

Combining Phenomenology and Grounded Theory in Software Engineering: An Experience

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Abstract: Phenomenology and grounded theory are two prominent qualitative methods, particularly used in social sciences research. Phenomenology is carried out to understand the individuals' actual experience regarding a phenomenon. The method describes "what" individuals experience and "how" they experience it. The focus is on the meaning of the exposures experienced by individuals regarding the phenomenon. Grounded theory on the other hand allows researchers to explore a phenomenon in depth with individuals, by which a theory is then generated. The goal is to go beyond the understanding of phenomenon by producing a theory that describes comprehensively the problem being studied. Although these two methods are initiated by similar motivations, namely to understand a phenomenon, they however employ slightly different approaches during execution. The differences make them fit complementary together to produce a more concrete and holistic outcome. To research that occasionally use qualitative methods such as Software Engineering, these methods bring new and multifaceted experience. Software Engineering research opts for qualitative methods to promote understanding, as many phenomena in the field have yet to be understood by its community. In that respect, grounded theory is becoming quite a norm in Software Engineering research in recent years, phenomenology however is relatively sporadic. This paper shares the experience of employing as well as combining phenomenology and grounded theory in Software Engineering research. The sharing is intended to inspire future research in twofold: more technical fields such as Software Engineering to employ qualitative methods in research; and leveraging the benefits of combining two qualitative methods complementarily in one study.

Keyword: Software engineering, grounded theory, phenomenology

1. Introduction

Qualitative research includes any study that produces findings that are not derived by means of quantification (Corbin & Strauss, 2015). It seeks understanding of a phenomenon in a context-specific setting with the aim to develop knowledge from the experience gained through humans' lives and social worlds. It comprehends and characterises human behaviours as the people encounter, engage and live through specific situations (Elliot et al., 1999; Patton, 1990). In contrast to quantitative, qualitative research gathers data from the participants' perspective in their natural settings besides being dynamic in nature with less restricted protocols for data collection and analysis. The qualitative research is beneficial in multifaceted situations where human behaviours, emotions, beliefs and values cannot be sufficiently described through quantitative methods (Seaman, 1999; Langley, 1999), as well as when there is a need to develop knowledge in poorly understood research areas (Stebbins, 2001; Fossey et al., 2002; Brown, 2006).

Software Engineering (SE) is the discipline that concerns developing and managing large-scale software systems. It bridges two distinct but related worlds, that is, the hard and soft facets in computing. Besides involving technical aspects, software itself is developed and used by humans. As such, SE research employs qualitative methods in order to understand humans and the context within which their actions take place. Even though the importance of considering human aspects in SE research has gradually been acknowledged by SE community (Weinberg, 1971; Perry et al., 1994; Highsmith, 2002; Lenberg et al., 2015a), such research is still considered undeveloped (Lenberg et al., 2015b). This is due the fact that the level of knowledge and the number of reports on qualitative methods in SE are relatively low, as compared to another computing discipline namely information systems.

To date, only a few publications address qualitative methods in SE research. For instance, one paper provides an overview of qualitative data collection and analysis. The paper presents participant observation and interviewing as the data collection techniques and grounded theory for the data analysis (Seaman, 1999). Another paper defines qualitative research by emphasising the diversity of qualitative methods and how they are used under different epistemological orientations and with different theoretical stances (Dittrich et al., 2007). The paper proposes a common way to evaluate the quality of qualitative research. In addition, there are

also guidelines of using qualitative methods produced by SE researchers (Runeson & Höst, 2009; Stol et al., 2016; Sharp et al., 2016; Stol & Fitzgerald, 2018). Although useful, these guidelines have yet to cover the full extent of qualitative methods and the best practices of using them in SE research.

The social sciences have a long history of studying human behaviour, thus qualitative methods are a norm in their research. The most commonly used qualitative methods in social science research are grounded theory, thematic analysis, ethnography, phenomenology, narrative analysis and discourse analysis (Smith, 2007; Camic et al., 2003). On the other hand, grounded theory (Glaser & Strauss, 1967; Corbin & Strauss, 2015; Charmaz, 2014), thematic analysis (Braun & Clarke, 2006) and ethnography seem to be the most established qualitative methods in SE research (Dittrich et al, 2007; Adolph et al., 2012; Hoda et al., 2012; DeFranco & Laplante, 2017). This brings to the quality of SE research using grounded theory has been criticised (Stol et al., 2016; Sharp et al., 2016). Other methods such as phenomenology, narrative analysis or discourse analysis do not appear much in SE related publications, despite the fact that these methods bring similar values and could work as good as others (Chia, 2000; Boje et al., 2004; Czarniawska, 1997; Feldman et al., 2004; Weick, 1995; Gill, 2014).

Based on the success stories in social science research, it is believed that phenomenology, narrative analysis or discourse analysis could also contribute to understanding human aspects of SE, as well as grounded theory, thematic analysis and ethnography. Unfortunately, their potentials and values are yet to be explored or less reported in SE research. This paper aims to share some experiences of employing grounded theory and phenomenology in SE research. In fact, the methods were combined complementary together in one research project, which was conducted by the authors to address a SE issue. The sharing is based on the experience taken from the lens of novices.

2. Related Work

Grounded theory is a systematic qualitative method, which was originally introduced by Glaser and Strauss (1967) for social science research. It establishes the principle that researchers could generate valuable theoretical contributions to the subject matter through theory development, rather than theory testing. Grounded theory has several major variants, namely Classic (Glaser & Strauss, 1967); Evolved (Corbin & Strauss, 2015), Constructivist (Charmaz, 2014), Critical (Kempster & Parry, 2011; 2014; Oliver, 2012) and Regenerate or Situational Analysis (Clarke, 2005). In general, each later variant is an extension of the classic grounded theory introduced by Glaser and Strauss (1967).

The important principles in grounded theory include theoretical sampling, theoretical sensitivity and theoretical saturation, which are achieved through coding, memoing and constant comparison (Glaser, 1978; 1992; 1998; Strauss, 1987). The objective of grounded theory is to develop a cohesive theory by treating everything openly as data through continuous data analysis and theoretical coding. There are three basic layers of coding in grounded theory. First, examining and labelling the data as codes; second, coding groups the codes to constitute inclusive categories; and finally, establishing conceptual relations between codes by deciding the principal category that major categories can relate to. The interrelation between categories through theoretical coding becomes the cohesive theory that describes the phenomenon. In essence, grounded theory relies profoundly on the data originated from the field, which are particularly captured through interviews. It thus adopts an inductive paradigm with some deductive and abductive (Glaser, 1992; 1998). Coding happens soon after the data is collected and the process continues until the theoretical saturation is achieved.

Phenomenology carries data collection to understand the actual or daily experience of an individual regarding a concept or phenomenon (Van Manen, 2017). By combining the experiences of several individuals, the method describes the essence of the experiences in detail related to the phenomenon being studied (Creswell & Creswell 2018). It describes "what" individuals experience and "how" they experience it (Moustakas, 1994). The focus is on the meaning or true nature of the experience besides similarities or differences experienced by individuals regarding the phenomenon being studied (Creswell & Poth, 2018; Van Manen, 1990).

In carrying out a phenomenological study, researchers set aside their personal experience of the phenomenon being studied in order to focus on the experiences of the individuals involved. However, it does not mean that the researcher totally disregards what he or she knows, but rather not letting the knowledge influence the

process of determining the actual experience of the individuals (Creswell & Poth, 2018). Similar to other qualitative methods, phenomenology also involves researchers making interpretations based on the explanations that have been given (Heinonen, 2015; Moustakas, 1994).

There are two common types of phenomenology, namely hermeneutic phenomenology and transcendental phenomenology. Hermeneutic phenomenology is an approach that is oriented towards the actual experience and the interpretation of experiential texts (Creswell et al., 2007; Van Manen, 1990). It involves the art of understanding the actual experience of individuals so that the direct and indirect meanings behind them can be fully understood (Creswell et al., 2007). The researcher delves deeper into the phenomenon being studied during interviews with individuals. The important themes related to the experience are extracted to establish the basic structure of the experience. The individuals' experiences are described and interpreted based on the themes while maintaining a strong connection with the phenomenon being studied (Creswell et al., 2007; Heinonen, 2015). In contrast, transcendental phenomenology is less focused on the researcher's interpretation as in the case of hermeneutic phenomenology. The researcher does his or her best to set aside their knowledge and experience of the phenomenon. He or she needs to welcome the experiences told by the individuals about the phenomenon being studied. The described individuals' experiences are all considered as original and newly discovered. Considering the fact that researchers may have preconceptions obtained through background study, this process is undeniably difficult to achieve perfection (Moustakas, 1994).

Since phenomenology is a qualitative study, it uses non-probability sampling. This type of sampling is divided into several sampling techniques, namely simple, quota and purposive sampling (Creswell & Creswell, 2018). In phenomenology, there is no predetermined number of samples, but selecting the right individuals who can provide the experience meaningfully is vital. Although a large number of samples may provide more extensive data, the data from only a few people who actually experience the phenomenon and provide good details of the experience is considered sufficient to explain the phenomenon under study. As such, the suggested sample for phenomenology is from 1 to 10 people (Starks & Brown Trinidad, 2013). For the analysis, phenomenology breaks, interprets and explains data without distorting the overall context of the phenomenon being studied (Anosike et al., 2012; Groenewald, 2017; Moustakas, 1994).

Grounded theory was firstly applied in SE research for investigating the use of Computer-aided Software Engineering (CASE) (Orlikowski, 1993). Other SE research that adopted grounded theory include topics concerning requirements engineering, distributed development and agile development (Badreddin, 2013; Alqudah et al., 2019; Alqudah et al., 2023). Some experience of using grounded theory in SE research have also been reported (Razali et al., 2020). Unfortunately, SE research that employed phenomenology and described extensively the method in SE literature seems very scarce. If any SE research employs phenomenology, the study concerns SE education such as to understand the experience in teaching programming (Bagiati et al., 2011). For non-computing fields, research that investigated the use of both methods in one study is mainly from health studies such as nursing (Annells, 2006).

3. Methodology

This paper intends to outline the experience of using and combining phenomenology as well as grounded theory methods in one research project. The project was carried out to investigate a SE issue concerning legacy systems modernisation for citizen-centric digital government (Abu Bakar et al., 2022). The project involved two empirical studies, which were executed independently and separately. The first empirical study conducted data collection and analysis using phenomenology whereas the latter employed grounded theory. The output was the factors and elements contributing to legacy systems modernisation for citizen-centric digital government, which were consolidated as a framework for guiding practitioners to execute such initiatives.

Phenomenology was used in the first study with the objective to identify the modernisation factors for legacy systems in the public sector through the selected individuals' real experiences. The phenomenon was initially understood in-depth through the experience-telling process before the factors were identified. The project adopted hermeneutic phenomenology whereby besides gaining the actual experiences of the individuals, the experiences were interpreted in accordance with the needs of the project. The real experiences were interpreted

and described according to the factors related to legacy systems modernisation for citizen-centric digital government. The method enabled the collection of valuable real experiences from a number of individuals with extensive involvement in the subject matter. The selected individuals were experienced personnel who had handled maintenance, redevelopment or modernisation projects for public sector legacy systems. They shared their experiences in those projects including the tasks taken, the issues faced as well as the lessons learnt. The data collection was carried out through individual interviews of experienced practitioners from various public sector agencies.

Similarly, the second empirical study used grounded theory to identify the factors related to the development, modernisation or maintenance of legacy systems. The study mainly adopted the Evolved grounded theory (Corbin & Strauss, 2015) variant. The data collection for the study was done through individual interviews and focus groups with individuals from several public sector agencies, which were identified through theoretical sampling. Theoretical sampling is a special type of purposive sampling whereby sampling is based on the concepts emerge in the data. Due to that fact, the number of individuals in the second study was more than the first study before the findings evolved and eventually became narrowed and later theoretical saturated. Moreover, the number of individuals in the first study was lesser as the interviews were intensive and thus the saturation period reached faster. Although both studies were conducted by the same researchers, the samples in the first and second studies were different individuals. None of the individuals were interviewed twice.

By combining the findings of both empirical studies, a legacy systems modernisation framework for citizen-centric digital government was developed. At the initial stage, the data from both empirical studies were collected and analysed separately so that they did not affect or influence one another, besides ensuring comprehensive and detailed understandings were obtained in each study. After all, grounded theory discourages preconceptions or predetermined knowledge in order to avoid testing theories (Glaser, 1992; Corbin & Strauss, 2015). The findings from each study were then integrated during the development of the framework, as shown in Figure 1. This was achieved by comparing and linking the findings until they could be interpreted as a complete view of the subject matter. The research design used in the project was the convergent design, similar to the one in mixed methods (Creswell & Plano, 2018).

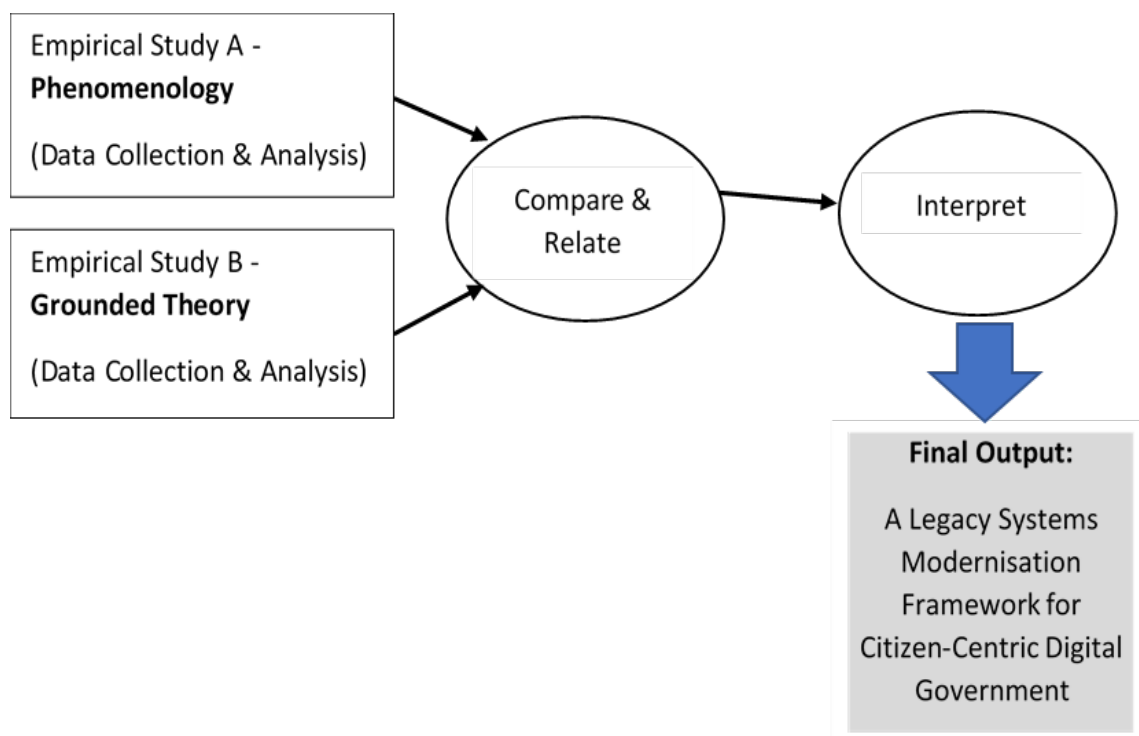


Figure 1: The Research Design

4. The Experience

The following paragraphs elaborate the experience of using phenomenology and grounded theory in one project, based on the reflections made by the authors as SE researchers who are novice phenomenology and grounded theory adopters.

Phenomenology was used in the project because the authors needed to understand in-depth the phenomenon under study through the individuals' actual experiences. The phenomenon under study in the project was so new where previous studies and references on them were almost non-existent. The method helped the authors to gather valuable experiences from a number of individuals who had been involved in the phenomenon during their career lives as practitioners in the field. The individuals had the opportunity to narrate each of those valuable experiences verbosely in a free-flow way. As such, the interview sessions appeared to be like informal story-telling meetings, which were more relaxing in nature. The environment had made the sessions to become fruitful with massive valuable data to be collected and analysed.

As practitioners themselves, the authors however had to reserve their personal experiences of the phenomenon as much as possible in order to capture genuinely the experiences of the individuals involved. They needed to be receptive when listening to the experiences shared by the individuals. The experiences were gathered as new and fresh, as the first time they were encountered. Having said that however, the authors found that some background information about the phenomenon was necessary to make the sessions productive by being objective. The background information however only acted as catalysts, rather than influencing the sharing. This was particularly helpful when the sharing went too far from the objective of the study or when the individuals were suddenly in silence due to loss of ideas.

Phenomenology relies on individuals' real-life experiences. As the phenomenon under study was new, the number of individuals who had the actual experiences in the phenomenon was limited. In fact, most of them obtained the experience through personal exposures or learning throughout their careers. The project managed to get five experienced individuals. Being an in-depth study, the sessions with five individuals were found to be adequate where most facts became saturated by the end of the fifth interview. Since SE practitioners are technical people, some of those individuals faced difficulties in articulating their experiences well and clearly. The authors had to play their roles well by giving scenarios or overviews that could trigger the individuals to elaborate and assist them in the explanation. This is an instance where the background information is highly needed to ensure the data collection process runs smoothly.

Due to the fact that phenomenology is uncommon in SE research, references on SE studies that employed this method were very limited. This situation had made the initiation stage not as easy as it was originally thought. Although the sessions were more conversational, the authors found that the data collection process was cognitive-intensive. The authors needed to give full attention when receiving and digesting the facts raised by the individuals. As the sharing was free-flow with very minimal interruption, the authors needed to instantly recognise which important facts that should be noted and which could be ignored, while ensuring the facts were still within the subject of interest. Moreover, the data analysis was challenging and time-consuming, especially during contextualising the data according to common themes and transforming the individual data into composite descriptions in order to provide a complete picture of the phenomenon being studied. This was particularly true as the individuals' experiences were somehow context-specific and personal where they shared based on what they had gone through, which were not quite the same from one to another. The authors had to be able to compare, contrast and later synthesise them to become the final interpretation.

On the other hand, grounded theory was employed in the project because the authors needed not only to explore the phenomenon in-depth but also with the intention to generate a theory about it. The goal of grounded theory is to go beyond the understanding of the phenomenon by producing a theory that describes comprehensively the phenomenon being studied. As novices, the authors faced some confusion when carrying out the method initially. In contrast to phenomenology, grounded theory imposes more stringent approaches towards data collection and analysis. Due to lack of references, the authors needed to acquire the skills the hard way by reading, doing and learning from the mistakes. In addition, there are several approaches in grounded

theory that originated from several schools of thought. This posed some dilemma to the authors about which grounded theory approach to better adopt.

Compared to phenomenology, the data collection and data analysis processes in grounded theory were more challenging. Grounded theory discouraged preconceptions, thus the authors needed to dwell into the data without being influenced by external sources and identified the relevant individuals through theoretical sampling. In fact, for the theoretical sampling, the appropriate individuals were only determined after the data analysis from each interview had been completed. This means it could not be pre-planned and thus the process was resource-intensive. In addition, the analysis process took a longer time because it involved three levels of systematic coding, namely open coding, axial coding and selective coding. In total, the study involved fourteen individuals before the theoretical saturation was achieved.

In the project, both methods were used complementary together to produce a more concrete and holistic outcome. The methods were initially employed independently in the respective concurrent studies where the data were collected and analysed individually by complying the methods' underlying principles. The authors started the empirical study that employed phenomenology earlier than the one that used grounded theory. To novices, this strategy turned out to be helpful because the former study offered the 'warming-up' field before embarking into the tougher one later. Since the first study was conducted earlier than the second one, one might argue that the first study would become prior knowledge to the second study. This situation was undeniably inevitable, but it was controlled strictly by having more than one researcher involved in the investigations, who cross-checked one another. After all, the second study adopted Evolved grounded theory, whereby it encourages a balance between keeping an open mind and recognising emerging noteworthy concepts. As such, literature review and existing knowledge are permissible provided that the researchers remain open to the data (Hughes & Jones, 2003; Hallberg, 2010; Dunne, 2011). The findings from both studies were then combined and conceptualised together under one interpretation. Similar concepts were grouped together using the appropriate labels and diverse concepts were reconceptualised to find the interconnections.

By having both methods together, some comparison can be made in terms of their similarities and differences. Being qualitative, both methods employ similar data collection techniques, mainly interviews. The difference is the way the interviews are conducted and the atmospheres. Phenomenology relies heavily on interviews as a sole means of data collection and thus the interview sessions are normally exhaustive. The focus remains centred on eliciting the experience of individuals so that the phenomenon could be revealed. As such, the atmosphere is more individual-centric whereby the individuals themselves determine the narratives of their experiences. Grounded theory on the other hand aims to discover and develop emerging theory that is grounded in the data, which means the interviews may not be the only means. The method has a systematic way of collecting and analysing data, the atmosphere is thus more directive and structured. Moreover, the analysis in phenomenology is retrospective transcript interpretation whereas grounded theory employs constant-comparative data analysis. The reflection in phenomenology happens during transcribing while in grounded theory, it occurs through memoing. The results of the analysis in phenomenology is a synthesis of interpreted meanings and in grounded theory, a substantive 'grounded' theory is produced. Combination of codes and memos are the substances that produce the concepts and eventually the theory. Despite the differences, both methods work quite well complementarily. Phenomenology allows the phenomenon under study to be appreciated deeply while grounded theory complements phenomenology by making sense of the phenomenon as a theory based on the grounded data.

Having to deal with both methods together was interesting, particularly when the convergent design was employed. The authors needed to learn-by-doing each study before strategising how to mix the two. In fact, the boundary of each study had to be strictly preserved in order to maintain its exclusiveness and to avoid one study influencing the other. In terms of the journey conducting a multimethod research (QUAL & QUAL) versus a mixed method research (QUAN & QUAL) as reported in previous study (Razali et al., 2016), the author found the former is more thought-provoking. The verbosity and subjectivity of the process were among the factors that contributed to the situation.

5. Conclusion

Adopting phenomenology and grounded theory in one research project is a challenging task but yet interesting. This paper has shared some experiences of using phenomenology and grounded theory in a study concerning a technical field, namely SE. Although the insights are not exhaustive, they provide some preliminary understanding of having both phenomenology and grounded theory as complementary methods in one SE research. Both methods have their respective underlying principles, which need to be understood and complied when such studies are being conducted together. Despite the fact that combining both methods can be very demanding, the effort is really worthwhile. The combination of two approaches provides several different perspectives about the phenomenon under study, which may not be achieved by one sole method. The experience shared in this paper could be viewed as opportunities to explore both methods in SE research in future.

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