

## THEORY

# New Perspectives for Implementing Grounded Theory

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**Background:** Grounded theory has evolved to become one of the most prominent qualitative approaches in social science research. However, this methodology has been adopted in a variety of ways across the engineering education landscape, reflecting and amplifying debates surrounding the nature and quality of grounded theory research. This can be problematic for novice researchers and those new to the methodology and may potentially limit its application and theoretical contributions to the field.

**Purpose:** In this theoretical manuscript, we reflect on the evolution of grounded theory and its core tenets to improve engineering education to think about the ways we can collectively conceptualize, interpret, and implement this methodology. By gaining a greater understanding of the paradigmatic underpinnings and practices of grounded theory, scholars in engineering education will be better equipped to assess the affordances and limitations of this approach and identify when, why, and how it is appropriate for implementation in their work.

**Scope:** First, we discuss the historical and paradigmatic underpinnings of three grounded theory traditions: classic, pragmatic, and constructivist grounded theory. Second, we describe the difference between implementing grounded theory methodology versus applying grounded theory methods. Third, we compare and clarify points of confusion often encountered in conducting grounded theory studies. Lastly, we offer a reconceptualized perspective of grounded theory and implications for expanding its use in the engineering education community.

**Discussion/Conclusions:** We encourage engineering education researchers to position grounded theory as a living methodology that not only generates new theory, but also bridges past and current research by deepening methodological and theoretical connections across contexts. Reconceptualizing grounded theory allows us to more intentionally account for evolving cultural nuances that influence the engineering education experience as to further broaden participation in the field and the impacts of our work.

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**Keywords:** grounded theory; research methods; theory; qualitative methods; analysis

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Since its inception in 1967, grounded theory has become one of the most prominent qualitative approaches in social science research (Bryant & Charmaz, 2007; Case & Light, 2011; Greckhamer & Koro-Ljungberg, 2005). Due to its hallmark of theory generation and descriptive nature, grounded theory has been applied across a variety of fields, such as medical sociology (e.g., Charmaz, 1990), education (e.g., Hachtmann, 2012; McKenna & Millen, 2013), nursing (e.g., Häggström et al., 2012; Williams, 1998), and even film (e.g., Jones & Alony, 2011). As the social science landscape of qualitative research evolved, scholars began to adapt this methodology to suit their own ontologies, epistemologies, and research contexts. These adaptations resulted in the emergence of grounded theory traditions (i.e., versions), namely pragmatic grounded theory (Strauss & Corbin, 1990, 1994) and constructivist grounded theory (Charmaz, 2014, 2006), that paradigmatically differed from Glaser and Strauss's (1967) classic version.

The overall premise of grounded theory has remained relatively unchanged; however, these adaptations have sparked much debate regarding what grounded theory is and what it is not. Proponents of classic grounded theory point to its rigor and quality theory generation, claiming that more contemporary versions erode the integrity of the methodology and fundamentally conflict with its initial purpose and goals (Glaser, 1992, 2002; Stern, 1994). At the same time, proponents of contemporary grounded theory traditions speak to adaptability and accessibility of research application, contending that the classic tradition is too esoteric and impractical (Clarke, 2007).

Little resolve for this debate can be found in the work of the founders themselves. For instance, Glaser has critiqued and challenged versions put forth by his grounded theory counterparts (Bryant, 2009; Glaser, 1992, 2002), while Strauss's perceptions of the methodology continued to evolve over time. In his earlier work, Strauss described grounded theory as a set of distinct processes that must be carried out, aligning with his work with Glaser (Strauss, 1987). But in his later publications with Corbin (Strauss & Corbin, 1990, 1998), Strauss alters his description by positioning grounded theory as a toolkit of procedures from which researchers can choose to implement or ignore based on their own contexts and research aims (Strauss & Corbin, 1990, 1998; Bello, 2015). This debate has resulted in a significant point of confusion identified by Charmaz (2003) and later articulated in Bryant and Charmaz (2007): in some cases, the term *grounded theory* is used to refer to the entire research process including design (i.e., methodology), whereas in others, it refers only to the procedures employed during the research process (i.e., methods). This confusion further led to questions related to the outcomes of grounded theory and how they are defined, such as generalizable, big "T" theories; subjective, small "t" theories; or non-theories that align with concepts of broader qualitative research. These discussions reveal the complexity of grounded theory while underscoring the lack of consensus regarding its implementation and outcomes, making it difficult for research communities to gain a full understanding of the methodology and its implications.

In the field of engineering education, the varied use of grounded theory is reflective of these debates. Some researchers have ascribed to the toolkit approach by applying grounded theory methods to investigate a topic (e.g., Anthony et al., 2007; Johnson-Glauch & Herman, 2019) while others utilize the methodology without claiming the development of a generalizable theory (e.g., McNeill et al., 2016; Walther et al., 2011). Indeed, this variation demonstrates a vast array of grounded theory adaptations implemented within engineering education literature; however, questions still loom regarding what constitutes a high-quality grounded theory study versus a poorly designed qualitative study posing as a grounded theory (Baker et al., 1992; Bello, 2015; Suddaby, 2006). This confusion can be particularly problematic for novice researchers and those new to grounded theory and could potentially limit its application and theoretical contributions to our field.

In this theoretical manuscript, we seek to shed light on these issues and implore the engineering education community to think about ways we can collectively conceptualize, interpret, and implement grounded theory in our work. Here, we position grounded theory and its associated practices as a living methodology that can be used to not only generate theory but also interrogate and adapt existing frameworks to engineering education contexts in a politically and socially evolving world. Conceptualizing grounded theory in this way will better equip engineering education scholars for assessing the affordances and limitations of this approach and aid in identifying when, why, and how it is appropriate for implementation in their work.

### Demystifying Grounded Theory Traditions

Grounded theory is best understood from a historical perspective (Dunne, 2011; Groen et al., 2017; Suddaby, 2006). That is, the historical context in which grounded theory was derived is critical for understanding its tenets, affordances, and variations (Dunne, 2011). Glaser and Strauss (1967) initially developed grounded theory to resist the quantitative and deductive ideologies that dominated the social science research landscape in the mid-1960s. By combining aspects of both quantitative and qualitative research traditions, they sought to move qualitative research beyond descriptive studies and advance the legitimacy of approaches that were often chided as anecdotal, biased, and impressionistic (Charmaz, 2006, 2014; Dunne, 2011). The result was a systematic, inductive, and comparative research process that could be used to conceptualize and develop theories of social processes and phenomena that were grounded in data (Bryant & Charmaz, 2007; Charmaz, 2014, 2006; Groen et al., 2017).

The foundational tenet of grounded theory is that social phenomena can be explored and understood by using a research process that is led and guided by participant experiences, resulting in a coherent theory that reveals and explains patterns reflected in those experiences (Glaser & Strauss, 1967; Hood, 2007). This pattern development and recognition is typically captured using units of analysis called *concepts* (for an in-depth description of grounded theory concepts, see Corbin & Strauss, 1990) and generated through constant comparative approaches. In the process of *constant comparison* (Boeije, 2002; Kolb, 2012), the researcher moves back and forth between systematic data collection and analysis to perform analytical checks and streamline the process of theory development. During this process, researchers are encouraged to consider all possible explanations emerging from the data as the analysis advances from examining a concrete collection of facts to developing an abstracted explanatory theory.

While grounded theory maintains a number of defining methodological characteristics, its various versions remain separated by paradigmatic nuances reflective of their originators. A *paradigm*, or philosophical worldview, consists of a basic belief system that a researcher holds to describe their ontological and epistemological assumptions (Creswell, 2014; Groen et al., 2017; Guba & Lincoln, 1994). These views vary by researcher and are influenced by past research experiences, disciplinary backgrounds, and personal beliefs (Creswell, 2014). They inspire the decisions researchers make regarding the questions to be investigated and the methods employed throughout their work (Secules et al., 2021). The most common forms of grounded theory traditions are summarized in **Table 1** and further described in the following sections.

**Table 1:** Paradigmatic Assumptions and Characteristics of Grounded Theory (GT) Methodologies (adapted from Groen et al., 2017).

|                 | <b>Classic GT<br/>(Glaser &amp; Strauss, 1967)</b>    | <b>Pragmatic GT<br/>(Strauss &amp; Corbin, 1990, 1998)</b>                | <b>Constructivist GT<br/>(Charmaz, 2006, 2014)</b>                        |
|-----------------|-------------------------------------------------------|---------------------------------------------------------------------------|---------------------------------------------------------------------------|
| Ontology        | Critical Realist                                      | Interpretivist                                                            | Constructivist                                                            |
| Epistemology    | Objective                                             | Pragmatic                                                                 | Subjective                                                                |
| Researcher Role | Observer                                              | Interpreter                                                               | Integrated Co-Constructor                                                 |
| Purpose         | Abstract theory and meaning                           | Abstract theory or gain in-depth understanding                            | Abstract theory and in-depth meaning                                      |
| Implementation  | Promotes adherence to rigorous, fundamental processes | Provides a set of tools that may be used, rejected, or ignored            | Highlights flexibility within the process; resists mechanical application |
| Outcome         | Generalized theory that transcends time and context   | Subjective theory dependent on time and context or descriptive non-theory | Subjective, descriptive theory dependent on time and context              |

***Classic Grounded Theory (Glaser & Strauss)***

The traditional approach to grounded theory by Glaser and Strauss reflects the objectivist worldview of Glaser and the pragmatist worldview of Strauss. Glaser, who was classically trained as a quantitative researcher, heavily influenced the objective and systematic processes embedded in grounded theory. Strauss impacted the development of grounded theory by bringing a symbolic interactionist lens to the methodology. *Symbolic interactionism* assumes that reality is constructed by individuals through language, symbols, and social interactions to make meaning and enact action (Blumer, 1969). Strauss's perspective gave grounded theory its approach of utilizing individual stories and accounts for the purpose of studying and understanding social processes.

This form of grounded theory was founded upon a positivist worldview, a realist ontology, and an objectivist epistemology, which position reality as an external, unyielding truth to be explored, determined, and understood through an objective, value-free means (Glaser & Strauss, 1967; Guba & Lincoln, 1994). Similar to quantitative research traditions, classic grounded theory emphasizes the importance of maintaining systematic adherence to methodological procedures regardless of context. As a result, the researcher employing this form of the methodology will produce a generalized, explanatory theory of a process, action, or interaction that intends to transcend time and context (Glaser & Strauss, 1967).

***Pragmatic Grounded Theory (Strauss and Corbin)***

We refer to the form of grounded theory developed by Strauss and Corbin (1990, 1994, 1998) as pragmatic grounded theory due to its pragmatic and interpretivist variations related to data collection, analysis, and researcher involvement. Strauss and Corbin maintained Glaser and Strauss's (1967) positivist slant toward theory generation, however, they began to introduce concepts of constructionism that considered a researcher's prior knowledge, interaction with participants, and interpretation of findings (Strauss and Corbin, 1990, 1998). Methodologically, they deemphasized the role of comparative analyses and focused on analytical verification by introducing such procedures as open, selective, and axial coding as well as extensive questioning and self-reflection (Corbin & Strauss, 1990). In contrast to adhering to a strict research process (Glaser & Strauss, 1967), Strauss and Corbin (1998) invited researchers to employ or reject study procedures based on their own contexts and aims. They also contended that the outcome of grounded theory can be a descriptive non-theory that consists of conceptual ordering and gaining an in-depth understanding of a particular process or phenomenon (Jones & Noble, 2007; Strauss & Corbin, 1990, 1998).

While Strauss (1987) initially described grounded theory similar to Glaser and Strauss (1967), Strauss and Corbin (1990, 1998) tended to back away from these implications in later publications, and in some instances, explicitly refuted them (Jones & Noble, 2007). In this manuscript, our description of pragmatic grounded theory is flexibly written to reflect this evolution. Despite the inconsistencies and critiques of this approach, including paradigmatic conflicts (for a full discussion, see Bryant & Charmaz, 2007), the pragmatic tradition has remained one of the most popular forms of grounded theory due to its user-friendly nature, particularly for novice researchers (Bryant & Charmaz, 2007; Charmaz, 2006, 2014).

***Constructivist Grounded Theory (Charmaz)***

Constructivist grounded theory was developed by Charmaz (2006, 2014) and reflects her constructivist and relativist worldview. Trained as a student under Strauss, Charmaz was influenced by his symbolic interactionist perspective and iterative research approaches. These influences were reflected in constructivist grounded theory, which maintained the basic com-

ponents of Glaser and Strauss's (1967) classic version yet acknowledged individual agency in making meaning associated with constructivism (von Glasersfeld, 1995). This form of grounded theory was informed by a relativist ontology and subjective epistemology in which reality is perceived as constructed by individuals and exists in multiple forms (Guba & Lincoln, 1994). That is, knowledge about reality is co-constructed and context dependent as individuals make meaning of and interpret their interactions with and the actions of others (Charmaz, 2014; Guba & Lincoln, 1994). This worldview is further underscored in constructivist grounded theory methodology in that it hinges on interactions between researcher and participant to co-construct knowledge. Due to these philosophical underpinnings, the result of a constructivist grounded theory is a theory that sophisticatedly describes and provides an explanation for a process, action, or interaction situated within a particular time and context (Charmaz, 2014).

### Implementing Grounded Theory: A Practical Comparison

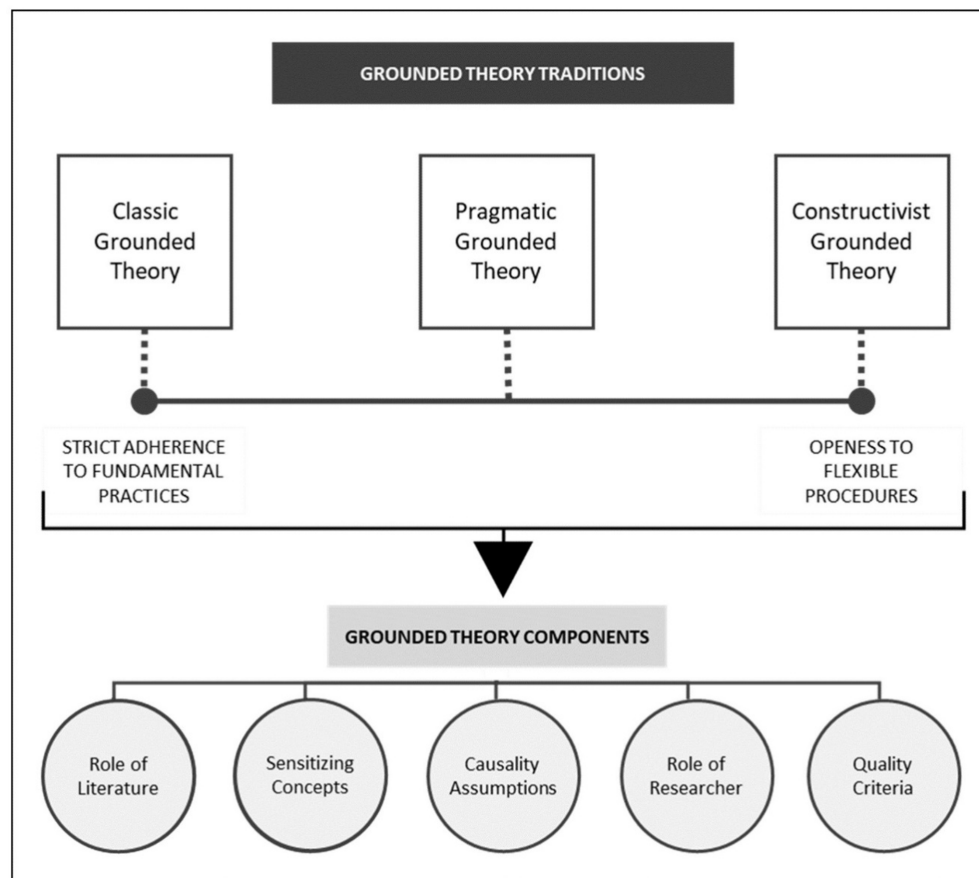
Many characteristics of grounded theory, such as the use of inductive logic, the use of constant comparative analyses, and continuous development of an increasingly theoretical analysis, remain constant across traditions (Charmaz, 2014). However, the role of other components, such as the use of prior literature and researcher positionality, among others, vary across traditions, which can serve as indicators to differentiate one grounded theory methodology from another (Groen et al., 2017). In **Table 2**, we identified five components that differ in nuanced yet significant ways and often serve as points of confusion for researchers new to the methodology. In **Figure 2**, we map these components to existing grounded theory traditions, which are ordered on a spectrum of flexibility that ranges from a strict adherence to established procedures (i.e., classic grounded theory) to flexible approaches (i.e., constructivist grounded theory). The positioning of the components, listed beneath the spectrum in **Figure 2**, indicates that the use and role of these components also differ based on the varied levels of flexibility across traditions. While the list presented in **Table 2** and **Figure 1** does not include all necessary components of grounded theory (discussed in Charmaz, 2014; Hood, 2007; Stern, 2007), we focus this comparison on these five components to inform researchers about their potential pitfalls and clarify their impacts on one's grounded theory work.

#### Role of Literature Review

The role of literature is one of the most hotly debated and divisive characteristics of the methodology. All grounded theory traditions acknowledge the use of prior literature at some point in the research process. In their introductory publication to classic grounded theory, Glaser and Strauss (1967) encouraged grounded theorists to maintain a stance as neutral, objective observers and actively advised against conducting a literature review in early stages of the research process, stating, "An effective strategy is, at first, literally to ignore the literature of theory and fact on the area under study" (p. 37). From this

**Table 2:** Comparison of Grounded Theory Methodological Characteristics and Paradigmatic-Related Definitions (adapted from Groen et al., 2017).

| Methodological Component      | Classic GT<br>(Glaser & Strauss, 1967)                                                                                 | Pragmatic GT<br>(Strauss & Corbin, 1990, 1998)                                                                                                      | Constructivist GT<br>(Charmaz, 2006, 2014)                                                                                                |
|-------------------------------|------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| Role of Literature Review     | General reading is used to establish a general problem area; focused reading occurs after emergent theory is developed | Literature serves as a way to establish the phenomenon that is to be studied and what is known about it                                             | Early review may be used to establish a research argument; later review can be used to compare and contrast emergent theory to prior work |
| Sensitizing Concepts          | Concepts that serve as departure points and to guide inquiry                                                           | Concepts that help guide but do not limit inquiry                                                                                                   | Background ideas that inform the overall research problem and initiate inquiry                                                            |
| Causality Assumptions         | Based on causal processes in which some events influence others                                                        | Causal mechanisms and their effects are not fixed, but contingent                                                                                   | Causal mechanisms and their effects are not fixed, but contingent                                                                         |
| Researcher Role and Influence | Maintains a neutral, expert, and passive researcher perspective                                                        | Maintains a neutral researcher perspective while acknowledging personal experience and knowledge                                                    | Maintains a non-neutral researcher perspective and acknowledges personal priorities, positions, and values                                |
| Quality Criteria              | Generated theories are general, modifiable explanations of process, actions, and interactions                          | Generated theories are researcher interpretations of process, actions, and interactions; can also be used for non-theory generation and description | Generated theories are suggestive, sophisticated, and informed explanations of process, actions, and interactions                         |



**Figure 1:** Summary of Grounded Theory Traditions and Methodological Components.

perspective, the less prior knowledge a researcher has acquired about a particular topic, the more unbiased and open they will be to emergent themes and patterns within collected data. This statement further demonstrated the objective and systematic influences of quantitative approaches brought to classic grounded theory by Glaser, as previously described. Yet, as Dunne (2011) points out, this advice explicitly contradicts both quantitative and qualitative methodologies that require and rely on in-depth literature reviews for question identification and problem scoping. Strauss and Corbin (1990) aligned pragmatic grounded theory with broader research norms and positioned the literature review as a way to establish the phenomenon to be studied and what is already known about it (Heath & Cowley, 2004; Strauss & Corbin, 1990; Thornberg, 2012). While Glaser (1992) initially critiqued this technique, he later acknowledged that broad reading is necessary to establish a general problem area and that focused, in-depth reading should only occur after the emergent theory is developed (Glaser, 1998; Heath & Cowley, 2004). Charmaz (2006) expanded on Strauss and Corbin's use of literature in constructivist grounded theory, where she acknowledges that an early review may be used to establish a research argument, but also emphasizes that later review can be used to compare, contrast, and verify emergent theory with prior work. Therefore, literature debates in grounded theory studies have shifted from *if* a literature review is conducted to *when*. For a detailed discussion of the affordances, critiques, and implications of the use of literature throughout the evolution of grounded theory, see Dunne (2011).

### ***Sensitizing Concepts***

Across traditions, *sensitizing concepts* are different from theoretical frameworks in that they do not prescribe or scope inquiry, but rather serve as guides that provide a general sense of reference for the researcher (Bowen, 2006). One of the most useful definitions of sensitizing concepts comes from Blumer (1954) in which he explains:

A sensitizing concept lacks specification of attributes or benchmarks and consequently, it does not enable the user to move directly to the instance and its relevant content [within the data]. Instead, it gives the user a general sense of reference and guidance in approaching empirical instances. Whereas definitive concepts provide prescriptions of what to see, sensitizing concepts merely suggest directions along which to look (p. 7).

Sensitizing concepts maintain the same general definition and serve the same purpose across grounded theory traditions; however, the point at which they are considered during the research process varies. In classic grounded theory, Glaser positioned these concepts as starting points for inquiry. He employed them as an analytical device that allowed researchers to move between existing literature and emerging findings to inform decisions for future data collection during the constant comparative process (Bowen, 2006). In constructivist grounded theory, Charmaz employed them in ways similar to classic grounded theory. However, due to the role of literature in constructivist grounded theory, she moves beyond Glaser by contending that sensitizing concepts may also be used to identify and shape the overall research problem. In their writings, Corbin and Strauss (2008) did not explicitly discuss sensitizing concepts in pragmatic grounded theory but referred to them as existing frameworks and sets of concepts that could be used as an extension of data analysis (e.g., tools that offer alternative explanations of generated theory or to compliment, extend, or verify findings).

### ***Causality Assumptions***

One key affordance of grounded theory is determining *causal conditions* (i.e., conditions that “influence or cause a phenomenon to occur” (Hachtmann, 2012, p. 18)). Many qualitative traditions do not attempt to determine causality (Creswell, 2014); however, Maxwell (2004) aligns the scientific aim of causality with the realist perspective of grounded theory. This perspective aligns with those underpinning classic grounded theory in that processes and events are positioned as variables, essentially merging quantitative and qualitative approaches. Rather than measuring causality through quantitative measures of variance theory and statistics, grounded theorists use process theory in which events are observed to influence others (Maxwell, 2004). This form of causality is most prominent in classic grounded theory and implies that the resulting theory should become more generalizable throughout the duration of the research process.

Other forms of causality align more closely with the pragmatic views of Strauss and Corbin and the constructivist views of Charmaz. These forms of causality emphasize the influence of context and maintain that “to a greater or lesser extent, [context is] intrinsically involved in [the research] process and often cannot be ‘controlled for’” (Maxwell, 2004, p. 6). In both pragmatic and constructivist grounded theory, researchers are encouraged to identify causal conditions while emphasizing their contextual and contingent nature. This perspective of causality supports Strauss and Corbin’s (1998) claim that grounded theory may be used to develop descriptive non-theory as well as Charmaz’s (2014) view that theories can be sophisticated explanations of a phenomenon (Creswell, 2013). Therefore, an analysis may become more abstract and encompassing throughout the research process but the resulting theory or non-theory will still be context dependent.

### ***Researcher Role and Influence***

As grounded theory evolved, the role and influence of researcher values on a study and the interpretation of findings grew increasingly constructive. Therefore, the type of grounded theory employed drastically influences why, how, and when a researcher’s values are acknowledged and integrated into the study. Due to the positivist underpinnings of classic grounded theory, Glaser and Strauss (1967) contended that the researcher should remain objective and neutral to the study as a passive, expert observer. In their version of grounded theory, Glaser and Strauss accounted for researcher influence on a study through the process of *bracketing*. Bracketing occurs when a researcher acknowledges their own preconceived notions, biases, and beliefs (i.e., reflexivity) and brackets or suspends those biases throughout the research process (Creswell & Miller, 2000; Tufford & Newman, 2010). In this sense, bracketing serves as a form of normalizing researchers at the outset of a study (Tufford & Newman, 2010), much like normalizing an instrument in a quantitative study. Bracketing only occurs one time, which further reinforces an adherence to research procedures reflective of quantitative research traditions (Creswell, 2014). According to classic grounded theory, the only time the researcher may make any interpretation is during the development of categories in which codes are clustered (Glaser & Strauss, 1967).

The researcher role is one of the most identifiable characteristics that distinguishes classic (i.e., Glaserian) from pragmatic (i.e., Straussian) grounded theory. Upon Strauss’s departure from classic grounded theory, he and Corbin (1990, 1998) began to shift the role of researcher values toward a constructivist lens while still maintaining positivist origins in pragmatic grounded theory. Keeping a neutral researcher perspective, Strauss and Corbin (1990, 1998) acknowledged that all researchers inherently influence a study by bringing their personal experience and prior knowledge to their work. These researcher characteristics are most prominent during the analytical phases of pragmatic grounded theory and are captured through memo writing. These memos provide space for researchers to document their perspectives and feelings to provide context for data interpretation.

Charmaz fully embraced the constructivist lens introduced by Strauss and Corbin by “loosen[ing] grounded theory from its objectivist foundations and bring[ing] the grounded theorist into the research situation and process of inquiry” (Charmaz, 2014, p. 321). Researcher positions, prior experience, and values are acknowledged and maintained throughout the duration of the research process, which includes a dynamic, continuous dialogue between a researcher and their data. Similar to Strauss and Corbin, Charmaz utilizes memo writing, but goes one step further by framing memos as a source of data that can be analyzed alongside participant data. She also contends that the researcher’s viewpoints may—and probably

will—change throughout the research process as a result of being engaged in it. Therefore, memos serve as a way to continuously capture that change and to enhance a study's overall quality (Charmaz, 2014). From the pragmatic and constructivist perspectives, resulting theories are enriched by the context and subjectivity in which they are generated and interpreted (Charmaz, 2014; Hallberg, 2006).

### Quality Criteria

A final characteristic that drastically differs across grounded theory traditions is the quality criteria used to evaluate a grounded theory study. Glaser and Strauss (1967) utilize the following criteria: a close fit with the data (i.e., credibility), usefulness, conceptual density, durability over time, modifiability, and explanatory power. From these criteria, Glaser and Strauss emphasize the development of theories that align with positivist perspectives and transcend time through meaningful, accurate explanations. Classic grounded theory considers true theory as the resolution of a main concern that can be theoretically analyzed in many ways while still coming to the same conclusion. In contrast, Charmaz utilizes the following quality criteria to evaluate constructivist grounded theory: credibility, originality, resonance, and usefulness (Charmaz, 2006, 2014). These criteria assume that any conclusions developed by a grounded theory are suggestive and context dependent (Charmaz, 2014; Creswell, 2013). Strauss and Corbin (1990) identify a list of quality criteria derived from scientific canons of quantitative research that emphasize consistency and verification, which they adapted to qualitative contexts. Their resulting list of quality criteria include: 1) validity, reliability, and credibility; 2) plausibility and value of the theory; 3) adequacy of the research process; and 4) empirical grounding of the research findings (see Corbin & Strauss, 1990 for an in-depth discussion of each criterion). However, Corbin and Strauss (2008) later write that they find Charmaz's list to be "the most comprehensive because [her criteria] address both the scientific and creative aspects of doing qualitative research" (p. 300). A summary of quality criteria listed for each grounded theory tradition is summarized in **Table 3**.

While quality criteria typically serve as indicators of merit and value for a research process and its outcomes, they are also useful for serving as guidelines at the outset of a grounded theory study. At the beginning of a grounded theory study, it is useful for a researcher to identify and align their own values with the quality criteria identified for a given grounded theory tradition. For example, if a researcher values the generation of a generalizable, time-transcending theory, they will be best suited to follow the classic grounded theory methodology established by Glaser and Strauss in lieu of the methodologies developed by Strauss and Corbin or Charmaz.

### Articulating Grounded Theory Methodology versus methods; Theories versus theories

To date, a single set of guidelines for conducting grounded theory work does not exist. Rather, grounded theorists hold differing opinions related to the mixing of grounded theory traditions and the selective adoption of their components. Some contend that this is permitted (e.g., Charmaz, 2014; Strauss & Corbin, 1990, 1994) while others do not (e.g., Baker et al., 1992; Glaser & Strauss, 1967). Still, grounded theory has been implemented both as a methodology and as a set of methods. *Methodology* describes the approach to grounded theory that captures the set of principles, ideas, and systematic approaches that inform the design and implementation of a research study (Birks & Mills, 2015; Kothari, 2004). Therefore, if a researcher ascribes to the components and the guiding worldview associated with the chosen grounded theory tradition, they are utilizing grounded theory as a methodology. This is often communicated using capital letters such as Grounded Theory Methodology (GTM, or big GT). In contrast, *methods* refers to the individual components that researchers choose to employ to collect and analyze data in a study (Birks & Mills, 2015; Kothari, 2004). The use of grounded theory methods is often expressed using lowercase letters such as grounded theory methods (gtm, or little gt). That is, data collection and analysis procedures (i.e., methods) are chosen and implemented within a larger research design that is informed by the researcher's worldview, positionality, and research questions (i.e., methodology). Therefore, not all studies

**Table 3:** A Summary of Quality Criteria for Grounded Theory (GT) Traditions.

| Classic GT<br>(Glaser & Strauss, 1967)     | Pragmatic GT<br>(Strauss & Corbin, 1990, 1998) | Constructivist GT<br>(Charmaz, 2006, 2014) |
|--------------------------------------------|------------------------------------------------|--------------------------------------------|
| 1. Close fit with data (i.e., credibility) | 1. Validity, reliability, and credibility      | 1. Credibility                             |
| 2. Usefulness                              | 2. Plausibility and value                      | 2. Usefulness                              |
| 3. Conceptual density                      | 3. Adequacy of process                         | 3. Resonance                               |
| 4. Durability over time                    | 4. Empirical grounding                         | 4. Originality                             |
| 5. Modifiability                           |                                                |                                            |
| 6. Explanatory power                       |                                                |                                            |

that employ grounded theory methods utilize grounded theory as a methodology; however, all studies that adopt grounded theory as a methodology use grounded theory methods. Differentiating between grounded theory methodology and applying grounded theory methods comes down to the components implemented within a study and how they are related to make meaning.

Similar nuances exist related to the outcome of grounded theory studies. As identified in the comparison of grounded theory traditions, employing the methodology or its methods will result in different outcomes (depicted in **Figure 2**). Classic grounded theory can be used to develop a generalizable theory that transcends time and context, which we refer to as big “T” theory. Other traditions, such as constructivist and pragmatic grounded theories, generate subjective, contextualized theory, which we refer to as small “t” theory. Notably, Strauss and Corbin (1990, 1998) also contend the use of pragmatic grounded theory can result in a description or non-theory, which closely aligns with the application of grounded theory methods in conjunction with other qualitative research designs. Therefore, it is imperative that researchers articulate and identify the type of implementation and research design (i.e., grounded theory methodology and/or methods) employed in their study as well as the nature of its outcomes (i.e., a big “T” theory, a small “t” theory, or a non-theory).

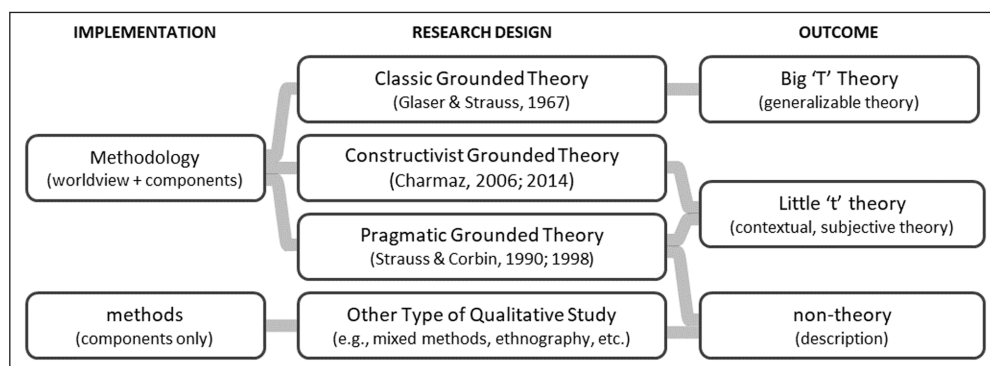
These are important distinctions to make when conducting grounded theory work because they inform conceptions about what grounded theory is; how it can be adapted across a variety of research topics; and the potentials it holds for not only generating theory, but also for examining and modifying existing theories. These perspectives have significantly influenced how we, the authors, have reconceptualized and implemented grounded theory in our own work (e.g., Groen, 2017; Groen et al., 2017, 2018; McCall et al., 2020).

### Reconceptualizing Grounded Theory

Charmaz (2006) argues that neither data nor theory are discovered but rather interpreted through engagement with the past and present. Consequently, the methods associated with grounded theory allow for unique and intricate examinations of theory and data through this engagement. Yet, the wealth of discourse surrounding the grounded theory, as described throughout this manuscript rarely acknowledges these potentials. As a result, these discords have contributed to diminishing the methodological bandwidth of grounded theory. As such, rarely has prominent grounded theory literature acknowledged the potential for employing the methodology to transcend beyond theory construction to the interrogation of outdated and ineffective conceptual frameworks.

This sentiment was reflected by Bryant and Charmaz (2007), who stated the criticality to reposition grounded theory so that we better understand the social locations, research perspectives, data production, and relationships between sensitizing concepts and interpretation. This repositioning can further the perceived capacity of grounded theory by encouraging a deeper and more intimate examination of not only theoretical frameworks but also the research lens from which these frameworks are conceived (Charmaz, 2017). Reexamining the lens from which theories are constructed can aid in effectively constructing/reconstructing frameworks to live beyond their initiators. This philosophy was held by Strauss and Corbin (1994), who contended that theories should be viewed as interpretations that are temporally limited, provisional, and require some form of qualification and renegotiation. As most fields transition to accommodate the present needs of learners, particularly in times of drastic educational change (e.g., the switch to online education during the COVID-19 outbreak), generating and restructuring conceptual frameworks for contemporary contexts is vital.

Engineering education exemplifies this point. While change in engineering education has been slow, the desire to diversify and remain globally competitive have thrown the field into a profound stage of transformation (Tryggvason & Apelian, 2012). As the field transforms, an emphasis has been placed on better understanding the ways students learn, perceive themselves, and perform in the classroom (Marjoram, 2013). Prominent theoretical frameworks that once guided pedagogical



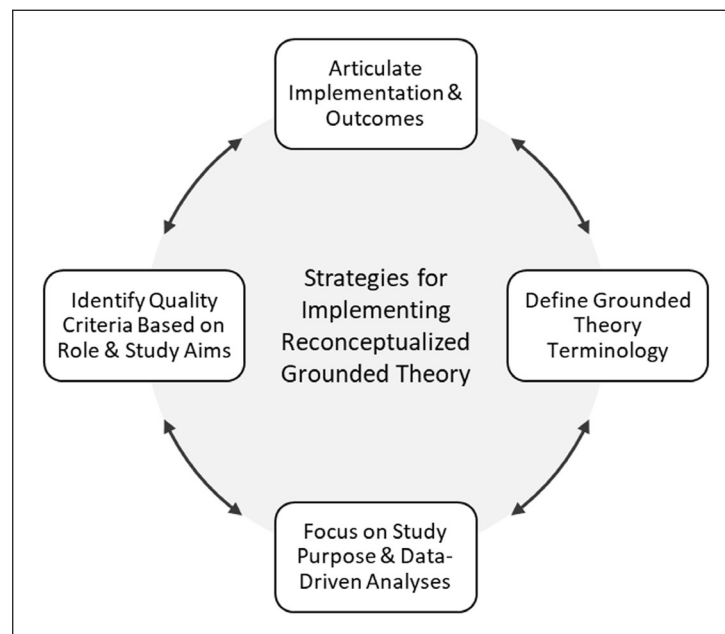
**Figure 2:** Relationships Among Grounded Theory Implementation, Research Design, and Outcomes.

practices and investigations of student experiences are unlikely to withstand these transformations without meaningful adaptations for new and relevant contexts. Identity-based frameworks such as professional socialization and communities of practice illustrate how new dimensions of prominent frameworks in engineering education can emerge when confronted with new technologies, societal factors, and political landscapes. For example, Ma and colleagues (2016) illustrate how to enhance understandings of communities of practice by examining them through a social networking lens. Findings from this study expanded the conceptualization of how communities of practice are structured, revealing that various levels of engagement exist within them (Ma et al., 2016).

Therefore, in this reconceptualized version, we combine characteristics of classic, constructivist, and pragmatic grounded theory to argue that grounded theory may be applied in a variety of ways and contexts that remain true to its original tenets while expanding its implications for engineering education. Aligning with the toolkit approach proposed by Strauss and Corbin (1990, 1998), we contend that grounded theory can be used both as a method and as a methodology. Therefore, this reconceptualized version emphasizes the importance of one's own paradigmatic (i.e., ontology and epistemology) and axiological views (i.e., values) and intentional implementation that is grounded in a study's purpose and aims. In this conceptualization, we draw from Charmaz's constructivist and Strauss and Corbin's pragmatic perspectives to emphasize the role of researchers to utilize Glaser's established traditions and procedures, to gain meaningful insights into the topic under study, and to generate outcomes that advance our knowledge in a particular domain. In the following sections, we examine our own experiences in implementing grounded theory as well as those observed in others' work to provide broad, overarching strategies that both align with existing grounded theory traditions and can expand the use of grounded theory methodology and methods across engineering education research. These strategies are summarized in **Figure 3**.

### ***Articulate Grounded Theory Implementation and Outcomes***

A key strategy for implementing grounded theory is to articulate implementation approaches (i.e., use of grounded theory methodology versus grounded theory methods) and study outcomes (i.e., the development of a generalizable, big "T" theory; a subjective, small "t" theory; or a descriptive non-theory). The majority of studies in engineering education employ grounded theory methods during the data analysis phases of research (Beddoes et al., 2014). Grounded theory methods have been used to describe inductive or comparative coding practices (e.g., Anthony et al., 2007; Bilén et al., 2005; Brawner et al., 2012; Dunsmore et al., 2011; Kong et al., 2017; Tang, 2013; Tonso, 2006), to supplement other qualitative or quantitative analyses (e.g., Baker et al., 2002; Diefes-Dux et al., 2012; Nelson et al., 2017; Wilson-Lopez et al., 2016), and for theme identification (e.g., Blosser, 2019; Johnson-Glauch & Herman, 2019; Jonassen et al., 2006). Other researchers have utilized grounded theory methods to develop conceptual models (e.g., McNeill et al., 2016; Walther et al., 2011) or taxonomies (e.g., Gainsburg, 2015) to be used elsewhere. In these studies, researchers have utilized components of grounded theory methods to generate causal descriptions or non-theories of the phenomenon or process being studied and, appropriately, do not claim theory development.



**Figure 3:** Strategies to Consider When Implementing Reconceptualized Grounded Theory.

However, grounded theory in engineering education is beginning to move beyond the application of methods to generate non-theory and toward the implementation of a methodology to develop theory. Groen-McCall and colleagues (Groen, 2017; Groen et al., 2017, 2018; Groen-McCall et al., 2019), Faber and colleagues (Faber et al., 2019), and Simmons and colleagues (Simmons, 2012; Simmons & Martin, 2014) have utilized constructivist grounded theory to explore processes of professional and researcher identity formation in undergraduate engineering students and student perceptions of family roles in academic decision making. In these studies, constructivist grounded theory methodology served as a flexible guideline for contextualized theory generation that was loosely structured by sensitizing concepts yet driven by emerging findings grounded in the data. The theories generated from these studies hinge on *conceptual density* (i.e., the richness of emergent abstract concepts and their relationships), which rests on a researcher's familiarity with the data. This is different from *thick descriptions* typically seen in qualitative research that emphasize description rather than conceptualization (Strauss & Corbin, 1994; Stern, 2007). In our reconceptualized view of grounded theory, both approaches are valuable. However, the researcher must clearly communicate the implementation they choose to adopt as well as the nature of the study's outcome (similar to those relationships identified in **Figure 2**).

### **Define Grounded Theory Terminology**

As a field, we can demystify the use of grounded theory methodologies and their associated methods by clearly and intentionally defining and contextualizing the terminology used to conduct these types of work. Much of the confusion surrounding grounded theory methodology and methods can be attributed to a current lack of consensus regarding the language used to describe these studies and procedures in engineering education research. In her work, Groen et al. (2017) described a number of operational challenges not articulated in the literature. For example, Charmaz (2006) defines focused coding as "using the most significant and/or frequent earlier codes to sift through large amounts of data. Focused coding requires decisions about which initial codes make the most analytic sense to categorize your data incisively and completely" (p. 57). Indeed, Charmaz's definition is valuable for implementing grounded theory methods; however, this definition can be difficult to operationalize when faced with the decision of choosing the most prominent themes across a plethora of open codes. Therefore, it is important for those conducting grounded theory studies and applying grounded theory methods to provide examples for contextualizing and operationalizing such procedures and to promote the transferability and expand the use of the approach in our field.

### **Maintain Focus on Study Purpose and Data-Driven Inductive Analyses**

Regardless of a researcher's decision to implement grounded theory as a methodology or as a set of methods, we recommend that researchers maintain a focus on study purpose and data-driven inductive analyses. Maintaining these foci opens up the researcher to options for conducting their work and can assist in determining implementation decisions and anticipated study outcomes. For example, the purpose of Johnson-Glauch and Herman's (2019) study was to determine how students with different levels of expertise coordinate problem-solving features when sketching shear force and bending moment diagrams. The outcome of their study was the identification of three themes that described students' problem-solving strategies using constant comparative techniques, which they draw from Strauss and Corbin's (1998) approach. Appropriately, Johnson-Glauch and Herman clearly articulate the use of grounded theory methods as part of their data analysis procedures and do not claim to generate theory. Rather, their study revealed three abstracted (i.e., conceptual) themes that contributed to an overarching finding that students tend to rely on heuristics triggered by recognizable problem features to solve problems in statics courses.

In prior work, the first author, McCall, employed constructivist grounded theory to develop a framework to capture the complex negotiation processes of undergraduate students as they formed professional identities as civil engineers (Groen, 2017; Groen et al., 2017, 2018). With a focus on bringing undergraduate civil engineering students' perspectives to the forefront of this work, McCall and colleagues used constructivist grounded theory to inform every step of the research process from the generation of research questions to model visualization (for an in-depth description of this process, see Groen, 2017). The worldview and constant comparative methods associated with constructivist grounded theory encouraged McCall to continuously interact with participant data, interrogate emerging findings, and question the developing theory. These procedures allowed for greater levels of abstraction to occur during data analysis by challenging the researcher to identify conceptual themes across participants, despite their varied representations in participants' lives. For example, McCall identified an identity negotiation strategy of *reinforcing self*, which captured non-negotiable personal characteristics that participants integrated into conceptions of civil engineering (Groen, 2017). This strategy included reinforcing self as a woman in civil engineering, reinforcing self as an individual with a learning disability in engineering, and reinforcing one's own values in civil engineering (e.g., turning down a position at a company whose values conflicted with one's own). Similar to Johnson-Glauch and Herman's (2019) study, findings were not superficially deduced by clustering the content of participant quotes, but abstracted from deeper meanings embedded within the experiences described by participants.

Rather than relying on a prescribed process to dictate design, maintaining an emphasis on study aims and allowing the data to drive the analysis can help researchers determine how, why, and when grounded theory methods or methodology should be used. This adds a flexibility to the approach that allows researchers to adapt and apply research procedures to their data for their purposes in their contexts and uncover new insights into existing research areas or explore a new research area altogether.

### **Identify Quality Criteria Based on Researcher Role and Study Aims**

In this reconceptualized version of grounded theory, we rely on researcher role and overall study aims as key benchmarks for assisting researchers in choosing the quality criteria appropriate for different implementations and outcomes of grounded theory studies. For example, if it is important to a researcher to maintain an objective researcher role and develop a theory that is generalizable, modifiable, and durable over time, they would be more inclined to implement the classic grounded theory methodology and use its associated quality criteria listed in **Table 3**. For researchers who would like to be an integrative co-constructor with participants to create a theory that is credible and resonates with individuals in a particular context, it would be more advantageous to implement constructivist grounded theory and consider its associated criteria. Researchers applying grounded theory methods alone or with other research tools for description generation should refer to general qualitative research quality criteria such as those outlined in Borrego et al. (2009), Creswell (2013), and Walther et al. (2013).

The most significant difference between general qualitative research criteria and grounded theory criteria is focus. General qualitative quality criteria tend to focus on thick description and detail, whereas grounded theory criteria emphasize the quality of concept development and analytical abstraction which, in turn, improves the quality of the generated theory. For example, Charmaz's (2006) criterion of *resonance* asks the researcher, "Have you revealed both liminal and unstable taken-for-granted meanings?" (p. 182). We see this criterion addressed in Groen (2017), in which the significance of participants' career expectations was not realized until analytical interrogation of the emerging theory. The concept of participants using career expectations as a benchmark for identity formation—whether expectations were accurate or not—became the foundation of the resulting theory.

### **Conclusions**

While grounded theory has been applied to a variety of research contexts and fields, the core tenet of this methodology remains the same: to conceptualize social phenomena through inductive, systematic, and comparative approaches that are guided by and grounded in participant experience. In this article, we encourage engineering education researchers to reconceptualize grounded theory as a living methodology that affords opportunities for establishing new or expanding on existing theories to understand the current and lived experience of individuals. From this perspective, the use of grounded theory may bridge past and current research by deepening methodological and theoretical connections across contexts. As a researcher, it is ultimately your decision to determine what type of grounded theory to implement and when. Rather than using the tools presented and discussed throughout this manuscript as a checklist, consider their individual implications on your research process, including the data you are collecting and where they are coming from, your role as a researcher, and the overarching purpose and outcomes of your work.

Conceptualizing grounded theory in this way is particularly useful for the engineering education community as we seek to broaden participation in the field. This approach allows researchers to more intentionally account for broader cultural nuances that influence the engineering education experience (e.g., changing demographics, evolving social and political norms and values, and advancing technologies) that may be currently missing from prior frameworks created in a different time with different people. To broaden the scope of engineering education research, we must reconsider the norms and practices that guide our work and its dissemination. In this manuscript, we write in opposition to systematic conceptions of qualitative research that promote rote adherence to formulaic procedures and checkbox approaches to quality. We encourage researchers to consider themselves as integral instruments of research design, and as such, maintain a focus on research aims and purpose while allowing data to guide inquiry and reveal findings.

### **Acknowledgements**

The authors would like to acknowledge their grounded theory mentors: Drs. Elizabeth Creamer and Denise Simmons. You have significantly shaped and impacted the ways in which we conceptualize, design, and implement grounded theory studies and have inspired the content of this manuscript. We would also like to dedicate this manuscript to Dr. Kathy Charmaz, a brilliant grounded theorist, innovator, and mentor.

### **Competing Interests**

The authors have no competing interests to declare.

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**How to cite this article:** McCall, C., & Edwards, C. (2021). New Perspectives for Implementing Grounded Theory. *Studies in Engineering Education, 1*(2), pp. 93–107

**Submitted:** 01 June 2020

**Accepted:** 08 January 2021

**Published:** 17 February 2021

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