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Defining Exploratory-Descriptive Qualitative (EDQ) research and considering its application to healthcare.

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Abstract— This article aims to introduce readers to a distinctive approach to health research when the topic under investigation has received little previous attention. It provides details of the theoretical underpinnings of the methodology, as well as providing recommendations regarding the practicalities of its use.

To address a specific research aim, the primary author believed that an exploratory descriptive qualitative approach was the most suitable. A subsequent review of the relevant literature identified a number of published research articles, which claimed to use an "exploratory descriptive qualitative" design. Closer inspection revealed that these papers lacked theoretical underpinning. As a result, the authors created a conceptual framework, underpinned by appropriate theory, to support the use of an exploratory descriptive qualitative approach. We refer to this approach as EDQ and argue that there is a place in health research when it is deemed the most appropriate methodology to achieve the aims of a study.

Keywords- *exploratory descriptive research; qualitative; methodology.*

I. INTRODUCTION/BACKGROUND

"Qualitative research findings have been shown to be necessary to the advancement of health research" [1]. There are various qualitative approaches for researchers to choose from [2] to deliver such advancement. They include phenomenology, ethnography, grounded theory and action research. However, this is not an exhaustive list. Other qualitative methodologies exist which a researcher may choose to use if they can justify their rationale for using it [3]. Ultimately, a researcher has to defend their choice of methodology by demonstrating how it relates to the aims of the research and provides the most suitable way of achieving those aims [4].

This article discusses a methodology which we refer to as Exploratory-Descriptive Qualitative research, and for brevity, have abbreviated to EDQ research. Both exploratory and qualitative descriptive research have been discussed independently in the literature. Lederman [5] recognizes that both are used where the concepts under study are vague. While studies already exist that purport to use an 'exploratory descriptive' methodology; closer examination suggests that their theoretical underpinning is lacking. This article provides a theoretical framework, which would address this deficit. Discussion of potential research methods in relation to the methodology is also provided.

II. GENESIS OF THE METHODOLOGY

Polit and Beck [6] briefly consider exploratory research, and suggest that it is designed to illuminate how a phenomenon is manifested and is especially useful in uncovering the full nature of a little-understood phenomenon. Reid-Searl and Happell [7] concur suggesting that a qualitative exploratory design allows the researcher to explore a topic with limited coverage within the literature and allows the participants of the study to contribute to the development of new knowledge in that area.

As a result of paucity in the literature around exploratory research as a methodology in its own right, the work of Stebbins [8], a sociologist, is influential. Stebbins [8] defined exploratory research as "a broad-ranging, purposive, systematic, prearranged undertaking designed to maximize the discovery of generalizations leading to description and understanding of an area of social or psychological life. Such exploration is, depending on the standpoint taken, a distinctive way of conducting science - a scientific process - a special

methodological approach...". This definition is a useful starting point for understanding exploratory research as a methodology.

Description of phenomena is recognized by Polit and Beck [6] to be an important purpose for research and one which nurse researchers have embraced. Holloway and Wheeler [3] suggest that description of the phenomena provides a detailed account of its significance and generates a picture of the world from the perspective of the participants. The purpose of a descriptive study is to document and describe the phenomena of interest [9].

A key advocate of descriptive qualitative research is Sandelowski [2] whose seminal article "Whatever happened to qualitative description?" was published in 2000. Sandelowski revisited her work ten years later to clarify several misconceptions that the original piece had inadvertently created, the most notable being that qualitative description requires no interpretation of data [10]. Indeed, Sandelowski [10] reminds researchers that they must analyze or interpret in order to "make something of their data." She suggested that descriptive qualitative studies should be the methodology of choice when the aims of the research were to produce a straight forward description of the phenomena [2]. Caelli et al. [11] highlight that this approach is effective in allowing the researcher to understand who is involved, what was involved and where events took place in relation to the phenomena of interest. A key point, which Sandelowski [10] stresses, is that qualitative descriptive studies are not intended to be used to salvage pieces of research which have been poorly conceived or conducted. Qualitative descriptive studies cannot be justified when a different, more interpretive, qualitative methodology would have been more suited to the aims of the research [10]. These final points are also relevant to EDQ research.

Having recognized the potential application of Stebbins' [8] work to healthcare and the existing contributions of Sandelowski [2,10], the authors have formally created a hybrid of the two methodologies, as illustrated in Figure 1.

III. JUSTIFICATION FOR USING EDQ RESEARCH

The authors are not the first to coin the term "exploratory-descriptive qualitative research" however; we are the first to give it significant theoretical underpinning. To illustrate, a literature search using the CINAHL database was undertaken using the following key words: exploratory, descriptive AND qualitative, research AND nursing. This search resulted in 167 papers being identified, reduced to 66 when an age restriction of 'being published between 2010 and the present (2015)' was applied. This time scale was applied to identify the most current papers. Fifty papers were rejected as they were not available electronically, were not in English or were advertisements for future research. In total, 16 published articles were examined to draw out key information about their research approach. Table 1 provides examples from the 16 published articles which were considered.

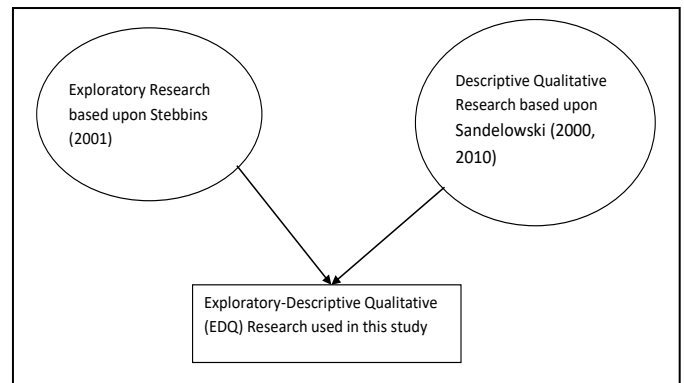


Fig. 1. The creation of EDQ [16]

The majority of the articles identified simply stated that an exploratory and descriptive piece of qualitative research had been conducted. An article by Sehularo et al. [12] imparts the most significant discussion around exploratory descriptive qualitative research as a methodology. This paper states that "explorative research examines a phenomenon of interest, rather than simply observing and recording incidents of the phenomenon..." and goes on to suggest that the descriptive element is used to gain insight and inform nursing care [12]. While Sehualro et al. [12] provide this information as background to the methodology, it lacks a detailed theoretical underpinning. This is a recurring theme in papers published which have used a similar approach and may be more related to the published works themselves, rather than the specific methodology. No papers were identified which claim to be based on a combined approach of using Stebbins [8] and Sandelowski [2,10] thus strengthening our assertion that this approach is new.

IV. METHODS FOR UNDERTAKING EDQ RESEARCH

The research methods discussed in this section are based, predominately, upon the work of Stebbins [8] and Sandelowski [2,10], as well as the other researchers [12, 13, 14, 15] who have used a similar design. The lead author of this paper [16] used the approach described here for his doctoral research, as illustrated in Figure 3. Stebbins [8] highlights that exploratory researchers should have "flexibility in looking for data and open-mindedness about where to find them" while Sandelowski [2] suggests that the descriptive researcher may use techniques that allow the item under investigation to present itself as if it was not under study. Regardless, decisions about the research methods used still have to be made and justified. Sandelowski [10] recognizes this and highlights that the researcher should describe and explain the various methods used over the course of the study.

Literature Review in an EDQ study

A review of the literature can, in its own right, be used to inform best clinical practice [17]. In the context of EDQ research, the review of the literature should identify a deficit of knowledge and therefore justify the need for further study in

Table 1: Examples and features of other studies using exploratory-descriptive qualitative research

Author(s)	Isaacs et al. [14]	Ranse et al. [15]	Smith and Wu [13]
Year	2013	2012	2012
Title	Registered nurses' role in diagnosing childhood tuberculosis in South Africa	End-of-life care in the intensive care setting: A descriptive exploratory qualitative study of nurses' beliefs and practices	Nurses' beliefs, experiences and practice regarding complementary and alternative medicine in Taiwan
Methodological discussion	"An exploratory, descriptive, qualitative study was conducted... The design was appropriate because it allowed the researchers to contextualise how the participants perceived their activities and environment and their role within the context of the study and provided a picture of what naturally occurred.."	"This study used a descriptive exploratory qualitative research approach. A descriptive exploratory qualitative approach is useful in summarising and understanding an area of interest, and was appropriately selected for this study to describe and explore the end-of-life care beliefs and practices of intensive care nurses."	"An exploratory, descriptive, qualitative research design was used in the present study..." "... descriptive method of qualitative research emphasis is on describing rather than on conceptualising or interpreting..."
Sample	6 nurses. Purposeful sampling with inclusion criteria discussed.	5 nurses, all female. Convenience sample.	11 nurses, all female. Purposeful sampling.
Data Collection method(s)	Semi-structured interviews, lasted approximately 45-60 minutes each. Recorded and transcribed. The researcher also made field notes during the interviews.	Semi-structured interviews, between 13-72 minutes each. Recorded and transcribed.	Semi-structured interviews, between 30-60 minutes each. Recorded and transcribed. The researcher also made field notes during the interviews.
Data Analysis method	thematic analysis based upon Braun & Clarke (2006)	"Transcripts were analysed using an inductive coding approach."	"The transcribed data were analysed using the constant comparative method (Glaser & Strauss 1967)."

that topic area [18]. It is important to identify a gap in the literature to justify the use of EDQ over other methodological approaches.

Sandelowski [2] makes no explicit comment on how, or if a literature review should be presented in a descriptive qualitative study. Stebbins [8], on the other hand, provides a detailed discussion and as such, has influenced the approach we recommend when utilizing EDQ. Stebbins [8] suggests that in exploratory research, literature reviews are "carried out to demonstrate that little or no work has been done on the group, process or activity under consideration". In exploratory research, and hence in EDQ, the literature review is short when compared to other qualitative approaches. This is because Stebbins [8] argues that an extensive review of studies, which are only marginally related to the topic of interest, is distracting. He goes on to suggest that the researcher should search for studies which are most closely related to the topic under investigation and then demonstrate how they leave certain critical aspects of that phenomena unexplored [8]. In EDQ, we propose that the researcher should follow Stebbins' [8] suggestion to devote the greatest energy to those papers which closely relate to the topic and then move outwards, as if by concentric rings, devoting less and less space to literature that is increasingly removed from the topic under study (figure 2).

Previous work that is considered in the outer rings of the literature review should not be ignored entirely. Although they may not appear in a "Literature Review" section of an EDQ report, EDQ researchers may use them to support or contradict the findings of their study and provide what Stebbins [8] terms "intellectual anchorage."

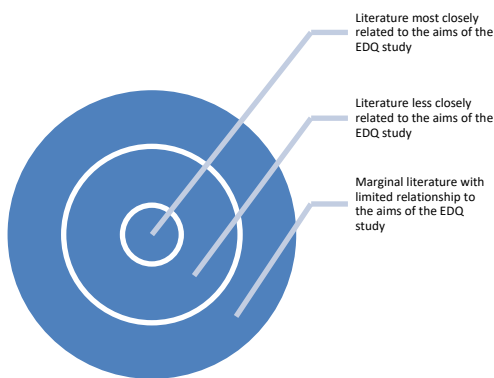


Fig 2: Literature review structure in EDQ research [16, based upon 8]

Sampling

The sampling strategy used in EDQ research can be classed as purposeful. Sandelowski [2] stated that purposeful sampling was the most appropriate strategy for descriptive qualitative research and that sampling should allow the researcher to capture and describe the phenomena over a variety of situations. Similarly, Stebbins [8] suggested that the aim of sampling should be to maximize the representativeness of a population and recognized that this might be achieved through purposeful or snowball procedures. Ultimately, the researcher has to obtain participants who can provide the information required to address the aims of the study [2]. Sandelowski [2,10] does not comment upon sample size. However, in previous work, Sandelowski [19] had suggested that it is important in qualitative research to ensure that the sample size enables the quality of information sought to be gained. Stebbins [8] recommends a sample size of 30 participants, as this should allow important categories and sub-categories to emerge, but does recognize that a smaller sample may be appropriate. Having considered studies that have used an exploratory-descriptive approach (n=16), the average sample size appears to be 15. EDQ gives flexibility in regards sample size, however it is the responsibility of the researcher to justify the sample size used in their study as long as the selection has a clear rationale with the potential to fulfil a specific function in relation to the aims of the research [20].

Neither Sandelowski [2] nor Stebbins [8] discuss the need to conduct a pilot study. Additionally, only one study which has used an exploratory-descriptive approach (n=16) included a pilot study. However, novice researchers may find this useful to test their data collection method and the information gained can form part of the data analysis [21].

Data Collection

While Sandelowski [2] recognizes that focus groups and the observation of certain target events may be used to collect data in descriptive qualitative studies, semi-structured interviews are normally used. Equally, Stebbins [8] suggests that while exploring through observation is useful, exploring through the use of interviews is more focused. Sandelowski [2] stated that the aim of descriptive qualitative studies was to uncover the 'who, what and where' of events or experiences while Stebbins [8] expanded this description suggesting that exploratory researchers should "try to generalize about who is doing (thinking, feeling) what to (with, for, about) whom and when and where the action is taking place". Other forms of data may be collected, including quantitative materials such as participant demographics, to help support the study.

Title: A strange, new world: compassion in the Emergency Department as experienced by student nurses. An exploratory-descriptive qualitative study.

Aim: To explore the experiences of student nurses in relation to the provision of compassionate care within the Emergency Department.



Literature review: no studies identified which directly address this topic. Surrounding literature critiqued.



Research questions:

1. What does the term "compassionate care" mean to student nurses?
2. How has student nurses' understanding of compassionate care been developed?
3. If, how and from whom do student nurses learn to deliver compassionate care within the Emergency Department?
4. What are the barriers and enablers of providing compassionate care within the Emergency Department, as experienced by student nurses?



Purposeful sample of 15 student nurses (5 x year 1, 5 x year 2, 5 x year 3)



Data collection: semi-structured interviews, transcribed verbatim



Data analysis: Thematic analysis based on Braun & Clarke [26]



Findings identified (see below). Some direct quotes used to illustrate. Discussed in relation to wider literature. Rigour demonstrated as suggested by Whitemore et al. [31].

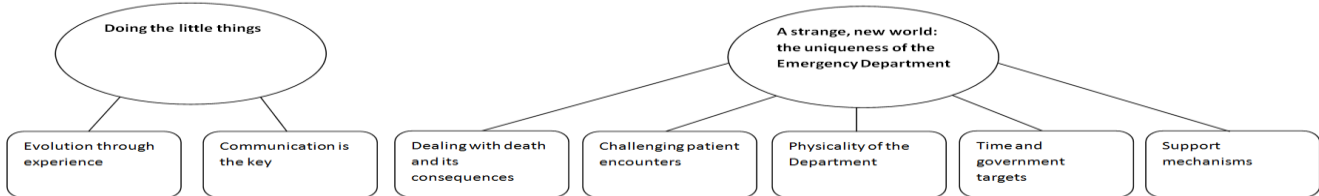


Fig 3: example of an EDQ study [16]

Interviews should be arranged at a time and venue that is convenient to participants. This approach is taken to help reduce the researcher-participant power imbalance which may exist [22]. Interviews should be recorded with the written consent of the participants using audio equipment that allows for accurate and verbatim transcription [23]. Participants can choose their pseudonym as it will allow them to recognize any comments made when the research is published [24].

Data Analysis

While content analysis is recommended by Sandelowski [2] and taking note that Stebbins [8] did not make explicit suggestions in relation to data analysis, reviewing articles (n=16) which claim to use an exploratory descriptive design indicate the application of various approaches. This includes content analysis (n=3), thematic analysis (n=5) and the constant comparative method (n=1). The remainder (n=7) use other methods of data analysis or do not make it clear how data analysis has been performed.

As Patton [25] highlights, there is no recipe for the process of qualitative data analysis, but there are guidelines and principles to aid the process. The chosen approach to data analysis in EDQ is that of thematic analysis, based upon the work of Braun and Clarke [26]. In their paper, Braun and Clarke [26] provide a detailed, six phased, step-by-step guide to undertaking thematic analysis, as well as considering other aspects about the interaction between thematic analysis and epistemological and ontological perspectives.

Thematic analysis is justified as the data analysis method in EDQ research for a number of reasons. Firstly, EDQ aims to explore and describe the experiences of participants in relation to phenomena under study. Green and Thorogood [27] suggest that thematic analysis is suited to this very purpose. Secondly, the exploratory aspect of EDQ is concerned with discovering generalizations [8] and as such, thematic analysis should identify the main statements, the core of the experience, from participants [3]. These 'statements' will be used to form the generalizations. Braun and Clarke's [26] work is considered in research textbooks [28, 29], as well as being recognized as seminal in relation to this aspect of qualitative nursing research [30]. Furthermore, thematic analysis appears to have worked in other, similar studies where Braun and Clarke [26] are referred to as respected thematic analysts.

Rigour

As with any research approach involving human subjects, full recognition of relevant ethical issues and the ethical approval processes is required. Taking cognizance of what both Sandelowski [31] and Stebbins [8] suggest about rigour, EDQ addresses rigour under the framework suggested by Whittemore et al. [32]. This approach has been used by Milne and Oberle [33] in a qualitative descriptive study and is discussed in detail by Polit and Beck [6]. The focus in EDQ is on the four main criteria suggested by Whittemore et al. [32]:

credibility, authenticity, criticality and integrity. Reflexivity should also be considered.

Milne and Oberle [33] suggested that the credibility of a piece of research is related to its purpose and its ability to achieve its stated aims. To assure the credibility of EDQ, the researcher would describe their experiences and should demonstrate prolonged engagement, observation (if appropriate) and audit trails [34]. Milne and Oberle [33] suggested that authenticity could be reached if the following criteria were met: "participants had the freedom to speak, participants' voices were heard, and participants' perceptions were accurately represented". This can be achieved through the data collection and analysis methods already discussed.

The overall integrity of a study can be gauged by the level of critical appraisal applied to the research decisions made [33]. The criticality and integrity of EDQ can be enhanced by reflecting on researcher bias, respondent validation and peer review. Reflexivity enhances the rigour of a qualitative study [35]. We, therefore, recommend that a reflexive diary is used by the researcher during the study to record thoughts, feelings and personal experiences. Polit and Beck [6] recognize that a reflexive journal is the most widely used strategy and that its purpose is to make the researcher aware of their unique background, values, social and professional identity, all of which can affect the research process.

V. CONCLUSION

EDQ is one formalization of an approach to qualitative research that appears in the literature, but is ill-defined. Other versions may well exist. By providing a foundation based on the respected works of Sandelowski [2,10] and Stebbins [8], EDQ has been identified as a suitable theoretical framework to study areas within healthcare practice that have previously received little or no attention. All things considered, EDQ has the potential to provide explorative researchers with a 'textured, toned and hued' approach, as Sandelowski [2] suggested.

Possible research methods, which relate to EDQ have been provided although the flexibility of the EDQ approach is also recognized, allowing researchers to be creative in their thinking. We believe that EDQ has the potential to both explore and describe aspects of clinical nursing practice (both nursing and patient perspectives), nurse education and nursing policy. It may also have applicability to other allied health professions, medicine and possibly beyond. However, researchers who choose to use an EDQ approach for their own work must acknowledge the concerns of Sandelowski [10] in that it must not be used as a fallback position to salvage pieces of research which have been poorly conceived or conducted and that it needs to be justified as being the most appropriate approach to address the aims of the study.

REFERENCES

- [1] M. Sandelowski, "Using qualitative research." *Qualitative Health Research*, vol. 14(10), pp. 1366-1386, 2004
- [2] M. Sandelowski, "Whatever happened to qualitative description?" *Research in Nursing & Health*, vol. 23(4), pp. 334-340, 2000.
- [3] I. Holloway and S. Wheeler, (2010) *Qualitative research in nursing and healthcare*. 3rd ed. Oxford: Wiley-Blackwell, 2010.
- [4] G. Thomas, *How to do your research project: a guide for students in education and applied social sciences*. 2nd ed. London: Sage Publications, 2013.
- [5] R. P. Lederman, "Comparative and consistent approaches to exploratory research." *American Journal of Maternal Child Nursing*, vol. 18(2), pp. 107, 1993.
- [6] D. F. Polit and C. T. Beck, *Nursing research: generating and assessing evidence for nursing practice*. 9th ed. Philadelphia: Lippincott, Williams & Wilkins, 2012.
- [7] K. Reid-Searl and B. Happell, "Supervising nursing students administering medication: a perspective from registered nurses." *Journal of Clinical Nursing*, vol. 21(13/14), pp. 1998-2005, 2012.
- [8] R. A. Stebbins, *Exploratory research in the social sciences*. London: Sage Publications, 2001.
- [9] C. Marshall and G. B. Rossman, *Designing qualitative research*. 6th ed. London: Sage Publications, 2016.
- [10] M. Sandelowski, "What's in a name? qualitative description revisited." *Research in Nursing & Health*, vol. 33(1), pp. 77-84, 2010.
- [11] K. Caelli, L. Ray and J. Mill, "Clear as mud: towards greater clarity in generic qualitative research." *International Journal of Qualitative Methods*, vol. 2(2), pp. 1-13, 2003.
- [12] L. A. Sehularo, E. Du Plessis and B. Scrooby, "Exploring the perceptions of psychiatric patients regarding marijuana use." *Health SA Gesondheid*, vol. 17(1), pp. 1-8, 2012.
- [13] G. D. Smith and S. Wu, "Nurses' beliefs, experiences and practice regarding complementary and alternative medicine in Taiwan." *Journal of Clinical Nursing*, vol. 21(17/18), pp. 2659-2667, 2012
- [14] W. Isaacs, S. Duma and P. Mayers, "Registered nurses' role in diagnosing childhood tuberculosis in South Africa." *African Journal of Nursing and Midwifery*, vol. 15(1), pp. 42-53, 2013.
- [15] K. Ranse, P. Yates and F. Coyer, "End-of-life care in the intensive care setting: a descriptive exploratory qualitative study of nurses' beliefs and practices." *Australian Critical Care*, vol. 25(1), pp. 4-12, 2012.
- [16] D. Hunter, *A strange, new world: compassion in the Emergency Department as experienced by student nurses. An exploratory-descriptive qualitative study*. ProfD thesis, Glasgow: Glasgow Caledonian University, 2017.
- [17] D. Hunter, "Diagnosis and management of scaphoid fractures: a literature review." *Emergency Nurse*, vol. 13(7), pp. 22-26, 2005.
- [18] P. Cronin, F. Ryan and M. Coughlan, "Undertaking a literature review: a step-by-step approach." *British Journal of Nursing*, vol. 17(1), pp. 38-43, 2008.
- [19] M. Sandelowski, "Focus on qualitative methods. Sample size in qualitative research." *Research in Nursing & Health*, vol. 18(2), pp. 179-183, 1995.
- [20] M. Cleary, J. Horsfall and M. Hayter, "Data collection and sampling in qualitative research: does size matter?" *Journal of Advanced Nursing*, vol. 70(3), pp. 473-475, 2014.
- [21] M. Davies and N. Hughes, *Doing a successful research project using qualitative or quantitative methods*. 2nd ed. Basingstoke: Palgrave MacMillan, 2014.
- [22] D. Parnis, J. Du Mont and B. Gombay, "Cooperation or co-optation? Assessing the methodological benefits and barriers involved in conducting qualitative research through medical institutional settings." *Qualitative Health Research*, vol. 15(5), pp. 686-697, 2005.
- [23] L. S. Whiting, "Semi-structured interviews: guidance for novice researchers." *Nursing Standard*, vol. 22(23), pp. 35-40, 2008.
- [24] L. E. Duers, "To see ourselves as others see us!" An exploration of student nurses' conceptions and implementation of peer review and self-assessment. EdD Thesis, Glasgow: University of Strathclyde, 2013.
- [25] M. Q. Patton, *Qualitative research & evaluation methods*. 4th ed. London: Sage Publications, 2015.
- [26] V. Braun, and V. Clarke, "Using thematic analysis in psychology," *Qualitative Research in Psychology*, vol. 3(2), pp. 77-101, 2006.
- [27] J. Green and N. Thorogood, *Qualitative methods for health research*. 3rd ed. London: Sage Publications, 2014.
- [28] N. King and C. Horrocks, *Interviews in qualitative research*. London: Sage Publications, 2010.
- [29] T. Rapley, *Some pragmatics of data analysis*. In D. Silverman, (Ed) *Qualitative research*. 3rd ed. London: Sage Publications, pp. 273-290, 2011.
- [30] M. Vaismoradi, H. Turunen and T. Bondas, "Content analysis and thematic analysis: implications for conducting a qualitative descriptive study." *Nursing and Health Sciences*, vol. 15(3), pp. 398-405, 2013.
- [31] M. Sandelowski, "Rigor or rigor mortis: the problem of rigor in qualitative research revisited." *Advances in Nursing Science*, vol. 16(2), pp. 1-8, 1993.
- [32] R. Whittemore, S. K. Chase and C. L. Mandle, "Pearls, pith and provocation: validity in qualitative research." *Qualitative Health Research*, vol. 11(4), pp. 522-537, 2001.
- [33] J. Milne and K. Oberle, "Enhancing rigor in qualitative description: a case study." *Journal of Wound, Ostomy and Continence Nursing*, vol. 32(6), pp. 413-420, 2005.
- [34] F. Ryan, M. Coughlan and P. Cronin, "Step-by-step guide to critiquing research. Part 2: qualitative research." *British Journal of Nursing*, vol. 16(12), pp. 738-744, 2007.
- [35] W. Darawsheh, "Reflexivity in research: promoting rigour, reliability and validity in qualitative research." *International Journal of Therapy and Rehabilitation*, vol. 21(12), pp. 560-568, 2014.