.e. the events or experiences that influence a phenomenon) [2, 4, 29], *intervening conditions* (i.e., broad and specific situational factors that influence strategies) [2, 4, 14], *strategies* (i.e. the strategic actions or interactions that influence the outcome of a process) [2, 4], and *consequences* (i.e. the outcome of using a specific strategy) [4]. Upon combining these iterations of axial coding, existing themes and their characteristics were organized to create a preliminary model of the emergent theory – a model of professional

identity formation, for this particular case. This preliminary model, consisting of previously clustered codes and categories, was then applied to the data at the document level. Theoretical coding was used to identify overall trends and capture the dynamism of the components of this emergent theory. From this coding, we were able to identify *negative cases* (i.e., data that sharply contrast the emerging themes) of which the current theory did not account. Upon identifying these negative cases for different portions of the model, we drew from existing theories (e.g., identity saliency, social identity theory, and discourse analysis) to develop theoretical categories and integrate the negative cases into the model. This process of theory application and abstraction revealed areas in which to adjust and finalize the overall theory structure. This process was repeated until theoretical saturation occurred and no new themes emerged from the data.

Table 4: Summary of Coding Implementation Strategies

Coding Phase	Implementation Strategy	Outcome	Example Approaches from Present Study
Initial Coding	<ul style="list-style-type: none"> • MaxQDA™ software: allows researchers to identify number and frequency of emergent codes • Line-by-line coding of interview transcripts 	<ul style="list-style-type: none"> • Initial codes to begin analysis 	<ul style="list-style-type: none"> • Identify actions performed by utterances (e.g., reinforcing self, using grades to measure knowledge gains)
Focused Coding	<ul style="list-style-type: none"> • Print codes on strips of paper and organize • Incident-by-incident coding of interview transcripts 	<ul style="list-style-type: none"> • Visualize relationships among codes • Identify incidents to be coded in further analysis 	<ul style="list-style-type: none"> • Identify a disconnect between a negotiation and their impacts on student identity • Identify coding themes (e.g., prior to college, managing life as a college student, and alignment of self and profession)
Axial Coding	<ul style="list-style-type: none"> • Document-based coding on printed interview transcripts • Organize properties of incidents according to GT framework 	<ul style="list-style-type: none"> • Identify properties of incidents • Identify relationships among incidents • Create initial structure of the emergent theory 	<ul style="list-style-type: none"> • Utilize GT components to organize data (e.g., strategies, causal conditions, outcomes, and intervening conditions) [2]
Theoretical Coding	<ul style="list-style-type: none"> • Incident-by-incident coding on printed interview transcripts 	<ul style="list-style-type: none"> • Identify overall trends for theory application • Identify and account for negative cases 	<ul style="list-style-type: none"> • Identify shifts in definitions of self vs. shifts in definition of the civil engineering profession
Theoretical Categories	<ul style="list-style-type: none"> • Document-based coding on printed interview transcripts • Draw from existing theories to articulate components of the emergent model 	<ul style="list-style-type: none"> • Articulate model • Abstract meaning 	<ul style="list-style-type: none"> • Identify orientations of identity negotiations inspired by identity saliency [10], social identity theory [30, 31], and discourse analysis [37]
Theoretical Saturation	<ul style="list-style-type: none"> • MaxQDA™ software: allows researchers to apply emergent theory to participant interviews • Incident-by-incident coding of printed interview transcripts 	<ul style="list-style-type: none"> • Examine and finalize theory 	<ul style="list-style-type: none"> • Tweak and identify nuanced characteristics of the model (i.e., identifying when the model dissolves)

Throughout the various coding phases, it is important to note that themes do not immediately translate into a theory. As comparisons are made and categories are identified, relationships between these categories become increasingly abstract and theoretically-focused. One way to bolster theory development is to draw and sketch proposed models of the emergent theory. This sketching process can be used as an analytical step itself and provides the researcher with the freedom to test different theoretical propositions. For our study in which we developed a grounded theory of professional identity formation for undergraduate civil engineering students, we began sketching theory relationships starting at the focused coding phase. These sketches were then tweaked and refined to aid in theory abstraction throughout data analysis.

Concluding Remarks

In this paper, we provided an overview of the classic and constructivist GT approaches to assist emerging grounded theorists in identifying, choosing, and implementing multiple forms of GT within their research. Understanding the origins of this methodology may inform a researcher's methodological decisions when choosing the type of data to collect and analytical strategies. We then introduced suggestions for implementing the various components of this emergent method using a current grounded theory study to provide examples and context. It is hoped that novice researchers may be able to utilize this paper as a quick reference guide for conducting GT and that it inspires ideas for ways in which they may conduct their own GT research. Overall, it is important to understand that there is no single "correct" way for conducting GT research; therefore, novice researchers should not be afraid to test approaches different from those listed in this paper.

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APPENDIX A: Participant Summary Sheet

Participant Summary Sheet: CE Professional Identity Formation

Participant ID No. (PID): _____
Assigned Pseudonym: _____
Major-Grade Level/Sex: _____
Contact Date: _____
Today's Date: _____
Contact Type: _____
Written by: _____
Future Plans: _____

<i>Notes:</i>

1) What main issues or themes stuck out at you regarding this contact?

--

2) What are the student's initial thoughts or conceptions regarding civil engineering? (RQ1)

--

3) How have the students' conceptions of civil engineering changed or shifted? (RQ2)

--

4) What are the outcomes that resulted from these changes? (RQ3)

--

5) How may these topics be connected to those presented by other students? (RQ4)

--

6) What are questions you would like to ask your participant in an upcoming interview? Why?

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APPENDIX B: Participant Interview Worksheet

Name: _____

Prior to College	Now	After Graduation