Exploring versus measuring: considering the fundamental differences between qualitative and quantitative research

Jennifer Cleland

I overheard some of the trainees/residents talking about the things that are important to them in terms of career decision making. It struck me that things are a bit different from ‘my day’; for example, they seem much more concerned with work-life balance. After looking at the literature, a colleague and I decided that there were various gaps in terms of what is known about the factors that influence medical student and trainee careers decision making in our country, particularly since the training pathway changed about 10 years ago. We wanted to explore this further, so first carried out some telephone interviews to gather the views of students and trainees. The participants suggested a number of factors, which we had not thought of, as particularly important in careers decision making. We then wanted to find out which factors were most important to the majority of trainees and if there were differences across students and trainees at different stages of training. To achieve this, we used the data from our literature review and the interviews to design a questionnaire, which we sent out to all students and trainees nationally.

Introduction

This true scenario, one which has underpinned, to date, a 5-year programme of work, highlights some of the differences between quantitative and qualitative research, but also how they can be used in a complementary manner in the same programme of research. It is easy to assume that the differences between quantitative and qualitative research are solely about how data is collected – the randomised controlled trial (RCT) versus ethnographic fieldwork, the cohort study versus the semi-structured interview. These are, however, research methods (tools) rather than approaches (methodologies). There are very important consequences of choosing (implicitly or explicitly) a particular methodological stance or position to guide and inform your research practice or an individual study. Quantitative and qualitative approaches make different assumptions about the world, about how science should be conducted and about what constitutes legitimate problems, solutions and criteria of ‘proof’. They also use completely different languages (see Fig. 1.1).

‘When we speak of ‘quantitative’ or ‘qualitative’ methodologies we are in the final analysis speaking about an interrelated set of assumptions about the social world which are philosophical, ideological and epistemological. They encompass more than just data collection methodologies’ (Rist, 1977, p. 62)

In this chapter, drawing on Bryman, I will talk about these assumptions and their implications for research practice. I will then compare and contrast the two approaches in terms of research design, methods are tools, analysis and interpretation. I will draw on examples from healthcare education research to illustrate these points. I will also discuss combined (‘mixed-methods’) approaches. The content of this chapter is more heavily ‘weighted’ towards quantitative research but cross-referenced with corresponding key information about qualitative research, which is presented in other chapters in this volume.

Philosophical differences

Research philosophies differ on the goals of the research and the way to achieve these goals. For example, is the purpose to test theories and discover general principles, or is it to describe and explain complex situations? Quantitative and qualitative research comes from different underlying assumptions of what is reality (ontology) and what is knowledge (epistemology) (see also chapters by McMillan, and Mann and Macleod in this book).
Chapter 1

In post-positivism, a variety of epistemologies underpin theory and practice in quantitative research. One of the most common post-positivism stances is that of critical realism or criticality. A critical realist believes that there is a reality independent of our thinking about it that science can study, and questions (hence the ‘critical’ label) the infallibility of observation and theory. Moreover, they also believe that while everyone is influenced by their cultural experiences, world views, and so on, researchers can put aside their biases and beliefs to strive for objectivity. The differences between positivism and critical realism are discussed further in the chapter by MacMillan later in this book. For the purposes of the current chapter, however, it is sufficient to know that those working from a (post-) positivist position believe that the scientific method (i.e. the approaches and procedures of the natural sciences such as chemistry, biology and physics) is appropriate for the study of social phenomena (e.g. learning).

**Qualitative research philosophies**

The premise of qualitative research is subjectivity. Qualitative research is concerned with how the social world is interpreted, understood, experienced or produced. Reality cannot be measured directly. It exists as perceived by people and by the observer. Reality is relative and multiple, perceived through socially constructed and subjective interpretations. There are many structured approaches to apprehending such realities and the methods and procedures of the natural sciences are not (generally) suitable for doing so (see later). The qualitative tradition is also underpinned by a number of different theories. These give researchers different ‘conceptual lenses’ through which to look at complicated problems and social issues, focusing their attention on different aspects of the data and providing a framework within which to conduct their analysis. Many of these are described elsewhere in this book (for example, see chapters by Mann and McLeod, Monrouxe and Rees, Varpio and colleagues) and see also Reeves et al. for a very useful overview.

**So what do these differences mean in practice?**

Broadly speaking, quantitative research involves hypothesis testing and confirmation whereas qualitative research is concerned with hypothesis generation and understanding (see Table 1.1). Expanding on this, quantitative research tends to be deductive, seeking to validate an idea or theory by conducting an experiment and analysing the results...
numerically (see Table 1.1). Theory is often seen as something from which to derive a hypothesis, a tentative explanation that accounts for a set of facts and can be tested by further investigation. For example, one hypothesis we might want to test (the null hypothesis) is that there is a relationship between students’ self-confidence in examination skills and the amount of time they spend on the wards. Hypotheses are often in the form of an if/then statement; for example, if we teach handwashing, then infection rates will reduce. A hypothesis is always provisional as data may emerge that cause us to reject it later on (i.e. the outcome might be to reject the null hypothesis if the data indicates no significant relationship between self-confidence and time on the wards).

In this way, in quantitative research, the theories determine the problems (the research moves deductively, from theory to the data), which generate the hypotheses, usually about causal connections. On the other hand, the use of theory in qualitative research tends to be inductive; that is, building explanations from the ground up, based on what is discovered (although more deductive qualitative studies are possible). Inductive reasoning begins with specific observations and measures, for detecting patterns and regularities, formulating tentative hypotheses to explore, and, finally, ends by developing some general conclusions or theories.

Finally, it is useful to make one final point about how qualitative and quantitative research ‘use’ theory. Theory is often ‘assumed’ in qualitative research, while its use is much more explicit in the qualitative tradition. Because of this, you are unlikely to see statements of theoretical stance in quantitative studies whereas these are an expected feature of healthcare education qualitative studies.

**Comparing research design in quantitative and qualitative research**

If quantitative research is concerned with establishing causal connections while qualitative research is concerned with describing phenomena in their natural setting, then different study designs are needed.

**Quantitative research design**

There are four broad approaches to study design within quantitative research: descriptive, correlational, quasi-experimental and experimental. These are described briefly in Table 1.2 and illustrated with hypothetical examples in the table. Published examples of each design are discussed in the text.

<table>
<thead>
<tr>
<th>Table 1.1 The hypothesis</th>
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<tr>
<td>To use the word hypothesis in qualitative research is incongruent (see Fig. 1.1). However, all studies have a research question. How do we define a research question? Statements of the research question are necessary to use the word hypothesis in qualitative research. Although statements of the research question are necessary to use the word hypothesis in qualitative research, they do not answer how/when/why questions, just the ‘what’ question (What are the characteristics of the population or situation being studied?). The hypothesis can be tested by further investigation. For example, here is a reasonably typical example of a hypothesis from a quantitative study in medical education research: ‘This study aimed to identify whether poor performance in degree assessments early in the medical degree course predicts poor performance in later MBChB assessments’ (10, p. 677). In this study, we wanted to know if x (early poor performance) predicted y (later poor performance). Compare that statement with this one from a qualitative study published in the same year: ‘Our study aimed to answer the research question: why do assessors fail to report underperformance in medical students?’ (17, p. 802). This is a much more open and exploratory approach, as it asks a question, which is concerned with exploring the views and beliefs underlying assessor behaviour. See the chapter by Bezuudenhout and Schalkwyk in this book for a more in-depth discussion of the research question.</td>
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Descriptive research is used to describe characteristics of a population or phenomenon – for example, how many students failed a certain assessment, how positively trainees rate the teaching in a particular department, what factors are important in medical student career decision making. Descriptive studies do not answer how/when/why questions, just the ‘what’ question (What are the characteristics of the population or situation being studied?).

Correlational research is used to identify trends and patterns in data. For example, Husbands et al. examined the predictive validity of the UKCAT, an aptitude test used for selection into medical school in the UK, and compared this with traditional selection methods (e.g. performance in an individual interview), in terms of performance in the senior years of medical school. They examined the relationships between admissions variables, examination scores, gender and age group using statistical tests, and found that the UKCAT predicted performance in the later years of medical school better than other selection methods.

Quasi-experimental research is used frequently in healthcare education research as random assignment to study conditions is often difficult due to practical and ethical constraints (e.g. it would be unethical to withhold teaching from a control group of students). However, this leaves quasi-experimental designs open to biases and confounders, (or ‘threats to validity’) of the conclusion about the relationship between the intervention and outcome studied. For example, in the early days of problem-based learning (PBL), Distlehorst
and Robb\textsuperscript{21} compared the academic performance (United States Medical Licensing Examination, clinical clerkship, and clinical practice examination) of students in a PBL curriculum with that of their counterparts in a standard curriculum, in the same medical school. They found that students in the PBL curriculum performed at least as well as, their counterparts and concluded that PBL students were not disadvantaged. This was on the face of it reassuring but the conclusion does not acknowledge the potential for this outcome to be due to confounders, such as the fact that a different type of learner may be attracted to PBL. If using a quasi-experimental design, it is thus critical to carefully consider threats to validity of the particular study and demonstrate that they can be ruled out. For example, if you think surgical experience will influence how students perform on a particular task make sure all participants do the task before their surgical rotation, if you are using a quasi-experimental design.

Finally, experimental research tests whether the independent variable(s) (controlled by the researcher) affects a dependent variable (the variable being measured for change) (see Table 1.3). An attempt may be made to control extraneous variables to ensure that the cause of change is, indeed, the independent variable – such as PBL in the aforementioned example. The RCT is an example of experimental research. A good illustration of an RCT in healthcare education research is provided by Watson et al.\textsuperscript{22} who used an RCT design to investigate whether education in simulated learning environments (SLEs) could substitute for part of traditional clinical education for physiotherapy students. They designed two SLE models, and

### Table 1.3 Independent and dependent variables in quantitative research

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Description</th>
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<tr>
<td>An independent variable is exactly what it sounds like. It is not changed by the other variables you are trying to measure. Examples would include age or gender – other factors (such as diet, amount of time spent studying or exercising, ward attendance) are not going to change a person’s age or gender. The point is to see if the independent variable causes some kind of change in the other, or dependent, variables. Dependent variables would include exam outcome, performance on a task, things that can be changed by other factors, such as how much you studied or practised. Thus, an independent variable causes a change in a dependent variable.</td>
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randomly assigned students (stratified by academic score) to either receiving SLE (intervention arm of the study) or ‘traditional’ (control arm of the study) teaching. The primary outcome measure (see later) was a blinded, structured assessment of student competency conducted over two clinical examinations. They found that students’ achievement of clinical competencies was no worse in the SLE groups than in the traditional groups. Because of the design of the study (e.g. randomising students to SLE or traditional teaching, assessor not knowing what teaching the student had received), the authors could confidently say that they had provided evidence that clinical education in an SLE can in part replace clinical time with real patients without compromising students’ attainment of the professional competencies required to practise. The chapter on Cognitive Load by Leppink and colleagues in this book is a good example of a topic area where most of the evidence is based on RCTs.

### Table 1.2 Types of quantitative design

<table>
<thead>
<tr>
<th>Type of Design</th>
<th>Description</th>
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<tbody>
<tr>
<td>Descriptive research</td>
<td>seeks to describe the current status of the variable under study (‘what is’). Designed to provide systematic information about a phenomenon. Example: a description of the alcohol use of medical and nursing students.</td>
</tr>
<tr>
<td>Correlational research</td>
<td>explores relationships (associations) between study variables using statistical data. This type of research will recognise trends and patterns in data, but it does not go so far in its analysis as to prove causes for these observed patterns. Example: the relationship between early and later performance on degree assessments (see previous sections).</td>
</tr>
<tr>
<td>Quasi-experimental research</td>
<td>attempts to establish cause–effect relationships among the variables. Groups are naturally formed or pre-existing rather than randomised. Example: the effect of attending extra clinical skills sessions on exam performance</td>
</tr>
<tr>
<td>Experimental research</td>
<td>looks to establish the cause–effect relationship among a group of variables that make up a study. An independent variable is manipulated to determine the effects on the dependent variables. Subjects are randomly assigned to experimental treatments. Example: the effect of different types of curricula design on students’ preparedness for practice</td>
</tr>
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Example

Designed to provide a description of the alcohol use of medical and nursing students.

The primary outcome measure of the study was examination performance (United States Medical Licensing Examination, clinical clerkship, and clinical practice examination). They found that students in the PBL curriculum performed at least as well as, their counterparts in a standard curriculum, in the same medical school. They found that students in the PBL curriculum performed at least as well as, their counterparts and concluded that PBL students were not disadvantaged. This was on the face of it reassuring but the conclusion does not acknowledge the potential for this outcome to be due to confounders, such as the fact that a different type of learner may be attracted to PBL. If using a quasi-experimental design, it is thus critical to carefully consider threats to validity of the particular study and demonstrate that they can be ruled out. For example, if you think surgical experience will influence how students perform on a particular task make sure all participants do the task before their surgical rotation, if you are using a quasi-experimental design.

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RCTs are a major undertaking but luckily, there is
guidance on how to plan and report them. Sibbald and Roland provide a useful summary of
the important features of a 'gold standard' RCT, including randomisation and the 'double-blind'
approach. CONSORT (Consolidated Standards of Reporting Trials) provides a set of recommenda-
tions, checklist and flow chart for reporting randomised trials, known as the Consort State-
ment (http://www.consort-statement.org/; see also). Most journals and funding bodies require a
CONSORT statement and flow diagram to be submitted alongside a paper reporting a randomised
trial.

There is, arguably, less explicit guidance available for planning other quantitative designs –
descriptive, correlational or quasi-experimental – but one useful source of guidance is critical
appraisal tools. These provide guidance on the essential components of what should be included
or considered in a study (for example, see the Critical Appraisal Skills Programme, or CASP
(http://www.casp-uk.net/).

A critical feature of quantitative research design lies in pre-planning and prescriptiveness. All aspects
of the study are carefully designed before data is collected. Each detail is worked out in advance – the
study design, participants, data collection tools, data collection procedures (e.g. timing of follow-up)
and the analysis plan. The aim of documenting quantitative research processes in detail, in advance,
is to ensure that each step is performed in the same way each time. This also means that the study can
be replicated or repeated using the same protocol at another time or by a different researcher, and the
same findings will be the same. This document or 'protocol' is planned in great detail, and quantitative
research protocols are publishable entities in their own right.

**Qualitative research designs**

Compare the above with the description of research design in Becker et al.'s classic qualitative study of
medical students:

> In one sense, our study had no design. That is, we had no well-worked-out set of hypotheses to be tested,
> no data-gathering instruments purposely designed to secure information relevant to these hypotheses, no set
> of analytic procedures specified in advance. Insofar as the term 'design' implies these features of elaborate prior
> planning, our study had none. If we take the idea of design in a larger and looser sense, using it to identify those

elements of order, system, and consistency our procedures did exhibit, our study had a design. We can say what this
was by describing our original view of the problem, our theoretical and methodological commitments, and the way
these affected our research and were affected by it as we proceeded. (p. 17)

In qualitative research, the design is predomin-
antly determined by the research question and, as
such, questioning and inquiring unfolds the process
of understanding. To do this requires scoping the
project and considering what data is required in
advance, with research design as 'a reflexive process
operating through every stage of a project'. Reflexive
refers to being thoughtful, constantly examining
what is affecting research decisions such as the
wording of questions or how one interprets data.
(A fuller explanation of reflexivity in the research
process is provided by Mann and MacLeod in
Chapter 6.) In the qualitative approach, the activ-
ities of collecting and analysing data, developing
and modifying theory, elaborating or refocusing
the research questions, are usually going on more
or less simultaneously, each influencing all of the
others (see Maxwell for a useful model of qualita-
tive research design (p. 216)). The researcher may
need to reconsider or modify any design decision
during the study in response to new developments.
This way, qualitative research design is less linear
than quantitative research, which is much more
step-wise and fixed.

These differences are a matter of degree, how-
ever. Most qualitative projects would have some
pre-structuring at least in terms of the equivalent of
a research protocol, setting out what you are doing
(aims and objectives), why (why is this important)
and how (theoretical underpinning, design, meth-
ods, analysis). Generally, however, a qualitative
research plan would be less fixed than its quanti-
tative equivalent, but it is still a critical component
of the research process. There are several excellent
textbooks that go into this in more detail and you can read examples of different qualitative
designs throughout this book.

**Data collection methods**

There is no one best way of quantitative or qual-
itative data collection: the method depends on
what you need to know. Only a broad overview
of different types of method is provided here.
For more detail, go to one of the major textbooks
recommended at the end of this section.
Quantitative data collection methods

Quantitative data collection methods involve objective measurements via structured data collection instruments that fit diverse experiences into predetermined response categories. The most common quantitative data collection tools are as follows:

- Surveys (e.g. questionnaires, structured interviews)
- Observations (e.g. number of students using the gym between 6 and 8 am)
- Measurements (e.g. ranking on graduation, number of doctors training in radiology)

Questionnaires or surveys (the terms are often used interchangeably) often look a relatively straightforward way to collect data. This is not the case. Designing a good questionnaire typically involves drawing on the literature, collecting some exploratory or consensus data, piloting a preliminary questionnaire for readability and acceptability, testing out the statistical qualities of the questionnaire, before actually using it in a study. Unless questionnaire design is the focus of your research, it is generally better to use a published questionnaire, ideally one which has been used previously with a similar population (group of participants) to the one you are studying.

Observations in quantitative research are structured in that the precise focus of the observations is decided in advance, and the method does not change as the study continues (compared to the more fluid research process in qualitative research). Collection of data by observations can be conducted on facts (e.g. the number of students in a classroom), events (e.g. the amount of collaborative work taking place between students in the classroom) or behaviours (e.g. the number of incidents of antisocial behaviour in a classroom), or skills (e.g. the number of attempts needed to put in a venflon correctly, checklist ratings of performance).

Data collection is planned to allow for easy recording – for example, ‘done’ or ‘not done’, ‘excellent’, ‘good’, ‘borderline’. Workplace-based assessment tools such as the Mini-CEX are good examples of structured observation tools.

Remembering that analysis in quantitative research is about number ‘crunching’ and statistics, it is worth emphasising that simple word data can be transformed into number data for analysis. For example, ‘Done’ or ‘not done’ can be transposed into 0 and 1 for analysis, ‘excellent’, ‘good’ and ‘borderline’ can become 0 and 1 for analysis, ‘excellent’, ‘good’ and ‘borderline’ can become 1, 2 and 3. This is particularly useful in surveys, where a popular technique is to ask respondents to choose between particular options or rate statements in different ways, such as ‘agree strongly’, ‘agree’, ‘disagree’ or ‘disagree strongly’, and give the answers a number (e.g. 1 for ‘disagree strongly’, 4 for ‘agree strongly’). Note that questionnaires often use a mixed-methods design, incorporating both statement ratings and free text questions such as ‘Please explain the reasons for your answer.’ Mixed-methods approaches are discussed in more detail later in this chapter.

In terms of data collection procedures, quantitative studies tend to involve relatively large numbers compared with qualitative studies. Qualitative study samples need to be of sufficient size to enable statistical analysis and to demonstrate associative or causative relationships between variables (more about analysis later). As one of the ultimate aims of quantitative research is generalisability, representative sampling is critical. A representative sample should be an unbiased indication of what the population is like. For example, in Scotland at the time of writing, the medical student population is 60:40 female:male. A representative sample of Scottish medical students would, therefore, have female and male subjects in these proportions. Unfortunately, it would be fair to say that much quantitative research in healthcare education continues to be single-site, where all data is collected from one institution or one sub-group (e.g. surgical trainees/residents from one hospital, or even those from one surgical sub-specialty), which limits generalisability. See Table 1.4 for a comparison of sampling approaches in quantitative and qualitative research.

### Table 1.4 Sample sizes

The sample size for a quantitative study is calculated using formulas to determine how large a sample size will be needed from a given population in order to achieve findings with an acceptable degree of accuracy. Generally, researchers seek sample sizes, which yield findings with at least a 95% confidence interval (which means that if you repeat the survey 100 times, 95 times out of a hundred, you would get the same response), plus/minus a margin error of 5 percentage points. Please see Chapter 5 by Stansfield and Gruppen for guidance on sample size and power calculations.

Sampling of research participants in qualitative research is described as purposive, meaning there is far less emphasis on generalising from sample to population and greater attention to a sample ‘purposely’ selected for its potential to yield insight from its illuminative and rich information sources (32, p. 40). See chapters by Mann and MacLeod, Rees and Monrouxe, Varpio and colleagues in this book for more extensive descriptions of sampling in qualitative research.
**Qualitative data collection methods**

The qualitative methods most commonly used for research purposes are mentioned very briefly in this chapter, as these are covered in more detail elsewhere in this book. They can be classified in three broad categories as follows:

- Interviews (individual or group)
- Observation methods
- Document review

The qualitative research interview seeks to describe and gain understanding of certain themes in the life world of the subjects. Interviews can be organised one-to-one or group (focus groups) depending on the topic under study and the cultural context, and the aims of the project. Observational data collection in qualitative research involves the detailed observation of people and events to learn about behaviours and interactions in natural settings. Such study designs are useful when the study goal is to understand cultural aspects of a setting or phenomenon, when the situation of interest is hidden, (tacit), or when subjects in the setting appear to have notably different views to other groups. Written materials or documents such as institutional records, personal diaries and historical public documents may also serve as a valuable source of secondary data, providing insight into the lives and experiences of the group under study. See Bowen for an excellent introduction to the purpose and practicalities of document review within qualitative research.

See Dicicco-Bloom and Crabtree for a useful summary of the content and process of the qualitative research interview, Creswell for further discussion of the many different approaches in qualitative research and their common characteristics, and later in this book for examples of different approaches to qualitative interviewing and observation.

**Data management**

Different research approaches generate different types of data. Quantitative research generates (quantifiable) numerical data, that is (if the sampling strategy is appropriate) generalisable to some larger population, for analysis. Aliaga and Gunderson sum up quantitative research neatly as ‘explaining phenomena by collecting numerical data that are analysed using mathematically based methods (in particular statistics)’ (p. 1). Qualitative research may use some form of quantification, but statistical forms of analysis are not seen as central (p. 4). Instead, qualitative data analysis (QDA) aims to uncover emerging themes, patterns, concepts, insights, and understandings. The data are allowed to ‘speak for themselves’ by the emergence of conceptual categories and descriptive themes. Trying to squeeze narratives into boxes (like ‘0’ and ‘1’) would result in the loss of contextualisation and narrative layering. The researcher must immerse themselves in the data in order to be able to see meaningful patterns and themes, making notes as they go through the processes of data collection and analysis, and then using these notes to guide the analysis strategy.

In both approaches, data has to be managed before it can be analysed. Statistical and qualitative data management and analysis software are pretty much essential at this stage unless you are working with a very small dataset. If you are working with numbers, or data, which can be sensibly coded into numerical form, you need a database that is designed to store and analyse numerical data. It is a good idea to enter your data directly into a statistical package to avoid problems transferring data from one package (e.g. a spreadsheet) to another for analysis. SPSS is one of the most commonly used statistical software packages. On the other hand, if your study design is qualitative and hence your data takes the form of ‘words’ and text, or images and visual material, you may want to use a specialist qualitative database to facilitate data management and analysis. NVivo is a well-known QDA software package (note that qualitative software packages enable you to make and store notes, and explanations of your codes, so you do not need to juggle bits of paper and electronic data files). These and similar databases are available commercially (i.e. at a cost) and are used widely by universities. The choice of database may be dictated by the resources of your institution, your personal preference and/or what technical support is available locally.

A word of caution – data management software does not describe or analyse your data for you. You have to enter and manage data in such a way to facilitate the processes of description and analysis. Thinking about the analysis early on in the project plan can save a lot of time later in the process. See Cleland et al. for comprehensive guidance on how to use quantitative and qualitative databases in education research.
Chapter 1

Data analysis

As mentioned earlier, different research methods generate different types of data and these different types of data require different analysis approaches.

Quantitative data analysis

Quantitative analysis is the process of presenting and interpreting numerical data. Statistical analysis is inherent to quantitative research. Quantitative data analysis usually involves descriptive statistics and inferential statistics. Descriptive statistics give a ‘picture’ of the data in terms of, for example, number of male and female respondents, age of respondents, frequency of particular responses, as and describe the pattern of the data in terms of averages (mean, median and mode) and measures of variability about the average (range and standard deviation). A useful overview of descriptive data and how to present descriptive data can be found in Cleland et al.\textsuperscript{40}

Inferential statistics are the outcomes of statistical tests, helping deductions to be made from the data collected, testing hypotheses and relating findings to the sample or population. In terms of selecting a statistical test, the most important question is ‘what is the main study hypothesis and/or research question?’ Are you looking for an association or relationship between x and y, or a difference between a and b? Different statistical tests are used for testing each type of question, and within each type of question, different statistical tests are used depending on the precise nature of your study design. The next question is ‘what types of data are being measured?’ Is your data in the form of frequencies or measured from a discrete scale (e.g. height)? Or is the data binary (e.g. pass/fail)? Is the data from two independent groups of subjects or from the same group before and after an intervention (such as training of some sort)? Is it from more than two groups? How many independent variables (see earlier) will be entered into the analysis, and how will you decide which ones to include?

Identifying the appropriate statistical test for quantitative analysis can be complicated but luckily most statistical analysis books provide handy decision trees to help with this. Some useful books for statistics in social science research are Foster et al.,\textsuperscript{41–43} Norman and Stryner,\textsuperscript{44} and Bryman and Cramer.\textsuperscript{45} A useful article is McCrum-Gardner’s ‘Which statistical test to use?’\textsuperscript{44} The major statistical software packages all have paper and online manuals, which can be invaluable.

Last, but not least, do seek advice and support from a statistician, statistics-friendly supervisor or able colleague when planning your project. This will save you hours of frustration when you reach the point of data analysis. Indeed, this point is equally made in relation to qualitative research. It is common for novices to qualitative research to have their papers rejected because the different components of their study – theory, design, methods and analysis – do not align appropriately. Seek early advice and support from, and collaboration with, colleagues whose expertise lies in qualitative theory, research design and methods, and analysis.

Qualitative data analysis

While bearing in mind that qualitative data collection and analysis are iterative rather than linear (see earlier), Miles and Huberman\textsuperscript{46} explain the process of QDA as follows:

- data reduction (extracting the essence);
- data display (organising for meaning);
- drawing conclusions (explaining the findings)

While arguably, quantitative research follows these steps also, if one interprets data reduction as occurring through statistical analysis, the process of QDA is a little different. It usually follows an inductive approach where the data are allowed to ‘speak for themselves’ by the emergence of conceptual categories and descriptive themes. The researcher must be open to multiple possibilities or ways to think about a problem, engaging in ‘mental excursions’ using multiple stimuli, ‘side-tracking’ or ‘zigzagging’, changing patterns of thinking, making linkages between the ‘seemingly unconnected’ and ‘playing at it’, all with the intention of ‘opening the world to us in some way’ (\textsuperscript{33}, p. 544). The researcher must immerse themselves in the data in order to be able to see meaningful patterns and themes, making notes as they go through the processes of data collection and analysis, and then using these notes to guide the analysis strategy and the development of a coding framework.

In this way, good qualitative research has a logical chain of reasoning, multiple sources of converging evidence to support an explanation, and rules out rival hypotheses with convincing arguments and solid data. The wider literature and theory are used to derive analytical frameworks as the process of analysis develops and different interpretations of the data are likely to be considered before the final argument is built. For example, one of our own studies\textsuperscript{15} aimed to explore how...
widening access policy is translated and implemented at the level of individual medical schools. Data was collected via individual interviews with key personnel. We initially conducted a primary level thematic analysis to determine themes. After the themes emerged, and following further team discussion, we explored the literature, identified and considered various theories, in some depth, before identifying the most appropriate framework for a secondary, theory-driven analysis.

There are some excellent text books that discuss QDA in detail.\textsuperscript{9,48,49}

**Judging the quality of research**

There are various criteria by which you can judge the quality of quantitative and qualitative research (see Table 1.5).

Validity refers to how well a measure captures what it is meant to measure. For example, how well does a questionnaire asking students to rate their satisfaction with a course assess satisfaction (rather than, for example, usefulness of the course, which is a different concept). Credibility, on the other hand, is about whether the study has been conducted well and the findings seem reasonable. External validity is the extent to which the results of a study can be generalised to other situations and to other people. For example, if peer-based learning in first year anatomy is found to be effective, will it also be effective in the clinical years or with students from another institution where the curriculum differs (this is where sampling is critical, see earlier)? Similarly, the transferability criterion asks if the findings of a study can be useful in other, similar contexts. Reliability refers to a measure’s precision and stability extent to which the same result would be obtained with repeated trials. Judgements of the dependability of research findings consider the extent to which the research process was carried out in a manner, which may be reviewed or audited by another. Finally, in quantitative research, objectivity refers to freedom from bias. According to Lodico,\textsuperscript{47} objectivity is possible when the researcher has little opportunity to interact with participants, as is the case when using quantitative methods to test hypothesis using statistical tests. The qualitative equivalent of confirmability refers to researchers providing sufficient detail of data collection and analysis that readers can see how their conclusions were reached. The criteria for judging qualitative research\textsuperscript{4} are discussed further in chapter six.

<table>
<thead>
<tr>
<th>Criteria for Judging</th>
<th>Quantitative Research</th>
<th>Qualitative Research</th>
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<tbody>
<tr>
<td>Internal validity</td>
<td>Credibility</td>
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<tr>
<td>External validity</td>
<td>Transferability</td>
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</tr>
<tr>
<td>Reliability</td>
<td>Dependability</td>
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<tr>
<td>Objectivity</td>
<td>Confirmability</td>
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</tbody>
</table>

**Mixed methods**

Despite some traditionalists’ reservations, it is now widely accepted that quantitative and qualitative approaches, designs and methods are compatible in the same programme of research. While most researchers have a preference for one camp over the other, depending on their own personal philosophy, many take a pragmatist approach to research, using different methods depending on the research question they are trying to answer\textsuperscript{46} and combine different methods in the same research programme. This may seem in direct opposition to the quote at the start of this chapter but pragmatism is a philosophy in itself.\textsuperscript{47–50}

Pragmatism content that the key question is not ‘is it true?’, or ‘is it right?’, but ‘does it work?’ John Dewey, for example, believed that when we first face a problem, our first task is to understand our problem through describing its elements and identifying their relations. Identifying a concrete question that we need to answer is a sign that we are already making progress. Much has been written on Dewey – a good starting point is Dewey: A Beginner’s Guide.\textsuperscript{51}

If we take a pragmatic approach to research methods, the main question is ‘what kind of question is best answered by what methods?’ The pragmatic philosophical stance is perfect for mixed-methods design, which incorporates both quantitative and qualitative methods. Mixed-methods research is a flexible approach, where the research design is determined by what we want to find out rather than by any predetermined epistemological position. Lingard \textit{et al.}\textsuperscript{52} set out some useful considerations when mixing methods within one study or across several studies in a research programme. They stress that central to the effectiveness of a mixed methods study is a clear relationship among the methods in order to ensure that the data converge or triangulate to produce greater insight than a single method could. Good mixed methods research negotiates the differences between qualitative and quantitative approaches (in terms of philosophy, design, methods and analysis) by articulating how and why both are integrated. See Creswell and
Table 1.6 Key characteristics of quantitative and qualitative research.

<table>
<thead>
<tr>
<th>Approach or philosophy</th>
<th>Quantitative</th>
<th>Qualitative</th>
</tr>
</thead>
</table>
| **Assumptions**        | • Positivism/post-positivism  
                        • Social phenomena and events have an objective reality  
                        • Variables can be identified and measured  
                        The researcher is objective and ‘outside’ the research    |
| **Purpose**            | • Generalisability  
                        • Prediction  
                        • Explanation   |  
                        • Constructivism/Interpretivism  
                        • Reality is socially constructive  
                        • Variables are complex and intertwined  
                        The researcher is part of the process |
| **Approach**           | • Hypothesis testing  
                        • Deductive, confirmatory, inferential – from theory to data  
                        • Manipulation and control of variables  
                        • Sample represents the whole population so results can be generalised  
                        • Data is numerical or transformed into numbers  
                        • Counting/reductionist  
                        • Statistical analysis |  
                        • Hypothesis generation  
                        • Inductive and exploratory – from data to theory  
                        • Emergence and portrayal of data  
                        • The focus of interest is the sample (uniqueness)  
                        • Data is words or language, minimal use of numbers  
                        • Probing/holistic  
                        • Analysis draws out patterns and meaning |

Plano Clark[53](#) for an excellent guide to designing and conducting mixed methods research.

So, returning to the example with which we opened this chapter, we started the programme of research into medical careers by seeking to extend understanding of the factors, which were important to medical students and trainees/learners in their careers decision making. Interviewees were selected on the basis of the degree to which they represented the diversity of background characteristics among the population under study. We analysed this data using framework analysis, and used the findings to inform the questions included in an initial survey of medical students across Scotland. These surveys included forced-choice and open questions. Data from the surveys and the interviews were triangulated in the analysis process in order to produce greater insight than would be gained by a single method. For instance, while the interview results emphasised the importance of location, the survey results illustrated that work-life balance, or quality of life, was the over-arching factor in careers decision making, and the importance of specific quality-of-life-related factors differed by stage of training.

**Conclusion**

In this chapter, I have set out the fundamental differences between qualitative and quantitative research approaches, which are summarised in Table 1.6. It may be clear from how I have done so that my personal stance is that both have a place in healthcare education research, reflecting the agenda in education (in the United Kingdom at least), where both qualitative and quantitative research are used to produce generalisable/transferable knowledge, which informs theory, practice and policy, and contributes to methodological and theoretical developments in the field.

**Practice points**

- All research requires a philosophical stance, a research question, study design, data collection methods and data analysis.
- Quantitative and qualitative research differ fundamentally at each of these steps in the research process.
- Incongruence across the different stages of any research project is very obvious to those reading and judging research.
- All designs and methods have their strengths and weaknesses, and it is critical to be aware of these when thinking about how best to address a particular research goal.

**Further reading**

fundamentals of research design and data management, followed by five distinct methods of analysis: exploring, describing, ordering, explaining and predicting.


References


