Choosing a Methodology: Philosophical Underpinning

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Abstract
As a university lecturer, I find that a frequent question raised by Masters students concerns the methodology chosen for research and the rationale required in dissertations. This paper unpicks some of the philosophical coherence that can inform choices to be made regarding methodology and a well-thought out rationale that can add to the rigour of a research project. It considers the conceptual framework for research including the ontological and epistemological perspectives that are pertinent in choosing a methodology and subsequently the methods to be used. The discussion is exemplified using a concrete example of a research project in order to contextualise theory within practice.

Key words
Ontology; epistemology; positionality; relationality; methodology; method.

Introduction

This paper arises from work with students writing Masters dissertations who frequently express confusion and doubt about how appropriate methodology is chosen for research. It will be argued here that consideration of philosophical underpinning can be crucial for both shaping research design and for explaining approaches taken in order to support credibility of research outcomes.

It is beneficial, within the unique context of the research, for the researcher to carefully consider the conceptual background, including ontological and epistemological perspectives, in order for informed decisions to be made regarding the methodology to be chosen in seeking answers to the research question(s). By strengthening the rationale for the methodology, the researcher is in a better position to justify the research process and defend the outcomes, making 'use of various philosophical tools to help clarify the process of inquiry and provide insight into the assumptions on which it conceptually rests' (Kincheloe and Berry, 2004:8). Through justification of the chosen methodology as matched to the research questions, credibility of the research can be strengthened (Sikes, 2004) and awareness of the philosophical underpinning for the research can 'secure the quality of the research produced' (Snape and Spencer, 2003:1).

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Every piece of research, every researcher and every context is, in some way, different and a host of factors contributes to interpretation of phenomena as knowledge is constructed but, as Pring (2000:89) suggests, 'without the explicit formulation of the philosophical background – with implications for verification, explanation, knowledge of reality – researchers may remain innocently unaware of the deeper meaning and commitments of what they say or how they conduct their research'. According to Wilson and Stutchbury (2009:57) 'philosophical ideas often remain largely hidden' and, as such, research rigour can be strengthened by the researcher making transparent the philosophy that underpins the justification of their research methodology.

Starting point for conceptual framework

Research can begin with initial thoughts of an area of interest. These thoughts become crystallised as further consideration is given to what is to be studied, the narrowing of the focus, the setting of aims and objectives for the research and the formulation of research questions. From this, the researcher is able to identify the key elements concerning the research and conduct a review of literature pertaining to key issues. As existing theory is examined, there will be methodologies outlined that may prove of interest as useful approaches to consider for new research. As Wilson (2009:59) suggests, analysing methodologies used by experienced 'researchers will not only help you to see what is possible but will also give you a good insight into the strengths and limitations of the various methodologies and methods being used'.

As indicated above, each research project is different in some way and the researcher needs to focus on the particular question(s) for his or her unique research for, as stated by Miles and Huberman (1984:42), 'knowing what you want to find out leads inexorably to the question of how you will get that information'.

A crucial aspect of choosing a methodology is 'researcher positionality' (Sikes, 2004:17) and the philosophical assumptions concerning beliefs, values, ontology, epistemology and relationality since research is subjective – even the most scientific, positivist, objective, quantitative researcher will make a subjective choice, for example, of which statistical measure to apply – and interpretative as the researcher's perceptions are utilised in all stages of decision-making throughout a research project. As Kincheloe and Berry (2004:6) suggest, 'assumptions shape the outcome of the research' and choices made about research methodology 'profoundly affects what I find' (Kincheloe and Berry, 2004:6). Consideration of the philosophical assumptions and researcher positionality is therefore crucial to methodological decision-making within research.

Example of positionality

As a university lecturer working with student primary teachers, the expression of negative attitudes towards mathematics from some students led to consideration of their learning within Initial Teacher Education (ITE). Theoretical reports of the unsatisfactory nature of provision for mathematics education in primary schools added to these personal concerns.

The subsequent research arose from the researcher valuing the quality of children's mathematical learning experiences in the primary school and believing that perceptions of a subject can affect learning. Hence, the research was based on a philosophical assumption that student primary teachers' perceptions of mathematics can potentially affect their learning within ITE to teach primary mathematics and their subsequent teaching of mathematics to primary children.

This led to an interest in investigating the perceptions held by student primary teachers towards mathematics from the perspective that, to be the best teachers they can be, awareness and preparation are crucial. It was posited that student awareness of their mathematical perceptions could provide an opportunity to consider the learning needed through their ITE course and potential changes needed to prepare them for both learning in ITE and teaching in school.

Whilst ITE provision is an obvious factor in students' development, the research was based on a premise of learners taking responsibility for their own learning. It was recognised that perceptions are intangible and often unconsciously held. It was regarded that, if mathematical perceptions held by student teachers could be determined from descriptions of their mathematical experience, there may be scope to create a reflective tool to facilitate awareness of differing perceptions, identification of personal perceptions and consideration of implications for ITE learning.

The positionality of this research therefore included the value placed on children's mathematical learning opportunities in the primary school and the responsibility of student primary teachers in the future teaching of mathematics in primary schools; together with the belief that mathematical perceptions are a result of experience and that perceptions can influence the way ITE students learn and subsequently teach mathematics.

Further development of a conceptual framework

Review of literature pertinent to the key elements of a research project will inform the researcher of existing theory, gaps in existing research, and provide background information to enable the formation of an argument for the need for the research and the shape it will take, helping also with the firming up of research questions. This argument builds a theoretical framework for the substantive aspect of the research.

The background reading will also help to inform the strengths and limitations of different methodologies that other researchers have used in the field. This reading will be accompanied by thinking about the researcher's unique context and extend the philosophical preparation for the research in terms of making explicit the researcher's position regarding beliefs and values, and ontological and epistemological perspectives. As Kincheloe and Berry (2004:2) advocate, there is a need for the researcher to be conscious of the 'way the researcher sees and the social location….to focus on the clarification of his or her position in the web of reality'.

Ontological perspective

Ontology is the philosophical study of the nature of reality. In terms of education it is therefore the philosophical study of the nature of educational reality and how there may be different perceptions of what is known.

From an ontological perspective, the researcher thinks 'about issues such as whether the world exists independently of your perceptions of it' (Greener, 2011:6). The researcher's ontological position therefore begins to shape the methodological decision-making, dependent on whether the researcher sees an external, independent reality or an experienced, constructed reality based on social or individual human conception. The perspective taken will affect whether a quantitative approach is necessary to fit an objective and measurable study, a qualitative approach to encompass a subjective and interpretative study or a mixed-methods approach.

The researcher's position on this informs choices made about methods to be used for, as Sikes (2004:21) explains, 'in terms of research design and choice of procedures, if the assumption is that knowledge is real, objective and out there in the world to be captured, researchers can observe, measure and quantify it. However, if it is assumed to be experiential, personal and subjective, they will have to ask questions of the people involved'. The researcher's ontological perspective is also therefore 'closely related to issues of how we decide to collect our research data…they are intimately linked to the basis upon which we think we know something to be true' (Oliver, 2010:34).

To aid in the choice of methodology and to add to the credibility of research, it is useful for the researcher to both consider and articulate their ontological framework and to ensure that the methodology fits their ontological perspective, providing a rationale for the choices made that seeks to validate the methodology and the subsequent methods of data collection and analysis.

Example of ontological perspective and associated relationality:

An aim of the research was to determine student primary teachers' perceptions of mathematics. It was posited that perceptions were a result of mathematical experience and it was recognised that perceptions are intangible and unconsciously held. A qualitative approach was therefore needed in order to encourage research participants to describe

mathematical experience and an interpretative approach was needed to analyse those descriptions to determine perceptions.

Mathematics can be viewed as a scientific body of knowledge, ascertained as truth and proved by mathematicians before us – a set of rules and procedures that can be applied to reach answers to problems. However, a contrasting ontological perspective was taken by this researcher who views mathematics as a human conceptualisation of the phenomena we witness around us in our world. The researcher regards mathematics, not as an external body of fact to be transferred to a learner, but as a creation involving the way in which individuals relate to phenomena, make sense and meaning and form personal understanding. From this latter perspective, mathematics is therefore a human construction created of understanding as phenomena are interpreted. The subject we call mathematics was created by humans to make sense of and understand the world, to communicate our understanding and work with what is around us as well as for intrinsic enjoyment and challenge and is hence a social construction of ideas arising from interest, activity and practical need. It involves individual engagement in posing problems and seeking solutions (Szydlik, Szdlik and Benson, 2003) through an active process whereby activity is crucial for learners to reason, think, apply, discover, invent, communicate, test and critically reflect (Cockcroft, 1982).

From this ontological perspective, therefore, the focus for the research is not the subject of mathematics itself, nor indeed the learner, but the relationship between the two. In other words, determining students' mathematical perceptions involves focusing on the relation between the student and their experience of mathematics. Learning mathematically involves qualitative experience dependent on the interpretations learners put on their experiences – the 'internal relationship between the experiencer and the experienced' (Marton and Booth, 1997:113). With regard to the development of student primary teachers within ITE, learning is dependent on an individual's relationship between learner and what is learnt (Marton, 1986) – in this case the 'relationality' (Marton and Booth, 1997) between student (experiencer) and mathematics (experienced).

Epistemological perspective

Epistemology concerns the philosophical study of knowledge and 'the grounds upon which we believe something to be true' (Oliver, 2010:35) – in other words, 'what counts as educational knowledge and how is it obtained' (Sharp, 2009:5). As such, the researcher's epistemological stance is central to the choice of methodology in terms of its purpose and goals (Snape and Spencer, 2003:1), since research itself is concerned with seeking new knowledge. The ways in which that knowledge is developed is dependent on the methodology, and the rigour of the methodology therefore has a direct link to the strength of the claim to new knowledge.

The researcher's ontological stance links to their epistemological perspective – with the ontological perspective pertaining to the reality of the world and the epistemological perspective pertaining to knowledge of that world. In simple terms, an ontological view of

knowledge as reality that exists separately from a learner's interpretation means, epistemologically, knowledge can be obtained from objective observation, whereas an ontological view of knowledge as subject to interpretation means, epistemologically, that knowledge is arrived at through sense-making and meaning.
Just as it is important that the researcher determines their ontological stance, it is beneficial to ascertain and articulate their epistemological stance as the latter will also inform the methodology, and the decisions made therein are needed to justify the way in which the research brings about new knowledge and the strength of conviction within the research.

Example of epistemological perspective

The way in which mathematics is perceived has an effect on the learner. On the one hand, mathematics can be perceived as existing as a body of truth to be taught by instruction and transmission of facts, explanation and practice of procedural method leading to recalled and mechanical mathematical knowledge as opposed to relational understanding. In contrast, mathematics can be viewed as reaching an understanding that is created through teachers facilitating active engagement with hands-on, practical, contextual problem-solving and posing for the learner to form their own relationship with what is learnt through their personal sense-making.

The researcher's ontological perspective of mathematics being a human construction, created through the relationship between the experience of mathematics and the experiencer of mathematics supports an epistemological stance of learning mathematics through subjective, interpretative sense-making and meaning. This view therefore has an impact both upon the way the researcher decides to obtain data pertaining to mathematical perceptions and the way in which the data will be analysed in terms both of how mathematical knowledge is brought about and how new knowledge from the research is brought about.

In the research, in order to determine perceptions of mathematics amongst a group of students, the researcher's positionality could not be articulated at the risk of bias and the methodology needed to be one whereby participants were free to express their own views of mathematics, without leading questions from the researcher and without judgement. Hence, before the methodology was decided upon, aspects of the methods of data collection were apparent to the researcher in light of the philosophical underpinning of the research.

Similarly, in order to ascertain the full range of mathematical perceptions amongst a group of students, all data collected needed to be included, without preconceived ideas from the researcher on what that range might include. The collection of data needed to be true to what the students had to say. A method of data collection was therefore needed whereby students were free to recall and describe their experiences of mathematics and a method of analysis whereby those descriptions could be interpreted to ascertain the range of mathematical perceptions in a valid and reliable way.

At this point in the research design, there was also a need to consider ethical dimensions since, as already determined, mathematical perceptions can be negative and a review of literature had established that feelings towards mathematics could also be emotive and painful and so protection for participants potentially recalling damaging memories of mathematical experience had to be taken into account.

Hence, the ontological perspective related to the epistemological view of knowledge in terms of the positionality of the researcher regarding perceptions of mathematics, the focus on relationality between the learner and mathematics, the forming of mathematical perceptions through subjective mathematical experience and the creation of new knowledge pertaining to mathematical perceptions through an interpretative analysis of subjectively described mathematical experience. This philosophical undertaking began to frame some of the decision-making with regard to methods of data collection and analysis.

Choice of methodology

Once the nature of the research has been established and the conceptual framework formed through identification of ontological and epistemological perspectives and hence the underlying philosophy for the research clarified, decisions can be made about the methodology to be chosen, as informed by the underpinning philosophy to be appropriate for the aims and objectives of the study.

It is worth noting here that 'method and methodology are not the same thing' (Sikes, 2004:15). The methodology is the approach taken to the research design as a whole in relation to reaching answers to the research question(s), whereas methods are the techniques used to collect and analyse data to provide evidence for the posited knowledge that the research constructs.

A dissertation's methodology chapter includes the research design and the justification of the choices made, to provide an understanding of the process undertaken and the reasons for it.

Example of choosing an appropriate methodology:

The reading for the literature review plus specific reading of different methodologies led to a choice of phenomenographic methodology for the research. The reasons for this choice were specific and as such a strong rationale provided for the choice of methodology:

Phenomenography is a qualitative approach. Since the philosophical underpinning for the research was that mathematics is based on an individual's experience and their relation with phenomena, a qualitative methodology was needed in order to explore the way in which participants perceive mathematics. A phenomenographic approach was chosen as one which can 'describe an aspect of the world as it appears to the individual' (Marton,

1986:33).

Since it was established that mathematical perceptions differ and may be unconscious (Cross, 2009), not directly observable (Rokeach, 1968), difficult to articulate (MacNab and Payne, 2003) and reliant on inference (Leder and Forgasz, 2006), phenomenography was an approach that enabled students to describe 'the relation between an individual's prior experience and their perceptions of the situation' (Trigwell and Prosser, 2004:410). Phenomenographic methodology gave the means to determine different understandings (Marton, 1986) of the phenomenon of mathematics as experienced by the research participants.

A phenomenographic approach concentrates on the relation between the experiencer and the phenomenon (Marton and Booth, 1997) and was appropriate for the research whereby the relationship between the object [mathematics], and the subject [the person engaging in mathematical activity] were not considered separate (Marton, 2000), since the focus was the relational aspect between mathematics and student.

Mathematics was identified as a potentially difficult arena to engage with and as such, phenomenography provided a vehicle for exploration considered 'particularly appropriate for engaging with complex, controversial or deeply held issues or viewpoints' (Cherry, 2005:62).

It was established within the review of literature that mathematics can be an emotive subject and it was anticipated that for some, feelings associated with mathematics include embarrassment and shame. As such, phenomenography facilitated examination of a collective group as opposed to a means by which individuals could be identified or singled out in the research.

Since the purpose of this study was to provide a basis for reflection by student teachers, the phenomenographic methodology enabled determination of the range of variation of 'qualitatively different ways of experiencing' (Linder and Marshall, 2003:272), providing the means to 'move up conceptually' (Green, 2005:35) through analysis beyond individual experience and contexts (Green, 2005) to form a structured and hierarchical outcome space to form a reflective tool for students embarking on ITE to ascertain their personal mathematical philosophies and identify their learning needs to develop as necessary through ITE and beyond.

The intention was to explore perceptions of mathematics in a typical group of student primary teachers embarking on ITE to ascertain the range of variation in perceptions in line with what Marton (1986) termed 'pure' phenomenography whereby 'the qualitatively different ways of understanding a phenomenon or aspect of the world are seen as a main outcome of the research' (Dall'Alba, 2000:98). However, the study also extended to provide a structure for reflection intended to be an 'educational tool to improve teaching and learning' (Åkerlind, 2002) whereby students may clarify their personal mathematical philosophy and identify their associated ITE learning needs and hence potentially 'facilitate

the transition from one way of thinking to a qualitatively 'better' perception of reality' (Marton, 1986:33). Hence, whilst phenomenography does not claim to provide generalization (Bowden, 2005), 'developmental' phenomenography can be pragmatic with the intention to provide a practical outcome (Green, 2005).

Choice of methods

Methods are the tools and techniques that are used in the collection and analysis of data. As outlined above, the philosophical background to research can determine the types of methods that are appropriate.

Once the most appropriate methodology has been identified, there are likely to be methods specific to that methodology. As with the choice of overall methodological strategy, 'we should use the methods that are best suited to answering our questions about a phenomenon' (Kincheloe and Berry, 2004:4).

Within the methodology chapter of a dissertation, the methodological approach adopted is articulated and justified, as are the methods – both for collecting data and for analysis in order to provide evidence for answering the research question(s). Just as a rationale needs to be provided for the methodology, so should the choice of methods be supported as the selection of data sources and the interpretation and analysis of data need to be rigorous in terms of reliability (consistent methods of data collection that provide accurate evidence and give an honest representation of findings) and validity (accurate questioning, collected data and interpretation in relation to the research question) so that the quality of research is not compromised (Wilson, 2009:81).

Example of choosing appropriate methods:

Interviews are the most common method of obtaining phenomenographic data and were deemed in the research to give the richest means by which students' perceptions could be explored via their accounts of experience.

A pilot study was carried out with a group of students 'similar to the intended interview sample' (Bowden, 2005:19). Small scale analysis was used to ascertain any modification of questions, which was minimal, and the pilot interviews were then 'discarded and not used as part of the research study' as advocated by Bowden (2005:19).

Students new to ITE were invited to participate since it was perceptions of mathematics prior to beginning ITE that were to be examined.

The sample size was commensurate with phenomenographic study, forming a cross-section of ages, gender, cultures, degree specialisms, previous occupations and ITE institutions, and hence maximising the likelihood of variation in perceptions being determined.

Interviews consisted of semi-structured questions that were open-ended to allow scope for students to express themselves.

Initial questions were used as triggers but additional questions were not used in order to avoid potentially leading responses (Green, 2005).

Interviews continued until the position was reached where the experience and perceptions had been described.

Phenomenographic 'bracketing' was maintained throughout the research whereby the emphasis was on trying to see mathematics through the students' eyes. As described by Marton and Booth (1997:121), 'at every stage of the phenomenographic project the researcher has to step back consciously from her own experience of the phenomenon and use it only to illustrate the ways in which others are talking of it, handling it, experiencing it, and understanding it'. It is inevitable, and fully recognised, that one has personal views and thoughts on the phenomenon, as well as some relationship to the students, and so a conscious decision was made to focus on their descriptions and not impose researcher views within the interviews.

The ethical guidelines of the university were implemented throughout the research.

It was made clear at the outset that no students were under any obligation to take part and were free not to take up the invitation. They were not students who would be tutored by the researcher so that they were not subject to pressure to appease their tutor.

Anonymity was assured (Cohen, Manion and Morrison, 2000), the nature and purpose of the research was shared with all (McNiff, Lomax and Whitehead, 1996), and the use of the data was explained, as advocated by Bell (1999), but this was kept brief in order to avoid any potential influence.

Signed consent for participation was received and permission given for interviews to be recorded and, although it was recognised that this might cause constraint upon the interviewee (Cohen *et al.,* 2000:281), as an alternative to note taking it helped to maintain the flow of dialogue and clarity of responses, as well as enabling time to be kept to a minimum.

Interview transcripts were provided for those students who requested these, together with a second consent form for all students having been given further time to consider their data being used, as it was deemed important 'to ensure that the interviewees feel comfortable and that their willingness to co-operate is never abused' (Bowden, 2005:31).

The interviews were arranged at a date, time and place convenient to participants (Green, 2005:39) and they were reminded of the confidential nature of the process.

Time was given and silences accepted in order to allow thinking time (McNiff *et al.,* 1996) and students were assured that they could decline to answer any of the questions and it was important that there was trust between the interviewee and interviewer.

Interviews were analysed using a phenomenographic approach into categories of description that, according to Marton (1986:33) was *content oriented* (mathematics), *relational* (between mathematics and the students), *experiential* (based on students' past mathematical experiences) and *qualitative* (based on the students' descriptions of their experiences and perceptions).

Each was transcribed verbatim, the laborious and time-consuming nature (Marton, 1986) of this being avoided via use of a transcriber, with consent given by interviewees, based on assurance of confidentiality.

Tapes were coded so that only the researcher knew the students' identity, none were known to the transcriber, tapes were deleted once interviews were transcribed, and transcriptions were deleted from the transcriber's computer once passed to the researcher.

Transcriptions were completed immediately after the interviews so that they could be quickly checked against the recordings whilst fresh in the researcher's mind, errors amended, 'tainted data' (Green, 2005:40) omitted and transcripts then provided for interviewees to check as required.

Transcripts were read and re-read to gain a sense, within context, of an overview of what students were describing.

Care was taken in this study to use a qualitative mapping process, with exact wording used so that 'the concepts and terminologies of the interviewees speak for themselves' (Barnacle, 2005:49).

Excerpts were identified that represented particular meanings, as suggested by Marton (1986), and coded for reference, with whole transcripts continually revisited to check context and meaning, as the excerpts began to be categorised in terms of qualitative similarities and differences.

Individual responses from transcripts formed categories that described meaning from the whole set, a process supported by Marton and Booth (1997).

The formation of relational links between categories involved judgements based both on the empirical evidence of the data, and, inevitably, on logical decisions made by the researcher, for it is recognised that analysis is dependent on the researcher's background, knowledge and ideas.

Central to phenomenographic rigour, the data were <u>not</u> used to fit pre-existing themes (Barnacle, 2005). To do so, it was necessary to be aware of one's own ideas in order to

challenge any expectations one might have, with a conscious effort made to remain as objective as possible and true to the data, without pre-determining categories in advance of the analysis (Marton, 2000).

All data were used in formation of the categories – the categories being formed from the data as opposed to data being 'fitted in' to categories.

Through a process involving sorting and defining (Marton, 1986), ways of experiencing mathematics that qualitatively differed from others (Åkerlind, Bowden and Green, 2005) was established.

Transcripts provided 'pools of meaning across individuals' (Green, 2005:39) so that neither the students themselves, nor the actual experience, were analysed, perceptions being interpreted from the interview data to form the phenomenographic 'categories of description.'

To form a framework for students' reflection on clarifying a personal mathematical philosophy, the categories of description were structured into a hierarchy, an aspect of phenomenography that enables learning development (Marton and Säljö, 1976).

As with formation of categories not being pre-determined, neither were the structural relationships between them (Åkerlind, Bowden and Green, 2005), with the focus remaining throughout the analytical process on the 'relation between the subject and the phenomenon' (Bowden, 2005:16) with avoidance of imposing the researcher's own ideas (Ashworth and Lucas, 2000).

Conclusion

Clarification of philosophical underpinning is useful to research design in order for informed choices to be made regarding the methodology and the methods to be used. A conceptual framework that clarifies positionality, relationality, ontology and epistemology can lead to methodological decisions that are most appropriate to seeking answers to the research question(s). Through articulating and justifying the conceptual framework and the resulting methodology and methods, the rigour of the research can be supported, including the ethical dimensions, reliability and validity and the credibility of the research outcomes strengthened. A purpose of research is to further knowledge and the robustness of that contribution to the field of research is dependent on the strength of the rationale provided for the methodology and methods.

Concluding reflection

As research progresses the researcher may find that the process outlined above is not a linear one and certainly not straightforward. Flexibility and an open mind is needed as understanding of theory and practice develops in the researcher's mind and the research takes shape, is refined and perhaps changes direction. However, when writing the dissertation, a coherent and comprehensive account of the methodology and methods as

linked to the philosophical underpinning as explained in the conceptual framework is essential.

The research example given in this paper is qualitative, as befitting the nature of that particular study. The argument provided here concerning the choices made relating to methodology, however, is not confined to a qualitative approach but rather encompasses quantitative and mixed method approaches, since the justification of any methodological choice is necessary for the rigour of the research design to be defended.

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