Grounded Theory Evolution and Its Application in Health Informatics

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Abstract. The value of utilising qualitative research approaches to identify, describe and evaluate the impact of health information systems upon healthcare processes is becoming increasingly clear. The use of grounded theory has increased over the past decade within the health informatics discipline. However, for researchers new to the approach, the theory and conduct of grounded theory can be both confusing and daunting. This paper begins to dispel some misconceptions about the use of grounded theory and aims to assist researchers starting out using grounded theory in health informatics research. It also discusses the past and potential future application of grounded theory in health informatics.

Keywords. grounded theory, evaluation, methodologies

Introduction

In health informatics there exist a number of qualitative methods that can be used to identify, describe and evaluate the impact of health information systems (HIS) upon healthcare processes. Qualitative approaches that are frequently employed by health informatics researchers include ethnography, grounded theory and case study research. Grounded theory, as a qualitative approach, has been found to be especially effective in identifying and describing the impact of HIS upon health care processes especially in cases where the impacts of HIS and their associated devices (e.g. palm devices) are as yet un-discovered or are not easily described by quantitative approaches [1]. Methodologically, grounded theory's use in health informatics has evolved since its introduction to this field of research in the early 1990's [e.g. 2]. In this paper the researchers will: review the historic and theoretical origins of grounded theory; discuss the evolution of grounded theory and theory generation; reflect upon the challenges and processes involved in using grounded theory; and discuss the evolution of grounded theory use in information systems research and health informatics.

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1. Historic and Theoretical Origins of Grounded Theory

Grounded theory was developed as a methodology by sociologists. Its theoretical origins can be traced back to the literature on symbolic interactionism and the work of Mead [2]. Symbolic interactionism espouses the view that individuals develop a sense of self through their interactions with others [2]. In 1969 extensions to symbolic interactionism (see Blumer [3]) proposed that the meanings individuals and groups ascribe to things influence how they react to these objects in their environment. Individuals and groups who ascribe meanings to these objects also do so through their interactions with others. These interactions, in turn, shape and alter an individual’s or group’s interpretation of objects, events or situations. Therefore, grounded theory attempts to: (a) determine how individuals derive meaning (i.e. meaning from experienced objects, events and situations), (b) describe those objects, events and situations, and (c) describe how these meanings guide individual and/or group behaviours, actions and their experiences of the consequences of these actions. Grounded theory can therefore be described as a methodology that aims to understand how individuals and groups interact, act and engage in response to phenomena (i.e. objects, events and situations) they experience or encounter in their everyday lives. It is within this context that theory is developed that describes these underlying social processes and researchers conduct this work to better understand these processes [4].

2. Evolution of Grounded Theory and Theory Generation

Over the past several decades grounded theory as a methodology has evolved since its initial inception in the general sociology literature. In the early 1960’s grounded theory was initially associated with a positivist epistemology using quantitative data [5]. However, researchers observed that grounded theory provided “a logically consistent set of data collection and analysis procedures aimed to develop theory” [6:245]. Therefore, the approaches to coding that underlie grounded theory methods developed as key processes that researchers could undertake to systematically reduce and categorize data. Coding in grounded theory provided a link between the raw empirical data gathered by researchers and theoretical concepts that emerged from the data [7]. It is through the process of researcher identification of patterns in the data and analysis of these patterns empirically that theory can be developed [8,9]. In order for a researcher to be able to create theory the chain of evidence used in the analysis needs to be described precisely. This means the researcher must show how classification, theme identification and the linking of key properties occurs.

Since this work there has emerged a debate regarding the conflicting assumptions of the inherent positivist or interpretivist philosophical position of grounded theory (see [10, 11]) and this has affected how researchers conduct data analysis in grounded theory. Glaser suggested Strauss and Corbin’s [4] coding and analytical method (as described above) forced issues or problems to emerge. The precise process of coding has been a point of contention between Glaser and Strauss. Both Glaser [12] and Strauss and Corbin [4] describe coding as an essential aspect of transforming raw data into theoretical constructions of social processes [13]. However, Glaser [12] distinguishes between two types of coding, substantive (open) and theoretical, whereas Strauss and Corbin [4] define three levels, open, axial and selective coding. Essentially
open and substantive coding, and theoretical and selective coding are considered similar, making axial coding the point at which the two approaches diverge [13]. Many researchers have entered into this debate. For example, Parker and Roffey [14] suggested that Strauss and Corbin’s approach provided a structured approach to data analysis, whereas Glaser’s approach is often considered more difficult to operationalise. Strauss and Corbin seemed to offer more procedural advice than Glaser [14].

There has also emerged as a debate as to whether prior theoretical ideas should be set aside prior to coding the data. Some methodologists such as Creswell [15] and Dey [16] espouse the view that grounded theory aims to generate or discover a theory. In their work both Creswell and Dey suggested there is a need to set aside other theoretical ideas to allow for a substantive theory to emerge from the data. The theory generated through this method usually focuses on how individuals interact with the phenomenon under investigation and attempts to expose plausible relationships between concepts and sets of concepts that emerge from the data. In this view of grounded theory a range of data is acquired by the researcher through the conduct of fieldwork including, but not restricted to, interviews, observations and documents. Subsequent data analysis is systematic, iterative and commences as soon as data are available. Concepts are developed and refined through the analysis and constant comparison of new and old data. Alternatively, other researchers have suggested prior theoretical knowledge may be brought to bear in the process of coding.

3. The Challenges to Using Grounded Theory

As a result, there are a number of challenges associated with using grounded theory. Firstly, there appears to be an internal conflict with the process of “setting aside theoretical ideas”. However, this does not mean that the researcher can separate from previous theoretical knowledge but that they should not be restricted by their previous knowledge and so fail to question their existing assumptions or impose preconceived ideas on the data. This process can particularly be at odds with the academic world where some researchers consider it to be a less rigorous method. The truth is that “grounded theory is by definition a rigorous approach” requiring significant time, a chain of analysis, and the relating of findings back to other theories [17]. Secondly, one characteristic of research employing grounded theory is that often there is only a problem area identified at the commencement of the research. This can be confusing for researchers new to the approach. This is the reason why grounded theory is so well suited to the examination of processes rather than commencing with fixed research questions. Here, the research questions are developed and iteratively refined as an outcome of the open coding process. Glaser [12:25] notes that ‘out of open coding,,, theoretical sampling and analyzing by constant comparison emerge a focus for the research’. This process can be in conflict with the “scientific” requirements within the health informatics research community. The third challenge is confusion over the philosophical basis of grounded theory. In grounded theory, segments or slices of data are examined thereby providing researchers with expanded opportunities for data gathering. This includes the opportunity to employ different data types, data collection techniques, and to analyse the data to explore “different views or vantage points from which to understand a category and to develop its properties” [8:65]. This is not supported by the facts [18]. Consistent with Klein and Meyers [19] and Olson [20]
qualitative methods can be used in any underlying epistemology and so grounded theory can be influenced by researchers from any epistemological stance [21]. Glaser [22] provided the following assertion: “Let me be clear. Grounded theory is a general method. It can be used on any data or combination of data.” So the authors assert that irrespective of the research paradigm they are using health informatics researchers can safely use grounded theory approaches to analyse research data using any philosophical stance as long as they are systematic and clear about the method undertaken and the assumptions underpinning them.

4. Evolution of Grounded Theory in Information Systems Research

It is interesting and worthy to note, information systems researchers have suggested that the procedures outlined in grounded theory should be thought of as rules of thumb, rather than hard or fixed rules - and has advised researchers to study these rules of thumb, use them, and modify them in accordance with the requirements of the research. Thus, increasingly grounded theory is being used more flexibly and treated as a set of guidelines rather than a structured methodology in the field of information systems research [18,23]. Increasingly information systems researchers are using a hybrid of both Strauss and Corbin’s and Glaser’s coding approaches. These researchers have adopted a hybrid approach to assist with data reduction and organisation. To illustrate Strauss and Corbin’s three phase approach of open, axial and selective coding, is acknowledged by information systems researchers as a useful technique for breaking down and organising the data. However, some researchers have exercised caution when imposing the ‘coding paradigm’ advocated by Strauss and Corbin [4] rather than allowing theory to emerge [18]. So information system researchers have combined these approaches with the original concepts of constant comparison to provide a balance. The three-stage coding process has evolved as a result into the following commonly adopted steps:

1. **Open Coding** - reducing the voluminous data into more manageable chunks through the assignment of codes to passages within the data;
2. **Axial Coding** - comparing the open codes and identifying relationships between the codes so that categories emerge. This process facilitates building connections within categories; and
3. **Selective Coding** - the process of selecting and identifying the core category and systematically relating it to other categories. It involves validating the relationships, filling in, and refining and developing those categories. At this point, the researcher synthesizes or makes sense of the findings, and this forms the basis of theory discovery from data, as argued by Glaser and Strauss [8].

When employing a grounded theory approach a vital step in the development of theory from the data is using theoretical (or analytical) memos and integrative diagrams [4,12,24,25]. Through the use of these tools, whenever a researcher has an idea during coding, they write a memo to develop the ideas. “Memos are the theorizing write-up of ideas about codes and relationships as they strike the analyst while coding” [25:83]. They are recorded throughout the coding process as a way of fixing impressions of what was going on, and are written at the same time as, or as close as possible to, data collection and analysis in order to retain a fresh impression.
5. Grounded Theory in Health Informatics

Qualitative researchers were the first to have employed grounded theory in health informatics. These studies were conducted by researchers who wanted to obtain a better understanding of the underlying reasons for HIS successes and failures as quantitative studies were unable to do so [26]. Grounded theory, as a methodology, was therefore able to illuminate some of the factors that affect HIS success or failure. For example, in a series of studies Ash and colleagues [27, 28] documented the issues and factors that affect the diffusion of innovations such as physician order entry in hospital settings. Grounded theory has been used to identify key themes associated with the diffusion of innovations and the findings from these studies have been interpreted within the context of existing frameworks such as classical Diffusion of Innovations Theory [e.g. 27]. Such work has been essential to informing the field of health informatics about the success factors associated with some types of information systems [28] and has been used to inform system implementers about factors they must consider when implementing such systems in healthcare organizations [27,28]. In other works grounded theory has been used in an attempt to better understand how health professionals (e.g. physicians and nurses) derive meaning from their interactions with HIS and devices in health care settings. Here, researchers have attempted to understand and develop models that describe the interactions between the health professional and the social system within the context of the organization where they conduct work. More specifically, they have documented how these interactions influenced health professional perceptions of the technology, their subsequent interactions with the technology (including their decisions to adopt the health information system). For example, Peute et al. [29] investigated the human, social and organizational issues involved in implementing physician order entry. In this work the researchers not only identified lessons learned and recommendations on how to manage these issues but they outlined their work within a conceptual model that could be used to understand the impacts of physician order entry involving a laboratory system upon aspects of health professional work (e.g. workflow) [29]. In these studies researchers have developed or used theoretical frameworks to describe how health information systems are adopted [26] and the factors that influence their adoption from a human, social and organizational perspective [26,27,28,29]. Having demonstrated the ability of grounded theory to provide a greater understanding of the factors that affect the implementation process as well as the implementation process itself these researchers have used grounded theory to develop models and frameworks that can be used to guide practitioners in the real-world [27,28,29]. In the process these health informatics researchers have widened the use of this methodology in health informatics.

In health informatics one of the most powerful and emergent uses of grounded theory as a methodology has been its application to the development of frameworks, models and theories that form the basis for ontologies and models for HIS design [30, 31]. The application of grounded theory by Kuziemsky and colleagues has proven to be a useful and significant area of work [30,31]. The researcher has successfully developed ontologies that were later implemented during the development of HIS. Evaluations of the HIS developed using these ontologies have been positive among the user community (e.g. physician and nurses) [30, 31]. Health informatics as a research discipline has been informed by both the social sciences and information systems research where grounded theory is concerned. In the social science grounded theory
has traditionally been used in a very structured manner. More recently, information systems and health informatics researchers have begun to use the method more flexibly (see for example [11,18]). This has encouraged the use of grounded theory methods for broader applications within the discipline. The use of grounded theory methods can positively contribute to improving not only the evaluation phases of implementations but can be used for specification identification and development. To illustrate, research by Cummings and Turner [32] demonstrated that grounded theory could be used to not only learn about the experiences of users of a new HIS, but could be used to determine the potential outcomes of implementing such systems. Here, such information could be used to inform future systems development as well as modifications to existing systems to improve software quality.

Grounded Theory, as a methodology, has led to significant changes in the way HIS are designed, developed, implemented and evaluated in the health informatics community. Initially, grounded theory challenged the accepted primacy of the use of randomised control trials and other quantitative methods as the primary approach to evaluating HIS, demonstrating its value and ability to uncover the underlying factors that influence HIS success or failure. Today grounded theory is emerging as a methodology that can be used to gather requirements, develop ontologies, and develop systems (in addition to) being used as an evaluation approach. Further to this, grounded theory has allowed researchers to develop empirically based models and frameworks that can be used to guide systems design and implementation. Therefore, grounded theory is coming of age as a research methodology and tool to be used by health informatics professionals.

6. Conclusions

Researchers and health informatics professionals are increasingly using grounded theory. However, there is a need to further encourage the increased and appropriate use of grounded theory as it is emerging as a powerful methodology to be used in the design, development, implementation and evaluation of HIS. This paper has presented: a review of the historic and theoretical origins of grounded theory; discussed the evolution of grounded theory and theory generation; reflected upon the emergence of grounded theory as a powerful methodology; and discussed the evolution of grounded theory use in information systems research and health informatics. This is not an exhaustive review of the method or a full explanation of the processes involved in grounded theory but it offers some exploration of the current uses of grounded theory. The authors remain convinced that what is required is an easy navigation tool for students and new researchers in the processes involved in qualitative research using grounded theory. The authors offer a final word of caution, using grounded theory for data analysis is very time consuming. The researcher needs to be prepared to spend many months immersed in their data.

References
