

Mind mapping research methods

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Abstract The mind maps represent the authors' concept of research methods at this time. The major aspects, rather than a complete picture, of research methods are illustrated in seven distinct areas: research problem, research design, sampling techniques, ethical matters, data collection, data analysis, and report findings. Brief descriptions explain the mind maps and why items were placed in certain areas where as traditionally they may have been placed elsewhere. The mind maps show that although decisions made in one area of research methods may affect decisions made in another, there is no pre-determined connection between each area and the research design chosen. The mind maps can be used to as a guide to teach, supervise, and chart a way though the concepts of research methods and may help to produce more robust research.

Keywords Research methods · Research design · Research ethics · Data collection · Data analysis · Publishing

1 Introduction

As part of a study into research methods, for teaching and research purposes, it was difficult to conceptualise the whole topic so that it could be fully explored for the research and explained to research students. Although research methods information is readily available in text books, journals, and websites there was nothing available that brought the information

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into a coherent, easy to manage whole. As a result, it was decided to use mind maps to visualise the complexities and extent of research methods.

Mind maps were chosen because they can represent ideas that are linked around a central theme. There are also very few rules to creating mind maps and it has been said that the main rule is simply to bring your brain and imagination (Buzan and Abbott 2005). It is this lack of rules that makes creating mind maps an easy and natural method of organising and visualising complex data, such as research methods, and the interactions among the data. Furthermore, mind maps can also help people learn concepts better than traditional linear formats and note taking (Farrand et al. 2002; Williams et al. 1997)

The mind maps of research methods presented here were developed over 2 years and have been through at least nine major and numerous minor revisions. The mind maps represent the authors' understanding of research methods at this time and, even after 2 years, the mind maps are updated when new information is found or a deeper understanding of research methods is realised. However, changes do not happen as often now as when the mind maps were first being developed. Therefore, the mind maps in their current form should represent a reasonable and stable analysis of current research methods.

It should be noted, however, that not every single aspect of research methods was included in the mind maps as this would make the mind maps very large and unwieldy, and reduce their effectiveness as a research and teaching tool. The aim was, and still is, to show the major parts of research methods so that the mind maps could act as a visual guide to the topic rather than a comprehensive reference. This is a similar concept to the map of a city where major places of interest are included but not every detail as this would make the map too difficult to read or use.

Mind maps are also intended to be self-contained accounts of the idea they represent and they are built in a free-form manner rather than as a stepwise process (Buzan and Abbott 2005). However, for these particular mind maps to be useful to others, the decisions made in creating the mind maps need to be described briefly. The descriptions, however, do not give a full account of everything contained within each branch of the mind maps as this information can be found in good text books. Instead, the descriptions state why specific items have been placed in their current location, whereas traditionally they may be placed elsewhere, and to draw attention to some particular items.

Throughout this paper, the phrase *research methods* is used in the plural and indicates the overall process of initiating, implementing, analysing, and reporting research. The phrase *research design* refers to the overarching approach or approaches used to answer the research question such as true experimental or phenomenological designs. *Research methodology* refers to the philosophical and theoretical (or, if you prefer, the ontological and epistemological) basis for research designs and is not explored within this paper as it has been discussed previously (Crotty 1998; Crowe and Sheppard 2010).

2 Description

Although the mind maps can be shown as one large mind map, it is not possible to do this in limited space and instead the full mind map can be downloaded as an A3 PDF, Online Resource 1. Included here is a simple summary of the full mind map, as shown in Fig. 1. Each branch in Fig. 1 represents a distinct aspect of research methods and in turn the branches are shown as seven individual mind maps (Figs. 2,3,4,5,6,7 and 8). Although the branches are independent from each other, decisions made in one branch may influence or dictate decisions made in other branches. Furthermore, it is recognised that research is not a linear process

Fig. 1 Research methods

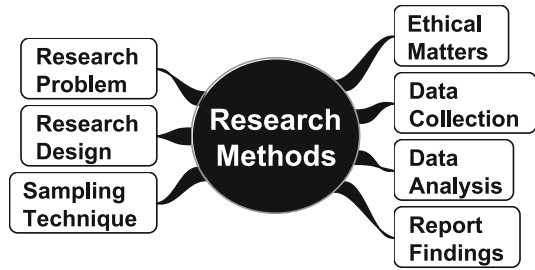
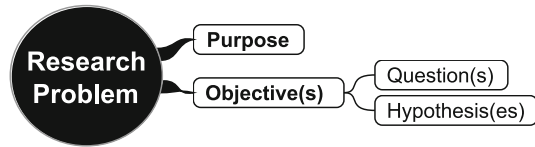


Fig. 2 Research problem



and that decisions are not necessarily made in the sequence outlined below. The sequence was chosen based on narrative rather than research considerations.

2.1 Research problem

The research problem (Fig. 2) is one of the most straight forward mind maps. Each piece of research normally begins with the definition of the research problem. The research problem itself usually has two aspects: Purpose (i.e. why is the research question important?); and, one or more objectives (i.e. how will I know if I have satisfactorily addressed the research problem?) (Miller and Salkind 2002; Onwuegbuzie and Leech 2005).

2.2 Research design

There is no agreement within or between disciplines on what different research designs are called. Therefore, alternative names for research designs are given in parenthesis and italics under the research design name most often used by the authors (Fig. 3). Experimental research designs are divided into the traditional true experimental and quasi-experimental designs (Campbell and Stanley 1966). However, a single system design group was created for research designs where the intervention group acts as its own control. This contrasts with true experimental and quasi-experimental designs which have separate intervention and control groups. In other texts, single system designs can be scattered among the quasi-experimental group, listed as a pre-experimental group, or some other combinations (Campbell and Stanley 1966; Polgar and Thomas 2007). Since this can be confusing for researchers and especially students, it appeared reasonable that a single system group should be created that contained all single system designs, whether they are quasi-experiment, pre-experimental, or some other term.

Descriptive, exploratory, and observational (DEO) designs are quantitative research designs where there is no experimentation, intervention, or treatment (Portney and Watkins 2008). This group of research designs has an awkward name because depending on the discipline (e.g. health, sociology, business) this group of research designs are called descriptive, exploratory, observational, or some combination of these terms. However, shortening the title to DEO designs helps reduce the bulkiness of the name.

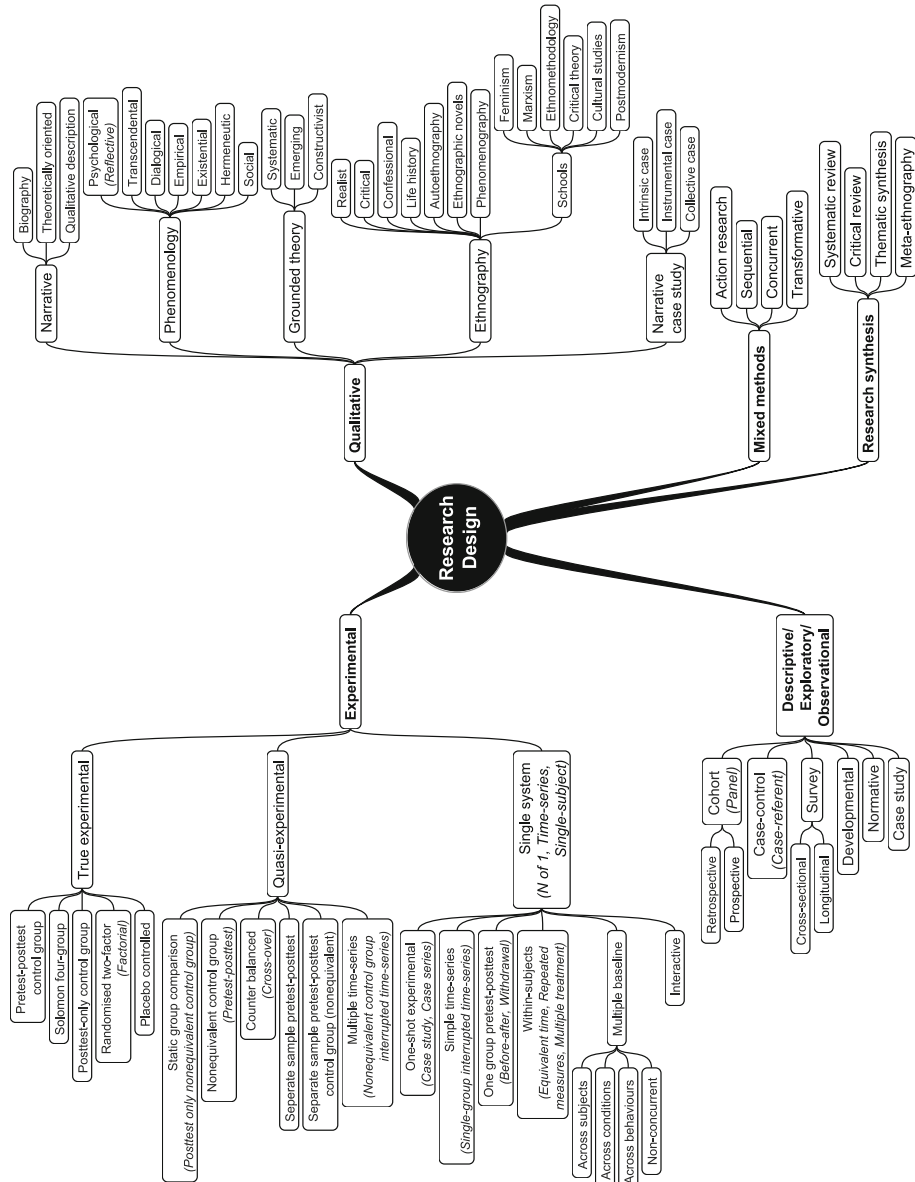


Fig. 3 Research design

For simplicity, five groups are used for qualitative designs though other authors have argued that there are as many as sixteen different qualitative designs (Patton 2002; Creswell 2008). Also, instead of putting the schools (also known as the orientations or ideologies) of qualitative research directly under qualitative design, they have been placed as a subset ethnographic research. This decision was made because for example a Marxist, feminist, or critical theory school or orientation can be seen as a social construct and, therefore, has a cultural or ethnographic context rather than being an inherent characteristic of societies.

Mixed methods designs refer to using multiple qualitative, quantitative, or a mix of both approaches within the same research study (Creswell 2008; Onwuegbuzie and Leech 2005). Mixed methods are in a separate group so that their value is not overlooked. It should be noted that action research has been placed in mixed methods rather than in qualitative research. While it is true that action research can be purely qualitative, other authors have argued that a more comprehensive form of action research can be achieved by collecting qualitative and quantitative data (Onwuegbuzie and Leech 2005).

The final group in research designs is research synthesis. Research synthesis has not traditionally been viewed as a research design in that the data collected have not been gathered directly from participants. However, research synthesis has become an important technique for gathering secondary sources of research and pooling the data to gain a better understanding of a topic (Cooper et al. 2009). As a result, a research synthesis when completed in a systematic and thorough manner can be a valuable and additive contribution to knowledge and could therefore be considered a research design. Looking at the types of research synthesis, the main difference between a systematic review and a critical review is that a systematic review requires at least two reviewers where as a critical review does not, otherwise they follow the same process (Cooper et al. 2009). The two most widely reported qualitative research synthesis methods are thematic synthesis and meta-ethnography, though other techniques have been developed (Barnett-Page and Thomas 2009; Dixon-Woods et al. 2007). It is important to note that meta-analysis which is often incorrectly used as a synonym for systematic review, is not listed here because it is a statistical technique which may be used in the data analysis part of a research synthesis.

2.3 Sampling technique

Sampling technique (Fig. 4) can be treated as being part of research design or sometimes data collection. However, good sampling technique is vital for good quality research and sampling deserves to be seen as a unique and separate part of research methods (Portney and Watkins 2008).

Sampling technique is divided into three groups: the method is the decision on which technique to use; the size refers to calculating the sample size; and, the process refers to any procedures used in selecting or grouping individuals from the population of interest. It should be noted that this is the first of two situations in the mind maps where a decision is required from each of the branches rather than following a single branch to its conclusion. In other words, defining a sample requires information from the method, size and process branches.

To point out the obvious to many but which confuses those who are new to research, when a research design is quantitative then the sampling technique does not need to be probability in nature (Zar 1999). Likewise, when using qualitative research designs the sampling technique does not have to be nonprobability. Most randomised controlled trials in health research use a nonprobability convenience or purposive sampling method even though the research would arguably be better if a random sample were used. In most cases, however, random samples in health research are unethical, unfeasible, or uneconomical (Portney and Watkins 2008). Further, there is nothing within the theory or philosophy of qualitative research that says all qualitative research must use nonprobability samples (DePaulo 2000; Onwuegbuzie and Leech 2007). If, for example, a qualitative study wanted to examine a specific issue across the population, there is nothing to stop the researchers from using a probabilistic stratified sampling method along with a nonprobability sample size method.

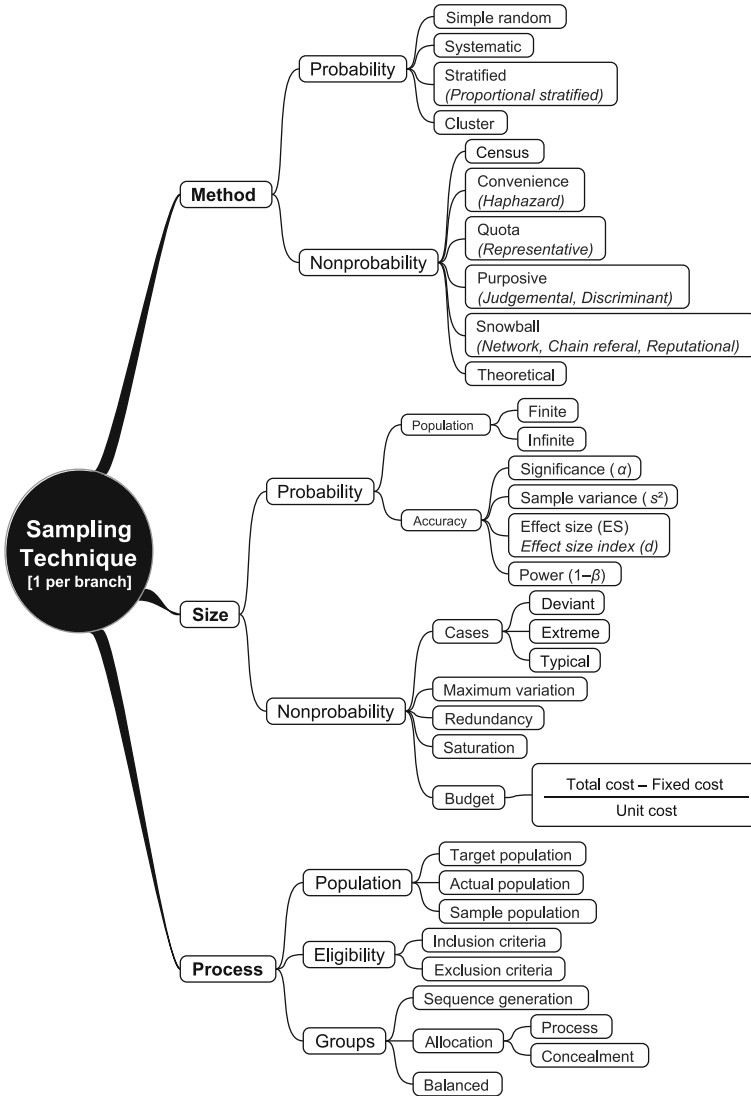


Fig. 4 Sampling technique

It may also be noticed that researcher, participant, and other forms of blinding are not included in sampling. This is because these are considered elements of data collection and in particular ensuring the quality of the data collected. On the other hand, group allocation is seen as part of sampling as this decision affects sample size considerations (Portney and Watkins 2008).

For a research synthesis design, sampling also needs to be considered. Although a sample size is not required, how search strategies were determined (method), how the population of papers was defined (process), and the eligibility of papers (process) are all important sampling considerations for research synthesis (Centre for Reviews and Dissemination 2009).

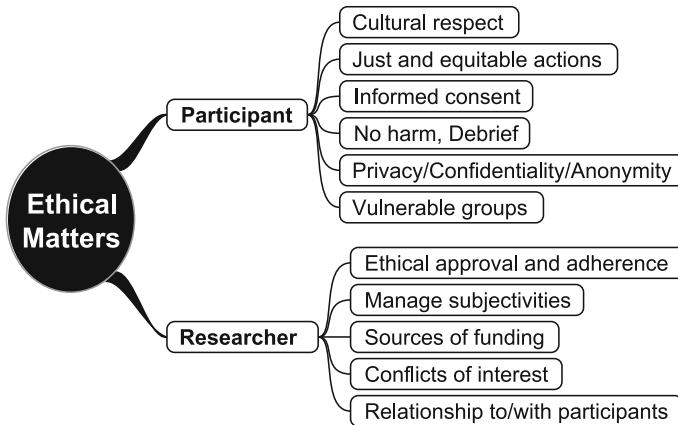


Fig. 5 Ethical matters

2.4 Ethical matters

Ethics is not just receiving ethical approval from an ethics board or committee. Ethical matters (Fig. 5) should be incorporated throughout the research study right from determining the research problem. Ethical matters encompasses ethical behaviour towards participants (whether they are an eco-system, animal, or human), ethical behaviour by the researcher, and are applicable for every research design (National Health and Medical Research Council 2007).

In the example of a systematic review, a recent study has shown that researchers may state that there are no ethical requirements (Crowe, Sheppard under review). However, when challenged about this the researchers realised that they had confused formal ethical approval for a study (which a systematic review does not normally need) and the wider concept of ethical behaviour by researchers (such as conflict of interest and funding disclosures). As a result, the researchers changed their minds and stated that ethical matters were a requirement for systematic reviews.

2.5 Data collection

Data collection is an area of research methods that receives very little attention. This is bizarre given that data collection is often the most time consuming part of any research project and the quality of data collected is the basis on which conclusions are drawn, i.e. poor data at best means poor research and at worst the implementation of harmful actions. In Fig. 6, data collection is divided into two groups.

The method group is concerned with what schemes are used to gather data (Polgar and Thomas 2007). The most common methods are: Audit/review, observation, interview (which includes questionnaires), testing, or any combination of these. As with the sampling technique mind map, the method part of the data collection mind map requires the selection of one element from type, structure, and process for each data collection method used.

The procedure group focuses on the actual gathering of data (Creswell 2008). Under organisation, the researcher arranges and notes when, where, by whom, and what are required to collect data. Under participant/cases, the researcher decides on how to deal with problems

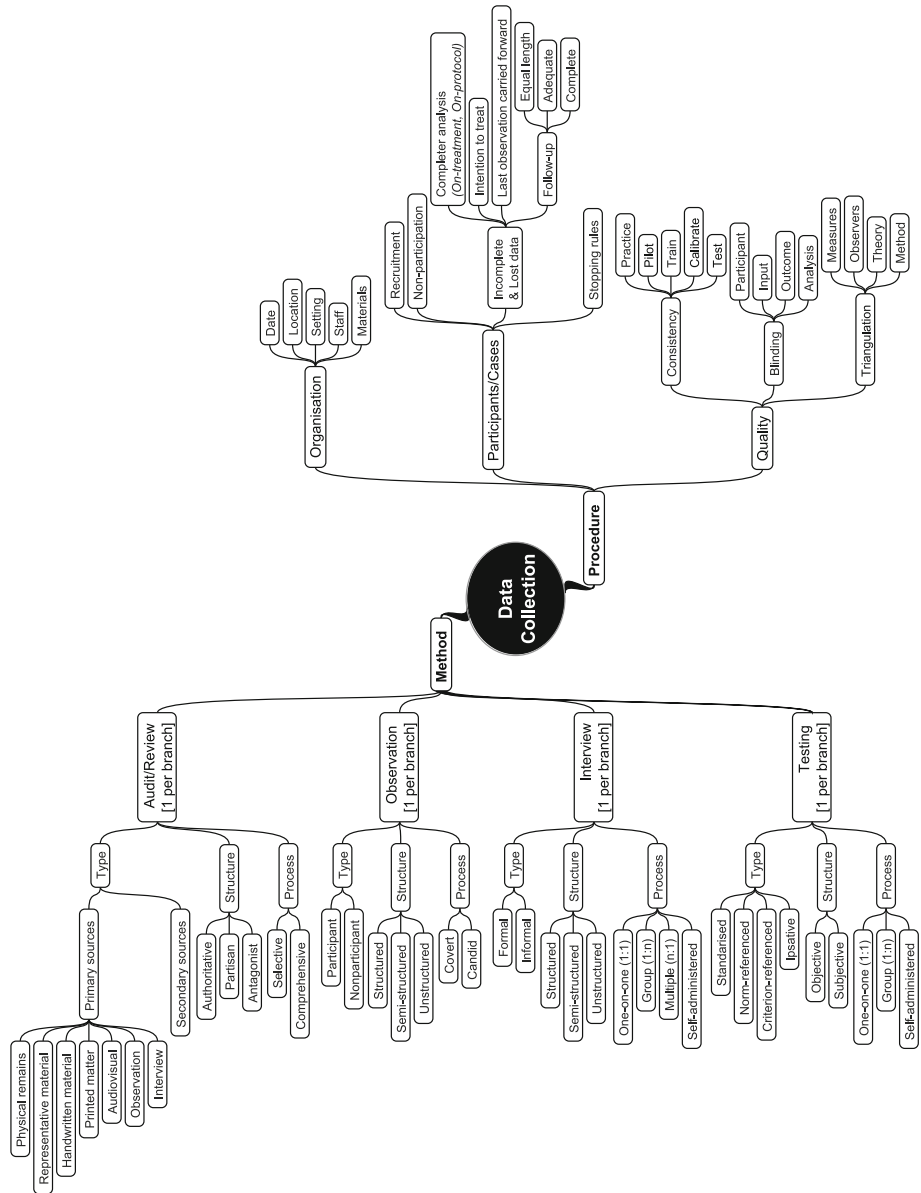


Fig. 6 Data collection

gathering data from participants or cases, such as non-participation, incomplete data, or when to stop an intervention if the results are harmful or so good that all participants should be included. Finally, under quality the researcher ensures that the data collected have consistency which includes practicing data collection, using pilot tests, training research assistants, and calibrating instruments. Here blinding is seen as being more appropriately a data quality issue where participants, researchers, and data analysts are kept unaware of certain aspects of the research project.

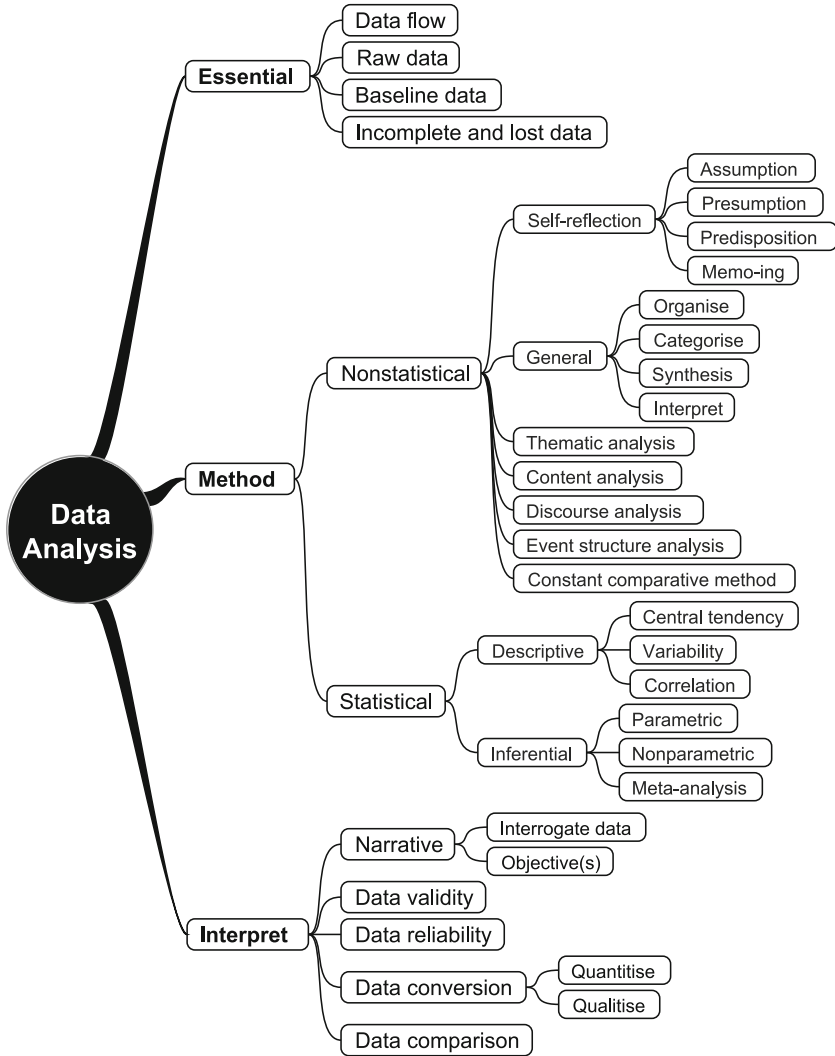


Fig. 7 Data analysis

Lastly, there is triangulation which is sometimes put together with data analysis techniques. However, triangulation starts by gathering data using multiple measures, observers, methods, or theoretical approaches (Polgar and Thomas 2007). After the data are collected, they are then analysed using normal data analysis methods.

2.6 Data analysis

Within data analysis (Fig. 7) there are three groups: essential, method, and interpret. The method group concerns which method or methods of analysis are being used. Since there are numerous materials available on both statistical and non-statistical methods of data analysis the mind map does not go into great detail here. It should be noted, however, that meta-analysis is placed in the methods group under inferential statistics. The other two groups

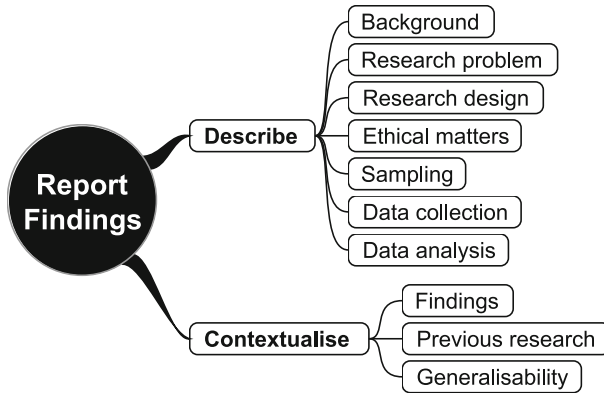


Fig. 8 Report findings

may be less familiar and are often overlooked (Cooper et al. 2009; Portney and Watkins 2008; Zar 1999).

The essential group relates to undertaking a basic analysis of the data rather than, for example, jumping straight into inferential statistics. By examining data flows, raw data, and baseline data, patterns within the data may become apparent. It is also at this stage that incomplete and lost data should be analysed. This analysis is used to determine whether there are any reasons why data may be incomplete or lost and how this may be analysed with respect to other data (Zar 1999; Onwuegbuzie and Leech 2005).

The interpret group shows that all results are interpreted no matter which data analysis methods are used. Interpretation can be as simple as constructing a narrative of what the results mean based on the objectives of the research. More formal ways to interpret the data include examining data validity and reliability, converting data between qualitative and quantitative forms, and comparing data from different data collection methods such as when using triangulation (Creswell 2008; Onwuegbuzie and Leech 2005).

2.7 Report findings

Unless research is reported, there is little point in undertaking a study to being with. Reporting findings (Fig. 8) has two dimensions: the first is describing what the researcher did; and, the second is contextualising the results based on the findings for the current research, findings from previous research, and whether the results can be further generalised (Onwuegbuzie and Leech 2005).

3 Conclusion

The most important aspect of the research methods mind maps is that none of the seven main branches are directly connected to each other. Although decisions made in one branch may affect decisions made in another, there is no pre-determined connection between them. For example, defining the research problem does not automatically identify the research design to be used. Likewise, whether the underlying research design is qualitative or quantitative in nature, all the techniques shown in defining a research problem, creating a sample, exploring ethical matters, collecting data, analysing data, and reporting findings can be used.

Remember also that not every aspect of research methods is illustrated in these mind maps. Some may disagree with where certain items are placed or how they are described, but this is the nature of mind maps. As has been previously pointed out, these mind maps can be considered a work in progress and they may change and develop as greater understanding of research methods is achieved.

The mind maps, then, can be seen as a good starting point for displaying the breadth and major components of research methods. This visual and non-traditional method of presentation can be used to learn, understand, and teach research methods. For the researcher, the mind maps show the variety of research methods available. For the research supervisor, the mind maps can be used to guide students through the research process. For the research methods teacher, the mind maps can be used to explain research methods from start to finish. By using these mind maps as a guide through the research process they could assist researchers to produce more robust, higher quality research.

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