



'Qualitative' and 'quantitative' methods and approaches across subject fields: implications for research values, assumptions, and practices

Nick Pilcher¹  · Martin Cortazzi²

Accepted: 21 August 2023
© The Author(s) 2023

Abstract

There is considerable literature showing the complexity, connectivity and blurring of 'qualitative' and 'quantitative' methods in research. Yet these concepts are often represented in a binary way as independent dichotomous categories. This is evident in many key textbooks which are used in research methods courses to guide students and newer researchers in their research training. This paper analyses such textbook representations of 'qualitative' and 'quantitative' in 25 key resources published in English (supported by an outline survey of 23 textbooks written in German, Spanish and French). We then compare these with the perceptions, gathered through semi-structured interviews, of university researchers ($n=31$) who work in a wide range of arts and science disciplines. The analysis of what the textbooks say compared to what the participants report they do in their practice shows some common features, as might be assumed, but there are significant contrasts and contradictions. The differences tend to align with some other recent literature to underline the complexity and connectivity associated with the terms. We suggest ways in which future research methods courses and newer researchers could question and positively deconstruct such binary representations in order to free up directions for research in practice, so that investigations can use both quantitative or qualitative approaches in more nuanced practices that are appropriate to the specific field and given context of investigations.

Keywords Qualitative · Quantitative · Assumptions · Disciplines · Semi-structured interviews

✉ Nick Pilcher
N.Pilcher@napier.ac.uk
Martin Cortazzi
M.Cortazzi@warwick.ac.uk

¹ The Business School, Edinburgh Napier University, Edinburgh, UK

² University of Warwick, Coventry, UK

1 Introduction: qualitative and quantitative methods, presentations, and practices

Teaching in research methods courses for undergraduates, postgraduates and newer researchers is commonly supported or guided through textbooks with explanations of 'qualitative' and 'quantitative' methods and cases of how these methods are employed. Student dissertations and theses commonly include methodology chapters closely aligned with these textbook representations. Unexceptionally, dissertations and theses we supervise and examine internationally have methodology chapters and frequently these consider rationales and methods associated with positivist or interpretivist paradigms. Within such positivist or interpretivist frameworks, research approaches are amplified with elaborations of the rationale, the methods, and reasons for their choice over likely alternatives. In an apparent convention, related data are assigned as quantitative or qualitative in nature, with associated labelling as 'numerical' or 'textual'. The different types of data yield different values and interpretive directions, and are clustered conceptually with particular research traditions, approaches, and fields or disciplines. Frequently, these clusters are oriented around 'quantitative' and 'qualitative' conceptualizations.

This paper seeks to show how 'qualitative' and 'quantitative', whether stereotyped or more nuanced, as binary divisions as presented in textbooks and published resources describing research methods may not always accord with the perceptions and day-to-day practices of university researchers. Such common binary representations of quantitative and qualitative and their associated concepts may hide complexities, some of which are outlined below. Any binary divide between 'qualitative' and 'quantitative' needs caution to show complexity and awareness of disparities with some researchers' practices.

To date, as far as the present authors are aware, no study has first identified a range of binary representations of 'quantitative' and 'qualitative' methods and approaches in a literature review study of the many research methods textbooks and sources which guide students and then, secondly, undertaken an interview study with a range of established participant researchers in widely divergent fields to seek their understandings of 'quantitative' and 'qualitative' in their own fields. The findings related here complement and extend the complexities and convergences of understanding the concepts in different disciplines. Arguably, this paper demonstrates how students and novice researchers should not be constrained in their studies by any binary representations of 'quantitative' and 'qualitative' the terms. They should feel free to use either (or neither) or both in strategic combinations, as appropriate to their fields.

1.1 Presentations

Characteristically, presentations in research methods textbooks distinguish postivist and interpretivist approaches or paradigms (e.g. Guba and Lincoln 1994; Howe 1988; Denzin and Lincoln 2011) or 'two cultures' (Goertz and Mahoney 2012) with associated debates or 'wars' (e.g. Creswell 1995; Morse 1991). Quantitative data are shown as 'numbers' gathered through experiments (Moore 2006) or mathematical models (Denzin and Lincoln 1998), whereas qualitative data are usually words or texts (Punch 2005; Goertz and Mahoney 2012), characteristically gathered through interviews or life stories (Denzin and Lincoln 2011). Regarding analysis, some sources claim that establishing

objective causal relationships is key in quantitative analysis (e.g. Goertz and Mahoney 2012) whereas qualitative analysis uses more discursive and interpretative procedures.

Thus, much literature presents research in terms of two generally distinct methods—quantitative and qualitative—which many students are taught in research methods courses. The binary divide may seem to be legitimated in the titles of many academic journals. This division prevails as designated strands of separated research methods in courses which apparently handle both (cf. Onwuegbuzie and Leech 2005). Consequently, students may follow this seemingly stereotyped binary view or feel uncomfortable to deviate from it. Arguably, PhD candidates need to demonstrate understanding of such concepts and procedures in a viva—or risk failure (cf. Trafford and Leshem 2002). The Cambridge Dictionary defines ‘quality’ as “how good or bad something is”; while ‘quantity’ is “the amount or number of something, especially that can be measured” (Cambridge 2022). But definitions of ‘Qualitative’ can be elusive, since “a precise definition of qualitative research, and specifically... its distinctive feature of being “qualitative”, the literature is meager” (Aspers and Corte 2019, p.139). Some observe a “paradox... that researchers act as if they know what it is, but they cannot formulate a definition” and that “there is no consensus about specific qualitative methods nor... data” (Aspers and Corte 2019, p40). In general, ‘qualitative research’ is an iterative process to discover more about a phenomenon (ibid.). Elsewhere, ‘qualitative’ is defined negatively: “It is research that does not use numbers” (Seale 1999b, p.119). But this oversimplifies and hides possible disciplinary variation. For example, when investigating criminal action, numeric information (quantity) always follows an interpretation (De Gregorio 2014), and consequently this is a quantity of a quality (cf. Uher 2022).

Indeed, many authorities note the presence of elements of one in the other. For example, in analysis specifically, that what are considered to be quantitative elements such as statistics are used in qualitative analysis (Miles and Huberman 1994). More generically, that “a qualitative dimension is present in quantitative work as well” (Aspers and Corte 2019, p.139). In ‘mixed methods’ research (cf. Tashakkori et al. 1998; Johnson et al. 2007; Teddlie and Tashakkori 2011) many researchers ‘mix’ the two approaches (Seale 1999a; Mason 2006; Dawson 2019), either using multiple methods concurrently, or doing so sequentially. Mixed method research logically depends on prior understandings of quantitative and qualitative concepts but this is not always obvious (e.g. De Gregorio 2014); for instance Heyvaert et al. (2013) define mixed methods as combining quantitative and qualitative items, but these key terms are left undefined. Some commentators characterize such mixing as a skin, not a sweater to be changed every day (Marsh and Furlong 2002, cited in Grix 2004). In some disciplines, these terms are often blurred, interchanged or conjoined. In sociology, for instance, “any quality can be quantified. Any quantity is a quality of a social context, quantity versus quality is therefore not a separation” (Hanson 2008, p.102) and characterizing quantitative as ‘objective’ and qualitative as ‘subjective’ is held to be false when seeking triangulation (Hanson 2008). Additionally, approaches to measuring and generating quantitative numerical information can differ in social sciences compared to physics (Uher 2022). Indeed, quantity may consist of ‘a multitude’ of divisible aspects and a ‘magnitude’ for indivisible aspects (Uher 2022). Notably, “the terms ‘measurement’ and ‘quantification’ have different meanings and are therefore prone to jingle-jangle fallacies” (Uher 2022) where individuals use the same words to denote different understandings (cf. Bakhtin 1986). Comparatively, the words ‘unit’ and ‘scale’ are multitudinous in different sciences, and the key principles of numerical traceability and data generation traceability arguably need to be applied more to social sciences and psychology (Uher 2022). The

interdependence of the terms means any quantity is grounded in a quality of something, even if the inverse does not always apply (Uher 2022).

1.2 Practices

The present paper compares representations found in research methods textbooks with the reported practices of established researchers given in semi-structured interviews. The differences revealed between what the literature review of methods texts showed and what the interview study showed both underlines and extends this complexity, with implications for how such methodologies are approached and taught. The interview study data (analysed below) show that many participant researchers in disciplines commonly located within an ostensibly ‘positivist’ scientific tradition (e.g. chemistry) are, in fact, using qualitative methods as scientific procedures (contra Tashakkori et al 1998; Guba and Lincoln 1994; Howe 1988; Lincoln and Guba 1985; Teddlie and Tashakkori 2011; Creswell 1995; Morse 1991). These interview study data also show that many participant researchers use what they describe as qualitative approaches to provide initial measurements (geotechnics; chemistry) of phenomena before later using quantitative procedures to measure the quantity of a quality (cf. Uher 2022). Some participant researchers also say they use quantitative procedures to reveal data for which they subsequently use qualitative approaches to interpret and understand (biology; dendrology) through their creative imaginations or experience (contra e.g. Hammersley, 2013). Participant researchers in ostensibly ‘positivist’ areas describe themselves as doubting ‘facts’ measured by machines programmed by humans (thus showing they feel researchers are not outside the world looking in (contra. e.g. Punch 2005)) or doubting the certainty of quantitative data over time (contra e.g. Punch 2005). Critically, the interview study data show that these participant researchers often engage in debate over what a ‘number’ is and the extent to which ‘numbers’ can be considered ‘quantitative’. For example the data show how a mathematician considers that many individuals do not know what they mean by the word ‘quantitative’, and an engineer interprets *any* numbers involving human judgements as ‘qualitative’. Further, both a chemist and a geotechnician routinely define and use ‘qualitative’ methods and analysis to arrive at numerical values (contra. Davies and Hughes 2014; Denzin and Lincoln 2011).

Such data refute many textbook and key source representations of quantitative and qualitative as being binary and separately ringfenced entities as shown in the literature review study below (contra e.g. Punch 2005; Goertz and Mahoney 2012). Nevertheless, they resonate with much recent and current literature in the field (e.g. Uher 2022; De Gregorio 2014). They also arguably extend the complexities of the terms and approaches. In some disciplines, these participant researchers only do a particular type of research and never need anything other than clear ‘quantitative’ definitions (Mathematics), and some only ever conduct research involving text and never numbers (Literature). Moreover, some participant researchers consider certain aspects lie outside the ‘qualitative’ or ‘quantitative’ (the theoretical in German Literature), or do research which they maintain does not contain ‘knowledge’ (Fine-Art Sculpture), while others outline how they feel they do foundational conceptual research which they believe comes at a stage *before* any quantity or quality can be assessed (Philosophy). Indeed, of the 31 participant researchers we spoke to, nine of them considered the terms ‘quantitative’ and ‘qualitative’ to be of little relevance for their subject.

1.3 Outline of the two studies

This paper reports and discusses findings from a constructivist grounded approach interview study that interviewed experienced participant researchers (N=31) in various disciplines (see Table 1 below) about their understandings of 'qualitative' and 'quantitative' in their subject areas. Findings from this interview study were compared with findings from a research methods literature review study that revealed many disparities with received and often binary presentations of the concepts in much key literature that informs student research methods courses. In this section we outline the review criteria, the method of analysis, and our findings. The findings are grouped according to how the sources reviewed consider 'quantitative' and 'qualitative' approaches the aspects of positivism and constructivism; the nature of research questions; research methods; analysis; issues of reliability,

Table 1 Participant researcher details and information

Participant and subject area	Years of experience	First Language
1. Geotechnical Engineering ('Science')	25+	English
2. Design ('Arts')	25+	English
3. Film and Media ('Arts')	15+	English
4. Logistics ('Science')	10+	Not English
5. Computational mathematics ('Science')	25+	English
6. Tourism ('Arts')	25+	English
7. Human Computer Interaction ('Science')	25+	English
8. Psychology ('Arts/Science')	5	Not English
9. Nursing ('Science/Arts')	15+	English
10. Communication Studies ('Arts')	10+	Not English
11. Music ('Arts')	15+	English
12. Chemistry ('Science')	25+	Not English
13. Psychology ('Arts/Science')	15+	English
14. Biology ('Science')	20+	English
15. Statistics ('Science')	15+	Not English
16. Engineering ('Science')	15+	Not English
17. Theoretical Physics ('Science')	20+	English
18. English Literature ('Arts')	20+	English
19. Architecture ('Arts')	20+	English
20. Mathematics ('Science')	15+	English
21. Linguistics ('Science/Arts')	10+	Not English
22. Clinical Psychology ('Science/Arts')	20+	Not English
23. Mathematical Biology ('Science')	5	English
24. Communication Studies ('Arts')	25+	English
25. Fine Art/Sculpture ('Arts')	20+	English
26. German Literature ('Arts')	25+	Not English
27. History ('Arts')	20+	English
28. Sciences (experience of a range ('Science'))	15+	Not English
29. Translation / Interpreting ('Arts/Science')	20+	Not English
30. Educational Philosophy ('Arts')	10+	English
31. Philosophy ('Arts')	15+	English

validity and generalizability; and the value and worth of the different approaches. Following this. We outline the approach, method, and procedure adopted for the interviews with research participants; sampling and saturation; and analysis; beside details of the participant researchers. Subsequently, Theme 2 focuses on contrasts of the interview data with 'binary' textbook and key source representations. Theme 3 focuses on what the interview data show about participant researcher perceptions of the value of 'quantitative' and 'qualitative' methods and approaches. This section outlines where, how, and sometimes why, participant researchers considered 'quantitative' and 'qualitative' methods approaches to be (or to not be) useful to them. These interview study findings show a surprising range of understandings, usage, and often perceived irrelevance of the terms. In the Discussion section, these findings form the focus of comparison with the literature as well as a consideration of possible implications for approaching and teaching research methods. In the conclusion we summarise the implications for research methods courses, for researchers in different disciplines and interdisciplinary contexts and discuss limitations and suggest future research. Besides adding to the debate on how 'quantitative' and 'qualitative' are conceptualized and how they are related, the paper appeals to those delivering research methods courses and to novice researchers to consider the concepts as highly complex and overlapping, to loosen constraints, and elaborate nuances of the commonplace binary representations of the terms.

2 Literature review study: some key textbooks and sources for teaching Research Methods.

2.1 Review criteria

To identify how concepts are presented in key materials we undertook a literature review study by consulting research methods course reading lists, library search engines, physically available shelves in institutional libraries, and Google Scholar. We wanted to encompass textbooks and some key texts which are recommended to UG, PG Masters and PhD students., for example, 'textbooks' like *Doing Your Research Project: A Guide for first-time researchers* (Bell and Waters 2014) and *Introduction to Research Methods: A Practical Guide for Anyone Undertaking a Research project (5th Edition)* (Dawson 2019). Such sources were frequently mentioned on reading lists and are freely available in many institutional libraries. We consulted seminal thinkers who have published widely on research methods, such as Denzin and Lincoln, or Cresswell, but we also considered texts which are likely less known such as 'A tale of two cultures' (Goertz and Mahoney 2012) and key articles such as 'Five misunderstandings about case-study research' (Flyvbjerg 2006). Students can freely find such sources, and are easily directed to them by supervisors. Although a more comprehensively robust search is possible, we nevertheless followed procedures and standard criteria for literature reviews (Atkinson et al. 2015).

3 Method of analysis

We assembled a total of 25 sources to look for a number of key tenets. We examined the sources for occurrence of the following: whether quantitative was described as positivist and qualitative was described as constructivist; whether quantitative was said to

be science-based and qualitative was more reflective and non-science based; whether the research questions were presented as predetermined in quantitative methods and initially less focused in qualitative methods; whether quantitative methods were structured and qualitative methods were discussed as less structured; whether quantitative analysis focused on cause-effect type relationships and qualitative analysis was more exploratory; whether reliability, validity and generalizability were achieved through large numbers in quantitative research and through in-depth study in qualitative research; whether for particular subjects such as the sciences quantitative approaches were perceived to be of value (and qualitative was implied to have less value) and whether the converse was the case for other subjects such as history and anthropology; and whether mixed methods were considered possible or not possible. The 25 sources are detailed in Appendix 1. As a confirmatory but less detailed exercise, and also detailed in Appendix 1, we checked a further 23 research methods textbooks in German, Spanish and French, authored in those languages (rather than translations from English).

3.1 Findings

Overall, related to what quantitative and qualitative approaches, methods and analysis are, we found many key, often binary representations in this literature review. We outline these here below.

3.2 Positivism and constructivism

Firstly, 20 of the sources we reviewed stated that quantitative is considered positivist, and qualitative constructivist (e.g. Tashakkori et al 1998; Guba and Lincoln 1994; Howe 1988; Lincoln and Guba 1985; Teddlie and Tashakkori 2011; Creswell 1995; Morse 1991). Even if not everyone doing quantitative research (e.g. in sociology) consider themselves positivists (Marsh 1979), it is generally held quantitative research is positivist. Here, 12 of the sources noted that quantitative is considered 'scientific', situating observers outside the world looking in, e.g. through gathering numerical data (Punch 2005; Davis and Hughes 2014) whereas qualitative "locates the observer in the world" (Denzin and Lincoln 2011, p.3). Quantitative researchers "collect facts and study the relationship of one set of facts to another", whereas qualitative researchers "doubt whether social 'facts' exist and question whether a 'scientific' approach can be used when dealing with human beings" (Bell and Waters 2014, p. 9).

3.3 The nature of research questions

Secondly, regarding research questions, "qualitative research... typically has... questions and methods... more general at the start, and... more focused as the study progresses" (Punch 2005, p.28). In contrast, quantitative research uses "numerical data and typically... structured and predetermined research questions, conceptual frameworks and designs" (Punch 2005, p.28). Of the sources we reviewed, 16 made such assertions. This understanding relates to type, and nature, of data, which is in turn anchored to particular world-views. Punch (2005, p 3–4) writes of how "in teaching about research, I find it useful to approach the qualitative-quantitative distinction primarily through... the nature of the data. Later, the distinction can be broadened to include ways of conceptualising the

reality being studied, and methods.” Here, the nature of data influences approach: numbers are for quantitative, and not-numbers (commonly words) for qualitative. Similarly, for Miles et al. (2018) “the nature of qualitative data” is “primarily on data in the form of words, that is, language in the form of extended text” (Miles et al. 2018, no page). These understandings in turn relate to methods used.

4 Methods

Commonly, specific types of methods are said to be related to the type of approach adopted, and 18 of the sources we reviewed presented quantitative methods as being structured, and qualitative methods as less structured. For example, Davies and Hughes (2014, p.23) claim “there are two principal options open to you: 1... quantitative research methods, using the traditions of science. 2... qualitative research, employing a more reflective or exploratory approach.” Here, quantitative methods are “questionnaires or structured interviews” whereas qualitative methods are “such as interviews or focus groups” (Dawson 2019, no page given). Quantitative methods are more scientific, involve controlling a set of variables, and may involve experiments, something which, “qualitative researchers are agreed in their opposition to this definition of scientific research, or at least its application to social inquiry” (Hammersley 2013, p. ix). As Punch notes (2005, p.208), “the experiment was seen as the basis for establishing cause-effect relationships between variables, and its outcome (and control) variables had to be measured.”

4.1 Analysis

Such understandings often relate to analysis, and 16 of the sources we reviewed presented quantitative analysis as being statistical and number related, and qualitative analysis as being text based. With quantitative methods, “the data is subjected to statistical analysis, using techniques... likely to produce quantified, and, if possible, generalizable conclusions” (Bell and Waters 2014, p.281). With qualitative research, however, this “calls for advanced skills in data management and text-driven creativity during the analysis and write-up” (Davies and Hughes 2014). Again, the data’s nature is key, and whilst qualitative analysis may condense data, it does not seek numbers. Indeed, “by data condensation, we do not necessarily mean quantification”, however, “occasionally, it may be helpful to convert the data into magnitudes... but this is not always necessary” (Miles et al. 2018, npg). Qualitative analysis may involve stages such as assigning codes, subsequently sorting and sifting them, isolating patterns, then gradually refining any assertions made and comparing them to other literature (Miles et al. 2018). This could involve condensing, displaying, then drawing conclusions from the data (Miles et al. 2018). In this respect, some sources consider qualitative and quantitative analysis broadly similar in overall goals, yet different because quantitative analyses use “well-defined, familiar methods; are guided by canons; and are usually more sequential than iterative or cyclical” (Miles et al. 2018, npg). In contrast, “qualitative researchers are... more fluid and... humanistic” in meaning making (Miles et al. 2018, npg). Here, both approaches seek causation and may attempt to reveal ‘cause and effect’ but qualitative approaches often seek multiple and interacting influences, and effects and are less rigid (Miles et al. 2018). In quantitative inquiry search for causation relates to “causal mechanisms (i.e. *how* did X cause Y)” whereas in “the human sciences, this distinction relates to causal effects (i.e. *whether* X causes Y)” (Teddle and

Tashakkori 2011, p.286). Similarly, that “scientific research in any area... seeks to trace out cause-effect relationships” (Punch 2005, p.78). In contrast, qualitative research seeks interpretative understandings of human behaviour, “not ‘caused’ in any mechanical way, but... continually constructed and reconstructed” (Punch 2005, p.126).

4.2 Issues of reliability, validity and generalizability

Regarding reliability, validity and generalizability, 19 of the sources we reviewed presented ideas along the lines that quantitative research is understood to seek large numbers, so quantitative researchers, “use techniques... likely to produce quantified and, if possible, generalizable conclusions (Bell and Waters 2014, p.9). This means quantitative “research researches many more people” (Dawson 2019, npg). Given quantitative researchers aim, “to discover answers to questions through the application of scientific procedures” it is anticipated these procedures will “increase the likelihood that the information... will be reliable and unbiased” (Davies and Hughes 2014, p.9). Conversely, qualitative researchers are considered “more concerned to understand individuals’ perceptions of the world” (Bell and Waters 2014, p.281) and consequently aim for in-depth data with smaller numbers, “as it is attitudes, behaviour and experiences that are important” (Dawson 2019, npg). Consequently, generalizability of data is not key, as qualitative research has its “emphasis on a specific case, a focused and bounded phenomenon embedded in its context” (Miles et al. 2018, npg). Yet, such research is considered generalizable in theoretical insight if not actual data (Flyvbjerg 2006).

4.3 The value and worth of the different approaches

Regarding ‘value’ and ‘worth’, many see this related with appropriacy to the question being researched. Thus, if questions involve more quantitative approaches, then these are of value, and if more qualitative, then these are of value, and 6 of the sources we reviewed presented these views (e.g. Bell and Waters 2014; Punch 2005; Dawson 2019). This resonates with disciplinary orientations where choices between given approaches are valued more in specific disciplines. History and Anthropology are seen more qualitative, whereas Economics and Epidemiology may be more quantitative (Kumar 1996). Qualitative approaches are valuable to study human behaviour and reveal in-depth pictures of peoples’ lived experience (e.g. Denzin and Lincoln 2011; Miles et al. 2018). Many consider there to be no real inherent superiority for one approach over another, and “asking whether quantitative or qualitative research is superior to the other is not a useful question” (Goertz and Mahoney 2012, p.2).

Nevertheless, some give higher pragmatic value to quantitative research for studying individuals and people; neoliberal governments consistently value quantitative over qualitative research (Barone 2007; Bloch 2004; St Pierre 2004). Concomitantly, data produced by qualitative research is criticised by quantitative proponents “because of their problematic generalizability” (Bloor and Wood 2006, p.179). However, other studies find quantitative researchers see qualitative methods and approaches positively (Pilcher and Cortazzi 2016). Some even question the qualitative/quantitative divide, and suggest “a more subtle and realistic set of distinctions that capture variation in research practice better” (Hammerley 2013, p.99).

The above literature review study of key texts is hardly exhaustive, but shows a general outline of the binary divisions and categorizations that exist in many sources students and

newer researchers encounter. Thus, despite the complex and blurred picture as outlined in the introduction above, many key texts students consult and that inform research methods courses often present a binary understanding that quantitative is positivist, focused on determining cause and effect, numerical or magnitude focused, uses experiments, and is grounded in an understanding the world can be observed from the outside in. Conversely, qualitative tends to be constructivist, focused on determining why events occur, is word or textual based (even if these elements are measured by their magnitude in a number or numerical format) and grounded in understanding the researcher is part of the world. The sciences and areas such as economics are said to tend towards the quantitative, and areas such as history and anthropology towards the qualitative.

We also note that in our literature review study we focused on English language textbooks, but we also looked at outline details, descriptions, and contents lists of texts in the languages of German, Spanish and French. We find that these broadly confirm the perception of a division between quantitative and qualitative research, and we detail a number of these in Appendix 1. These examples are all research methods handbooks and student guides intended for under and post-graduates in social sciences and humanities; many are inter-disciplinary but some are more specifically books devoted to psychology, health care, education, politics, and management. Among the textbooks and handbooks examined in other languages, more recent books pay attention to online research and uses of the internet, social media and sometimes to big data and software for data analysis.

In these sources in languages other than English we find massive predominance of two (quantitative/qualitative) or three approaches (mixed). These are invariably introduced and examined with related theories, examples and cases in exactly that order: quantitative; qualitative; mixed. Here there is perhaps the unexamined implication that this is a historical order of research method development and also of acceptability of use (depending on research purposes). Notably, Molina Marin (2020) is oriented to Latin America and makes the point that most European writing about research methods is in English or German, while there are far fewer publications in Spanish and few with Latin American contextual relevance, which may limit epistemological perspectives. This point is evident in French and Spanish publications (much less the case in German) where bibliographic details seem dominated by English language publications (or translations from them). We now turn to outline our interview study.

5 Interview study

5.1 Approach and choice of method

We approached our interview study from a constructivist standpoint of exploring and investigating different subject specialists' understandings of quantitative and qualitative. Critically, we were guided by the key constructivist tenet that knowledge is not independent of subjects seeking it (Olssen 1996), nor of subjects using it. Extending from this we considered interviews more appropriate than narratives or focus groups. Given the exploratory nature of our study, we considered interviews most suited as we wanted to have a free dialogue (cf. Bakhtin 1981) regarding how the terms are understood in their subject contexts as opposed to their neutral dictionary definitions (Bakhtin 1986), and not to focus on a specific point with many individuals. Specifically, we used 'semi'-structured interviews. 'Semi' can mean both 'half in quantity or value' but also 'to some extent: partly:

incompletely' (e.g. Merriam Webster 2022). Our interviews, following our constructionist and exploratory approach, aligned with the latter definition (see Appendix 2 for the Interview study schedule). This loose 'semi' structure was deliberately designed to (and did) lead to interviews directed by the participants, who themselves often specifically asked what was meant by the questions. This created a highly technical dialogue (Buber, 1947) focused on the subject.

5.2 Sampling and saturation

Our sampling combined purposive and snowball sampling (Sharma 2017; Levitt et al. 2018). Initially, participants were purposively identified by subject given the project sought to understand different subject perspectives of 'qualitative' and 'quantitative.' Later, a combined purposive and snowball sampling technique was used whereby participants interviewed were asked if they knew others teaching particular subjects. Regarding priorities for participant eligibility, this was done according to subject, although generally participants also had extensive experience (see Table 1). For most, English was their first language, where it was not, participants were proficient in English. The language of interview choice was English as it was most familiar to both participants and interviewer (Cortazzi et al. 2011).

Regarding saturation, some argue saturation occurs within 12 interviews (Guest et al. 2006), others within 17 (Francis et al. 2010). Arguably, however, saturation cannot be determined in advance of analysis and is "inescapably situated and subjective" (Braun and Clarke 2021, p.201). This critical role of subjectivity and context guided how we approached saturation, whereby it was "operationalized in a way consistent with the research question(s) and the theoretical position and analytic framework adopted" (Saunders et al. 2018, p.1893). We recognise that more could always be found but are satisfied that 31 participants provided sufficient data for our investigation. Indeed, our original intention was to recruit 20 participants, feeling this would provide sufficient saturation (Francis et al. 2010; Guest et al. 2006) but when we reached 20, and as we had already started analysis (cf. Braun and Clarke 2021) as we ourselves transcribed the interviews (Bird 2005) we wanted to explore understandings of 'qualitative' and 'quantitative' with other subject fields. As Table 1 shows, 'English Literature', 'Philosophy, and 'Sculpture' were only explored after interview 20. These additional subject fields added significantly (see below) to our data.

5.3 Analysis and participant researcher details

Our analysis followed Braun and Clarke's (2006) thematic analysis. Given the study's exploratory constructionist nature, we combined 'top down' deductive type analysis for anticipated themes, and 'bottom up' inductive type analysis for any unexpected themes. The latter was similar to a constructivist grounded theory analysis (Charmaz 2010) whereby the transcripts were explored through close repeated reading for themes to emerge from the bottom up. We deliberately did not use any CAQDAS software such as NVivo as we wanted to manually read the scripts in one lengthy word document. We recognise that such software could allow us to do this but we were familiar with the approach we used and have found it effective for a number of years. We thus continued to use it here as well. We counted instances of themes through cross-checking after reading transcripts and discussing them, thereby heightening reliability and validity (Golafshani 2003). All interviews

were undertaken with informed consent and participants were assured all representation was anonymous (Christians 2011). The study was approved by relevant ethics committees. Table 1 above shows the subject area, years of experience, and first language of the participant researchers. We also bracket after each subject area whether we consider it to be ‘Science’ or ‘Arts’ or whether we consider them as ‘Arts/Science’ or ‘Science/Arts’. This is of course subjective and in many ways not possible to do, but we were guided in how we categorised these subjects by doing so according to how we feel the methodology sources from the literature review study would categorize them.

5.4 Presentation of the interview study data compared with data from the literature review study

We present our interview study data in the three broad areas that emerged through analysis. Our approach to thematic analysis was to deductively code the interview transcripts manually under the three broad areas of: where data aligns with textbook and key source ‘binary’ representations; where the data contrasts with such representations; and where the data relates to interviewee perceptions of the value of ‘qualitative’ and ‘quantitative’. The latter relates to whether participant researchers expressed views that suggested they considered each approach to be useful, valuable, or not. We also read through the transcripts inductively with a view to being open to emerging and unanticipated themes. For each data citation, we note the subject field to show the range of subject areas. We later discuss these data in terms of their implications for research values, assumptions and practices and for their use when teaching about different methods. We provide illustrative citations and

Table 2 Summarised details of the main points from the three thematic analysis themes

Theme 1: Alignments with ‘binary’ textbook and key source representations

- Quantitative is ‘objective’; ‘scientific’; ‘positivist’; ‘number-based’; ‘uses numbers to establish causal relationships’; ‘measurement focused’; ‘uses closed questions’
- Qualitative is ‘constructivist’; ‘interpretivist’; ‘anything other than numbers’; not measuring the extent’; ‘verbalistic’; ‘uses open-ended questions’
- Mixed methods: there was an equal split between those who felt both could be used and those who felt their subject area deeply entrenched in one of the approaches

Theme 2: Contrasts with ‘binary’ textbook and key source representations

- Sciences use both qualitative and quantitative approaches and methods; both qualitative and quantitative are numerical; qualitative measures a state change or the existence of something; quantitative then measures its extent or amount
- Quantitative can be uncertain in sciences
- Qualitative and quantitative approaches can use the exact same method in some sciences
- Qualitative can be a visual expression of large quantitative data sets
- Some sciences see any measurement involving human subjects’ decisions as qualitative
- Qualitative is highly subject specific and differs in meaning in Film; Biology; Chemistry etc
- Qualitative and quantitative do not follow textbook presentations in many subjects

Theme 3: Perceptions on the value of ‘Quantitative’ and ‘Qualitative’ methods and approaches

- Both quantitative and qualitative are valuable depending on the question asked
- Many scientists consider quantitative as worthless / counterproductive when used in inappropriate areas such as measuring IQ; when samples have no meaning and; when statistics are driven to make a point
- Quantitative is considered of value over qualitative in certain subject areas
- Qualitative is valued over quantitative in certain subject areas
- The terms qualitative and quantitative have no value or ever arise in many subjects

numbers of participant researchers who commented in relation to the key points below, but first provide an overview in Table 2.

5.4.1 Theme 1: Alignments with 'binary' textbook and key source representations

The data often aligned with textbook representations. Seven participant researchers explicitly said, or alluded to the representation that 'quantitative' is positivist and seeks objectivity whereas 'qualitative' is more constructivist and subjective. For example: *"the main distinction... is that qualitative is associated with subjectivity and quantitative being objective."* This was because *"traditionally quantitative methods they've been associated with the positivist scientific model of research whereas qualitative methods are rooted in the constructivist and interpretivist model"* (Psychology). Similarly, *"quantitative methods... I see that as more... logical to a scientific mode of generating knowledge so... largely depends on numbers to establish causal relations... qualitative, I want to more broadly summarize that as anything other than numbers"* (Communication Studies). One Statistics researcher had *"always associated quantitative research more with statistics and numbers... you measure something... I think qualitative... you make a statement... without saying to what extent so... so you run fast but it's not clear how fast you actually run.... that doesn't tell you much because it doesn't tell you how fast."* One mathematics participant researcher said mathematics was *"super quantitative... more beyond quantitative in the sense that not only is there a measurement of size in everything but everything is defined in... really careful terms... in how that quantity kind of interacts with other quantities that are defined so in that sense it's kind of beyond quantitative."* Further, this applied at pre-data and data integration stages. Conversely, 'qualitative' *"would be more a kind of verbalistic form of reasoning or... logic."*

Another representation four participant researchers noted was that 'quantitative' has structured predetermined questions whereas 'qualitative' has initially general questions that became more focused as research proceeded. For example, in Tourism, *"with qualitative research I would go with open ended questions whereas with quantitative research I would go with closed questions."* This was because 'qualitative' was more exploratory: *"quantitative methods... I would use when the parameters... are well understood, qualitative research is when I'm dealing with topics where I'm not entirely sure about... the answers."* As one Psychology participant researcher commented: *"the main assumption in quantitative... is one single answer... whereas qualitative approaches embrace... multiplicity."*

Nineteen participant researchers considered 'quantitative' numbers whereas 'qualitative' was anything except numbers. For example, *"quantitative research... you're generating numbers and the analysis is involving numbers... qualitative is... usually... text-based looking for something else... not condensing it down to numbers"* (Psychology). Similarly, 'quantitative' was *"largely... numeric... the arrangement of larger scale patterns"* whereas, *"in design field, the idea of qualitative...is about the measure... people put against something... not [a] numerical measure"* (Design). One participant researcher elaborated about Biology and Ecology, noting that *"quantitative it's a number it's an amount of something... associated with a numerical dimension... whereas... qualitative data and... observations... in biology.... you're looking at electron micrographs... you may want to describe those things... purely in... QUALitative terms... and you can do the same in... Ecology"* (Human Computer Interaction). One participant researcher also commented on the magnitude of 'quantitative' data often involving more than numbers, or having a complex involvement with numbers: *"I was thinking... quantitative... just involves numbers.... but it's not... if..."*

NVivo... counts the occurrence of a word... it's done in a very structured way.... to the point that you can even... then do statistical analysis" (Logistics).

Regarding mixed methods, data aligned with the textbook representations that there are two distinct 'camps' but also that these could be crossed. Six participants felt opposing camps and paradigms existed. For example, in Nursing, that *"it does feel quite divided in Nursing I think you're either a qualitative or a quantitative researcher there's two different schools... yeah some people in our school would be very anti-qualitative."* Similarly, in Music one participant researcher felt *"it is very split and you'll find... some people position themselves in one or the other of those camps and are reluctant to consider the other side. In Psychology, "yes... they're quite... territorial and passionately defensive about the rightness of their own approaches so there's this... narrative that these two paradigms... of positivistic and interpretivist type... cannot be crossed... you need to belong to one camp."* Also, in Communication Studies, *"I do think they are kind of mutually exclusive although I accept... they can be combined... but I don't think they, they fundamentally... speak to each other."* One Linguistics participant researcher felt some Linguists were highly qualitative and never used numbers, but *"then you have... the corpus analysts who quantify everything and always under the headline 'Corpus linguistics finally gets to the point... where we get rid of researcher bias; it objectifies the analysis' because you have big numbers and you have statistical values and therefore... it's led by the data not by the researcher."* This participant researcher found such striving for objectivity a *"very strange thing"* as any choice was based on previously argued ideas, which themselves could not be objective: *"because all the decisions that you need to put into which software am I using, which algorithm am I using, which text do I put in.... this is all driven by ideas."*

Nevertheless, three participant researchers felt the approaches not diametrically opposed. For example, the same Psychology participant researcher cited immediately above felt people's views could change: *"some people although highly defensive over time... may soften their view as mixed method approaches become more prominent."* Comparatively flexibly, a Historian commented *"I don't feel very concerned by the division between qualitative and quantitative; I think they're just two that are separate sometimes complementary approaches to study history."* In Translation and Interpreting, one participant researcher said methods could be quantitative, but have qualitative analysis, saying one project had: *"an excellent use of quantitative tools... followed by not a qualitative method but qualitative analysis of what that implied."* Thus, much of the data did align with the binary representations of the key textbooks reviewed above and also the representation that approaches could be combined.

5.4.2 Theme 2: Contrasts with 'binary' textbook and key source representations

One recurrent contrast with common textbook representations was where *both* qualitative and quantitative were used in some sciences; nine participant researchers felt this. For example, in Geotechnics, when ascertaining soil behaviour: *"the first check, the Qualitative check is to look whether those [the traditional and new paths of soil direction] bear resemblance, [be]coz if that doesn't have that shape how can I expect there to be a quantitative comparison or... fit."* Both qualitative and quantitative approaches combined helped *"rule out coincidence"* and using both represented *"a check which moves through qualitative... to quantitative."* Quantitative was a *"capital Q for want of a better expression"* and consisted of 'bigger numbers', which constituted *"the quantitative or calculated strength."* However, this 'capital Q' quantitative data aimed to quantify a qualitatively measured

numerically estimated phenomenon. So *both* were numerical. Nevertheless, over the long-term, even the quantitative became less certain because: *“when you introduce that time element... you create... circumstances in which you need to be careful with the way you define the strength... different people have come up with different values... so the quantitative match has to be done with an element of uncertainty.”*

Similarly, in Chemistry, both qualitative and quantitative methods and analysis were used, where *“the qualitative is the first one, and after you have the other ones [I—Right to kind of verify] if... if you need that.”* Both were used because, *“we need to know what is there and how much of each component is there... and a knowledge of what is there is a qualitative one, how much of each one is a quantitative one.”* Moreover, *“they are analysed sometimes by the same technique”* which could be quantitative or qualitative: *“[I—and chromatography, again... would that be qualitative or quantitative or both?] Both, both... the quantitative is the area of the peak, the qualitative is the position in which this characteristic appears.”* Here, both were key, and depending on the research goal: *“we... use them according to what we need... sometimes it’s enough to detect [qualitative]... other times you need to know how much [quantitative]”*.

For Biology also, both were key: *“quantitative is the facts and... qualitative is the theory you’re trying to make fit to the facts you can’t do it the other way around... the quantitative data... just doesn’t tell you anything without the qualitative imagination of what does it mean?”* Inversely, in an area commonly understood as quantitative, Statistics, the qualitative was an initial, hypothetical stage requiring later quantitative testing. For example: *“very often the hypothesis is a qualitative hypothesis”* and then, *“you would test it by putting in all sorts of data and then the test result would give you a p-value... and the p-value of course is quantitative because that’s a number.”*

In Engineering, both helped research sound frequencies: *“we need to measure the spectrum of the different frequencies... created... all those things were quantifiable, but then we need to get participants to listen and tell us... which one do you prefer?... this is a qualitative answer.”* Mathematical Biology also used both: qualitative for change in nature of a state, and quantitative for the magnitude of that change. Here: *“quantitative changes the numerical value of the steady state but it doesn’t change its stability... but qualitative change is when you... change the parameters and you either change its stability or you change whether it exists or not... and that point over which you cross to change it from being stable to unstable is called a bifurcation point... that’s where I use quantitative and qualitative the most in my research.”*

The idea of ‘quantitative’ involving large data sets was expressed; however, the ‘qualitative’ could help represent these. In Computing Mathematics one participant researcher commented that: *“quantitative... I do almost 90% of the time... calculating metrics... and using significance testing to determine whether the numbers mean anything.”* Yet, this participant researcher also used qualitative representations for simplified visual representation of large number sets: *“I think for me QUALitative work is almost always about visualizing things in a way that tries to illustrate the trends... so I’m not actually calculating numbers but I’m just saying if I somehow present it in in this way.”* Concomitantly, ‘quantitative’ could be smaller scale. For example, in Architecture: *“my expectation is it wouldn’t be valid until you have a certain quantity of response but that said [I] have had students use... quantitative analysis on a small sample.”* Similarly, in History: *“you could have a quantitative study of a small data set or a small... number of statistics I really think it’s determined by the questions... you’re asking.”*

Interestingly, two participant researchers questioned their colleagues’ understandings of ‘quantitative’ and of ‘numbers’. For example, one Mathematician considered some

researchers did not know what ‘quantitative’ meant, because “*when they say quantitative... I think what they mean is the same as qualitative except it’s got numbers in it somewhere.*” For example, “*I’m talking to a guy who does research in pain and, so I do know now what he means by quantitative research, and what he means is that he doesn’t know what he means [both laugh] and he wants me to define what it means... I think he means he wants some form of modelling with data and... he’s not quite sure how to go about doing that.*” For this Mathematician, engineers would, “*Mean that purposefully when they talk about quantitative modelling*” whereas, “*generically you know when politicians [consider these things] quantitative just means there’s a number in it somewhere.*”

Three participant researchers felt that when ‘quantitative’ involved human elements or decisions, subjectivity was inevitable. One Logistics participant researcher felt someone doing materials research was “*Doing these highly quantitative analyses still there is a degree of subjectivity because... this involves human assessment... they’re using different photometric equipment... taking photos... what is the angle.*” Another researcher in Sciences similarly noted, “*I don’t know why people believe in machines so much because they’re built by humans and there’s so many errors.*” An Engineer commented: “*To me, just the involvement of humans... gives it a qualitative element no matter what.*” For this researcher, with people’s ‘quantitative’ reaction times and memory recall, “*I would call that again qualitative you know... yes we did quantify the reaction time... the correct number of answers, but... it’s a person... I could get somebody else now doing it and not get exactly the same answer, so that uncertainty of human participants to me make it a qualitative approach.*” For this participant researcher, anything involving human participants was ‘qualitative’: “*I would say anything that is measurable, but by measurable I mean physically measurable... or predictable through numbers is quantitative [and] anything that involves a judgment, therefore human participants... is qualitative.*”

‘Qualitative’ was often highly subject-specific. For example, in Film Studies and Media—English, ‘qualitative’ was: “*about... the qualities of particular texts.... I’ve read a lot about silence as a texture and a technique in cinema... so silence is a quality, and also what are the qualities of that silence.*” One Sciences researcher felt ‘qualitative’ involved experience applied to interpreting data: “*Qualitative I would define as using your own experience to see if the data makes sense... and... something that... cannot be measured so far by machine... like the shape of a tree.*” One Historian also highlighted the importance of subject-sub-branches, saying, “*I’d situate myself in history but I guess you’d probably get a different response depending on... whether that historian saw themselves as a cultural historian or as a social and economic historian or... an intellectual historian.*”

A fluidity regarding ‘quantitative’ and ‘qualitative’ was characterized. One Human Computer Interaction participant researcher commented, “*I think sometimes people can use both terms quite loosely without really sort of thinking about [them].*” Comparatively, one Psychology participant researcher commented that “*even within the Qual[itative] people they disagree about how to do things [laughs]... so you have people talking about doing IPA [Interpretative Phenomenological Analysis] and they’re doing... and presenting it in completely different ways.*” Another Psychologist felt using ‘quantitative’ and ‘qualitative’ as an ‘either/or’ binary division erroneously suggested all questions were answerable, whereas: “*no method... can... answer this question... and this is something... many people I don’t think are getting is that those different methodologies come with huge limitations... and as a researcher you need... to appreciate... how far your work can go.*” One Communication Studies participant researcher even perceived the terms were becoming less used in all disciplines, and that, “*we’re certainly in a phase where even these labels now are becoming so arbitrary almost... that they’re not, not carrying a lot of meaning.*”

However, the terms were considered very context dependent: *"I think I'd be very hesitant about... pigeonholing any particular method I'd want to look very closely at the specific context in which that particular method or methodology is being used."* Further, some concepts were considered challenging to align with textbook representations. One German Literature participant researcher, reflecting on how the 'theoretical' worked, concluded, *"... the theoretical... I'm not sure whether... that is actually within the terms quantitative or qualitative or whether that's a term... on a different level altogether."* Indeed, many participant researchers (nine in total across many subject areas e.g. Design, Film and Media, Philosophy, Mathematical Biology) confirmed they were fully aware of the commonplace representations, but felt they did not apply to their own research, only using them to communicate with particular audiences (see below).

5.4.3 Theme 3: Perceptions on the value of 'Quantitative' and 'Qualitative' methods and approaches

As the data above show, many participant researchers valued both 'quantitative' and 'qualitative', including many scientists (in Geotechnics; Biology, Chemistry, Engineering). Many considered the specific research question key. For example: *"I certainly don't think quantitative bad, qualitative good: it's horses for courses, yeah"* (Tourism). Participant researchers in History and Music Education felt similarly; the latter commenting how *"I do feel it's about using the right tools which is why I wouldn't want to... enter into this kind of vitriolic negative mud-slinging thing that does happen within the fields because I think people... get too entrenched in one or the other and forget about the fact that these are just various ways to approach inquiry."* Similarly, one Psychologist observed, *"I'm always slightly irritated [laughs] when I hear people you know say 'Oh I'm only doing... qualitative research' or 'I'm only doing quantitative research'... I think it's the research question that should drive the methodological choices."* This participant researcher had *"seen good quality in both quantitative and qualitative research."*

Five participant researchers considered quantitative approaches to be of little value if they were applied inappropriately. For example, a Translation and Interpreting participant researcher felt quantitative data-generating eye tracking technology was useful *"for marketing,... product placement,...[or] surgeons."* However, for Translation and Interpreting, *"I don't think... it is a method that would yield results... you could find better in a more nuanced manner through other methods, interviews or focus groups, or even ethnographic observation."* One Chemist questioned the value of quantitative methods when the sample was too small. For example, when students were asked about their feedback on classes, and one student in 16 evaluated the classes badly, *"4% it was one person [laughs] in 16, one person, but I received that evaluation and I think this is not correct... because sometimes... I think that one person probably he or she didn't like me... well, it's life, so I think these aspects... may happen also but it's with the precision of the system... the capacity of the system to detect and to measure."* Meaningfulness was held to be key: *"When we do the analysis the sample has meaning"*. Similarly, a Theoretical Physicist felt quantitative approaches unsuited to education: *"in the context of education... we all produce data all the time... we grade students... we assess creativity... people will say... 'you measure somebody's IQ using this made-up test and you get this kind of statis[ti]c...' and then you realize that all of those things are just bogus... or at least... doesn't measure anything of any real serious significance."* Comparatively, one participant researcher in Design felt 'quantitative' had a danger to *"lead to stereotypes"*; for example, when modern search

engines use quantitative data to direct people to particular choices, “*There’s potential there to constrain kind of broader behaviours and thinking... and therefore it can become a programmer in its own right.*” One Mathematical Biologist commented how statistics can be misused, and how a popular Maths book related “*How statistics are a light shone on a particular story from a particular angle to paint a picture that people want you to see but... it’s almost never the whole picture, it’s a half-truth, if you like, at best.*”

Seven participant researchers considered that their disciplines valued quantitative over qualitative. This could be non-judgmental, and perhaps inherent in major areas of a discipline, as in Theoretical Physics, where precision is crucial, although this was said not to be ‘disparaging’: “*theoretical physics... or physics in general... we... tend to think of ourselves as being very, very quantitative and very precise, and we think of qualitative, I guess... as being a bit vague, right?... which is not disparaging, because sometimes... we have to be a bit vague... and we’re working things out.*” In Psychology, however, despite “*a call to advocate for more qualitative methods*”, there, “*definitely... is a bias toward quantitative... measures in psychology; all the high impact factor journals advocate for quantitative measures.*” In Nursing, quantitative was also deemed paramount, with “*the randomized control trial seen as being... you know the apex and... some researchers in our school would absolutely say it’s the only reliable thing... would be very anti-qualitative.*”

Yet, four participant researchers were positively oriented towards anything qualitative. For example, one Tourism researcher felt that, “*in an uncertain world, such as the one we’re living in today, qualitative research is the way forward.*” Also, an Architect highlighted that in one of their studies, “*I think the most important finding of my questionnaires was in the subjective comments.*” One Music education participant researcher personally favoured qualitative approaches but regretted how their field was biased toward quantitative data, saying they had been informed: “*‘what journals really care about is that p-value...’ and I remember... thinking... that’s a whole area of humanity... you’re failing to acknowledge.*”

Nevertheless, side-stepping this debate, nine researchers considered the terms of little value, and simply irrelevant for their own research. One Film and Media—English participant researcher commented: “*I have to say... these are terms I’m obviously familiar with, but... not terms... I... tend to really use in my own research... to describe what I do... mainly because everything that I do is qualitative.*” As an English Literature participant researcher noted in email correspondence: “*they are not terms we use in literary research, probably because most of what we do is interpretation of texts and substantiating arguments through examples. I have really only encountered these terms in the context of teaching and have never used them myself.*” In the interview, this participant researcher commented that “*I can imagine... they would be terms... quite common in the sciences and mathematics, but not Social Sciences and Arts.*” A German Literature participant researcher felt similarly, commenting that in “*German Literature... the term quantitative hadn’t even entered my vocabulary all the way through the PhD [laughs]... because... you could argue the methods in literary research are always qualitative.*”

Complementing such perspectives, in Theoretical Physics ‘qualitative’ and ‘quantitative’ was: “*not something that ever comes up... I don’t think I read a paper ever that will say we do qualitative research in any way, but I never... or hardly ever handle any data... I just have a bunch of principles that are sort of either taken to be true or are... a model... we’re exploring.*” In Mathematics, ‘quantitative’ was simply never used as all mathematics research was quantitative: “*I never use the word in the company of my colleagues, never, it’s a non-vocabulary word, for the simple reason that when everything is so well defined*

why do you need a generic term when you've got very specific reference points in the language that you're using?"

One Philosopher felt the terms did not fit conceptual analysis in philosophy, given that the object of consideration was uncertain: *"I guess... I thought it didn't fit conceptual analysis... you need to know what you're dealing with in order to then do the quantitative or qualitative whereas in philosophy it feels like... you don't quite know what you're dealing with you're trying to work out... what are rights?... What is knowledge? What is love?... and then look at its qualities."* For this researcher, Philosophy was tentatively pre-quantitative or pre-qualitative, because philosophy *"feels like it's before then."* The terms were not considered valuable for Philosophy or for the humanities generally: *"in philosophy we wouldn't use the term qualitative or quantitative research... you just use the tools... you need... to develop your argument and so you don't see the distinction... I would say in the humanities that's relatively similar."* Further, a Fine Art—Sculpture participant researcher said: *"they're not words I would use... partly because... I'm engaged with... through... research and... teaching... what I'd call practice research... and... my background's in fine art, predominantly in making sculpture and that doesn't contain knowledge."* Here, the participant researcher related how they may consider a student's work hideous but if the student had learned a lot through creating the work, they should be rewarded. This participant researcher spoke of a famous sound artist, concluding, *"if you asked him about qualitative and quantitative... it just wouldn't come into his thing at all.... He doesn't need to say well there were a thousand visitors plus you know it's just 'bang'... he wouldn't think about those things... not as an artist."*

Six participant researchers said they only ever used the terms for particular audiences. For example, for 'quantitative' in Film and Media: *"the only time is when it's been related to public engagement that we've ever sort of produced anything that is more along quantitative lines,"* and that *"it was not complex data we were giving them."* In Fine-Art Sculpture, too, the terms were solely used with a funder, for example, to measure attendance at an exhibition for impact, but *"that's not the type of research that I'm involved with necessarily."* One Logistics participant researcher commented that *"it really depends on the audience how you define qualitative or quantitative."* For this researcher, if communicating with *"statisticians econometricians or a bunch of people who are number crunchers"* then *"they will be very precise on what quantitative is and what qualitative is"* and would only recognise mathematical techniques as quantitative. Indeed, *"they wouldn't even recognize Excel as quantitative because it's not that hard."* In contrast, for social scientists, Excel would be quantitative, as would *"anything to do with numbers... I suppose you know a questionnaire where you have to analyse responses would be probably classed as quantitative."*

Conversely, a Mathematical Biology participant researcher commented they had been doing far more public outreach work, *"using quantitative data so numbers... even with things that might often be treated in a qualitative way... so stuff which... is often treated I think qualitatively we try to quantify... I think partly because it's easier to make those comparisons when you quantify something."* One researcher in Communication Studies said they advised a student that *"it depends on your research objectives; if you are focusing on individual experiences... I think naturally that's going towards qualitative, but if you're ... doing this research oriented to a leader of ... [a] big number of people... for informing policy... then you need some sort of insights that can be standardized... so it's a choice."*

Another Communication participant researcher felt political shifts in the 1990s and 2000s meant that a 'third way' now dominated with a move towards hybridity and a breakdown in 'qualitative' and 'quantitative' with everything now tied to neoliberalism.

Therefore, since *“the late 90s and early noughties I’ve seen this kind of hybridity in research methods almost as being in parallel with the third way there seems to be... no longer opposition between left and right everything... just happens to buy into neoliberalism so likewise... with research methods... there’s a breakdown of qual and quant.”* Comparatively, a Historian felt underpinning power structures informed approaches, commenting that *“the problem is not the terminology it’s the way in which power is working in the society in which we live in that’s the root problem it seems to me and what’s valued and what’s not.”* A Philosopher felt numbers appealed to management even when qualitative data were more suitable: *“I think management partly... are always more willing to listen to numbers... finding the right number can persuade people of things that actually... you think really a better persuasion would do something more qualitative and in context.”* One Fine Art participant researcher felt ‘quantitative’ and ‘qualitative’ only became important when they focused on processes related to the Research Excellence Framework but not for their research as such: *“I guess we are using qualitative and quantitative things in the sense of moving ourselves through the process as academics but that’s not what I’d call research.”*

6 Discussion: implications for teaching research methods

Research Methods teaching for undergraduate, postgraduate and newer researchers is commonly guided by textbook and seminal text understandings of what constitutes ‘qualitative’ and ‘quantitative’. Often, the two are treated in parallel, or interlinked, and used in combination or sequentially in research. But the relations between these are complex. The above analysis of the interview study with established participant researchers underlines and often extends this complexity, with implications for how such methodologies are approached and taught. Many of these participant researchers in disciplines commonly located within an ostensibly ‘positivist’ scientific tradition are, in fact, using qualitative methods as scientific procedures. They do so to provide initial measurements of phenomena before later using quantitative procedures to measure the quantity of a quality. They also use quantitative procedures to reveal data for which they subsequently use qualitative approaches to interpret and understand through their creative imaginations or experience. Participant researchers in ostensibly positivist disciplines describe themselves as doubting ‘facts’ measured by machines programmed by humans or doubting the certainty of quantitative data over time. Critically, these participant researchers engage in debate over what a ‘number’ is and the extent to which ‘numbers’ can be considered ‘quantitative’. One mathematician spoke of how many individuals do not know what they mean by the word ‘quantitative’, and an engineer interpreted any numbers involving human judgements as ‘qualitative’. Both a chemist and a geotechnician routinely defined and use ‘qualitative’ methods and analysis to arrive at numerical values.

Although this analysis of participant researchers’ reported practices refutes many textbook and key research methods source representations of quantitative and qualitative as being binary and separately ringfenced entities (contra e.g. Punch 2005; Goertz and Mahoney 2012), they resonate with much recent and current literature in the field (e.g. Uher 2022; De Gregorio 2014). In some disciplines, participant researchers only do a particular type of research and never need anything other than clear ‘quantitative’ definitions (Mathematics); others only ever conduct research involving text and never numbers (Literature). Further, other participant researchers considered how certain aspects lie outside the

'qualitative' or 'quantitative' (the 'theoretical' in German Literature), or they did research which they maintain does not contain 'knowledge' (Fine-Art Sculpture), while others do foundational 'conceptual' research which they claim comes at a stage before any quantity or quality can be assessed (Philosophy). Nine researchers considered the terms of little relevance at all to their subject areas.

This leads to subsequent questions. Firstly, do the apparently emerging tensions and contradictions between commonplace textbook and key source presentations and on-the-ground participant researcher practices matter? Secondly, what kind of discourse might reframe the more conventional one?

Regarding whether tensions and contradictions matter: in one practical way, perhaps not, since participant researchers in all these areas continue to be productive in their current research practices. Nevertheless, the foundations of the binary quantitative and qualitative divide are discourse expressions common to research methods courses. These expressions frame how the two terms are understood as the guide for novices to do research. This guiding discourse is evident in specifically designated chapters in research handbooks, in session titles in university research methods modules, and in entries for explanations of research terms within glossaries. The literature review study detailed above illustrates this. 'Quantitative' means numbers, 'qualitative' means words. 'Quantitative' connotes positivist, objective, scientific; 'qualitative' implies constructivist, subjective, non-science-based. Arguably, any acceptance of the commonplace research method understanding gives an apparent solidity which can sometimes be a false basis that masks the complexities or inadequacies involved. Such masking can, in turn, allow certain agencies or individuals to claim their policies and practices are based on 'objective' numerical data when they are merely framing something as 'quantitative' when, as a cited Mathematician participant researcher observed above, it is simply something with a number in it somewhere. Conventionally, limitations are mentioned in research studies, but often they seem ritualized remarks which refer to insufficient numbers, or restricted types of participants, or a constrained focus on a particular area. Rarely do research studies (let alone handbooks and guides for postgraduates) question a taken-for-granted understanding, such as whether the very idea of using numbers with human participants may mean the number is not objective. Ironically, it is the field of Qualitative Inquiry itself in which occasionally some of these issues are mentioned. Concurrently, while the quantitative is promoted as 'scientific' and 'objective evidence', we find some scientists researching in sciences often question the terms, or consciously set them aside in their practices.

Concerning what could replace the commonplace terms and reframe the research discourse environment: arguably, any discussion of 'quantitative'/'qualitative' should be preceded by key questions of how they are understood by researchers. Hammersley (2013) has suggested the value of a more nuanced approach. As the Communication Studies participant researcher here commented, the two terms seem to be breaking down somewhat. Nevertheless, alongside the data and arguments here, we see some value in considering things as being 'quantitative' or 'qualitative', and other value in viewing them as separate. The terms can still be simply outlined, not just as methodological listings of characteristics, but as a critical point, Outlines of methods should include insider practitioner views—illustrations of how they are used and understood by practising researchers in different disciplines (as in Table 2 above). This simple suggestion has benefits. When outlining approaches as qualitative or quantitative, we suggest space is devoted to how this is understood in disciplines, together with the opportunity to question the issues raised by these understandings. This would help to position the understandings of qualitative and quantitative within specific disciplinary contexts, especially in inter-disciplinary fields and, implicitly, it

encourages reflection on the objectivity and subjectivity evoked by the terms. Such discussion can be included in research methods texts and in research methods courses, dissertations and frameworks for viva examinations (Cortazzi and Jin 2021). Here, rather than start with outlining what the terms mean by using concrete definitions such as ‘Quantitative means X’ the terms should be outlined using subject contextualised phrases such as ‘In the field of X quantitative is understood to mean Y’. In this way, quantitative and qualitative methods and approaches can be seen, understood and contextualised within their subject areas, rather than prescriptively outlined in a generic or common form. Furthermore, if the field is one that has no use for such terms, this can also be stated, to prevent any unnecessary need for their use. Discourse around the terms can be extended if they are seen in line with much current literature and the data above that shows their complexities and overlaps, and goes beyond the binary choices and representations of many textbooks.

7 Conclusion

This paper has presented and discussed data from an interview study with experienced participant researchers ($n=31$) regarding their perceptions of ‘qualitative’ and ‘quantitative’ in their research areas. This interview study data was compared with findings from a literature review study of common textbooks and research methods publications ($n=25$) that showed often binary and reified representations of the terms and related concepts. The interview study data show many participant researcher understandings do in some ways align with the binary and commonplace representations of ‘qualitative’ and ‘quantitative’ as shown to be presented in many research methods textbooks and sources from the literature review study. However, the interview study data more often illustrate how such representations are somewhat inaccurate regarding how research is undertaken in the different areas researched by the participant researchers. Rather, they corroborate much of the current literature that shows the blurring and complexity of the terms. Often, they extend this complexity. Sometimes they bypass complexity when these terms are considered irrelevant to their research fields by many researcher participants. For some researchers, the terms are simply valueless. We propose that future research methods courses could present and discuss the data above, perhaps using something akin to Table 2 as a starting point, so that students and novice researchers are able to loosen or break free of the chains of any stereotypical representations of such terms or use them reflectively with awareness of disciplinary specific usage. This could help them to advance their research, recognizing complex caveats related to the boundaries of what they do, what methods they use, and how to conduct research using both quantitative and qualitative approaches, as interpreted and used in their own fields. In multi- or inter-disciplinary research, such reflective awareness seems essential. Future research could also study the impact of the use of the data here in research methods courses so that such courses encompass both qualitative and quantitative methods (cf. Onwuegbuzie and Leech 2005) yet also question and contextualise such terms in specific subject areas order to free research from any constraints created by binary representations of the terms.

Whilst we interviewed 31 participant researchers to approach what seems a reasonable level of saturation, clearly future research could add to what we have found here by speaking to a wider range and larger number of researchers. The 25 research methods sources in English (supplemented by 23 sources in German, Spanish and French) examined here

can clearly be expanded for a wider analysis of 'quantitative' and 'qualitative' in other languages for a more comprehensive European perspective. This strategy might ascertain likely asymmetries between the numerous English language texts (and their translations) and relatively smaller numbers of texts written by national or local experts in other languages. As a world-wide consideration, given the relative paucity of published research guidance in many languages, this point is especially significant related to fitting research methods to local contexts and cultures without imposition. Translating and discussing the terms 'qualitative' and 'quantitative', in and beyond European languages, will need care to avoid binary stereotyped or formulaic expression and to maintain some of the insight, resonances and complexities shown here.

Appendix 1: Literature review study

The table below contains details of the binary representations and possibilities in the two columns on the left and in the right it contains the numbers of the key sources that conveyed or adhered to these binary representations. The details of these sources and their respective numbers are listed below.

Table: Textbook and key source binary representations

Quantitative	Qualitative	Sources
Positivist	Constructivist	1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15, 19, 20, 21, 22, 23, 24, 25
Using traditions of Science	Not science based; reflective/ exploratory	3, 5, 6, 7, 8, 9, 11, 14, 15, 19, 20, 25
Structured & predetermined questions	Initially general questions, more focused later	1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 14, 19, 20, 22, 23, 25
Structured methods: Surveys, questionnaires, experiments	Less structured methods: Interviews, focus groups, narratives	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 14, 18, 19, 20, 22, 23, 25
Analysis to establish cause-effect <i>what</i> and <i>how</i> type information—well defined methods of analysis	Analysis to establish interpretative causal explanatory reasons—goes iteratively through data	2, 3, 4, 5, 6, 7, 9, 11, 14, 17, 18, 19, 20, 22, 23, 25
Generate statistics and numbers for analysis	Condense, display, and conclude from data—focus not numbers	
Reliability, Validity and Generalizability achieved through large scale research & numbers	Reliability, Validity and Generalizability achieved through in-depth small-scale research & numbers	1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 13, 14, 18, 19, 20, 21, 22, 23, 25
Value: for specific subjects and approaches—for e.g. Economics, the Sciences and to research large numbers—may see Qualitative of little value	Value: for specific subjects and approaches—for e.g. History, Anthropology and to research individuals' lived experiences—may see Quantitative of little value	5, 7, 9, 19, 20, 25
Mixed methods—possible		1, 2, 3, 6, 7, 8, 9, 16, 17, 18, 19, 21, 22, 23, 24, 25
Mixed Method—not possible		4, 5, 11, 12, 14

1. Bell, J., & Waters, S. (2014). *Doing your research Project: A Guide for first-time researchers*. McGraw-Hill Education (UK). 6th edn
2. Bloor, M., & Wood, F. (2006). *Keywords in qualitative methods: A vocabulary of research concepts*. London, UK: Sage Publications.
3. Bryman, A. (2008). *Social research methods*. Oxford, UK: Oxford University Press. [with caveats for many but still using the divide as 'useful']
4. Bryman, A., & Cramer, D. (2009). *Quantitative data analysis with SPSS 14, 15 and 16: A guide for social scientists*. London, UK: Routledge.
5. Ceglowski, D., Bacigalupa, C., & Peck, E. (2011). Aced out: Censorship of qualitative research in the age of "scientifically based research." *Qualitative Inquiry*, 17(8), 679–686.
6. Daly, K. J. (2007). *Qualitative Methods for Family Studies and Human Development*. London, UK: Sage.
7. Davies, M. B., & Hughes, N. (2014). *Doing a successful research project: Using qualitative or quantitative methods*. Bloomsbury Publishing.
8. Dawson, C. (2019). *Introduction to Research Methods 5th Edition: A Practical Guide for Anyone Undertaking a Research Project*. Robinson.
9. Denzin, N. K., & Lincoln, Y. S. (Eds.). (1998). *The landscape of qualitative research: Theories and issues*. Thousand Oaks, CA: Sage Publications. [with caveat that original qual was positivist in root but not now]
10. Denzin and Lincoln (2011) Introduction: The Discipline and Practice of Qualitative Research. In Denzin, N. K., & Lincoln, Y. S. (2011). *The Sage handbook of qualitative research*. Thousand Oaks, Calif: Sage. Pp1-20
11. Goertz, G., & Mahoney, J. (2012). *A tale of two cultures*. Princeton University Press.
12. Grix, J. (2004). *The foundations of research*. New York, NY: Palgrave Macmillan.
13. Hammersley, M. (2007). The issue of quality in qualitative research. *International Journal of Research & Method in Education*, 30(3), 287–305.
14. Hammersley, M. (2013). *What is qualitative research?* London, UK: Bloomsbury Academic. [caveat that some qual do use causal analysis – and if you mix you abandon key assumptions associated with qualitative work]
15. Harman, W. W. (1996). The shortcomings of western science. *Qualitative Inquiry*, 2(1), 30–38.
16. Howe, K. R. (2011). Mixed methods, mixed causes? *Qualitative Inquiry*, 17(2), 166–171.
17. Mason, J. (2006). Mixing methods in a qualitatively driven way. *Qualitative Research*, 6(1), 9–25.
18. Miles, M. B., Huberman, A. M., & Saldaña, J. (2018). *Qualitative data analysis: A methods sourcebook*. Sage publications.
19. Punch, K. (2005). *Introduction to Social Research Quantitative and Qualitative Approaches*. Sage.
20. Sandelowski, M. (1997). "To be of use": Enhancing the utility of qualitative research. *Nursing Outlook*, 45(3), 125–132 [caveat – does rebut many of the ideas but nevertheless outlines them as how the two are seen – e.g. of generalizability]
21. Seale, C. (1999). Quality in qualitative research. *Qualitative Inquiry*, 5, 465–478.
22. Silverman, D. (2016). Introducing qualitative research. *Qualitative research*, 3(3), 14–25.
23. Tashakkori, A., Teddlie, C., & Teddlie, C. B. (1998). *Mixed methodology: Combining qualitative and quantitative approaches* (Vol. 46). sage. [with the caveat that they talk about the differences as existing even though say they are not that wide]

24. Teddlie, C., & Tashakkori, A. (2011). Mixed methods research. Contemporary Issues in an emerging Field. in *The Sage handbook of qualitative research*, 4, 285–300.
25. Torrance, H. (2008). Building confidence in qualitative research: Engaging the demands of policy. *Qualitative Inquiry*, 14(4), 507–527.

Sources in languages other than English, and brief notes regarding their focus and content

Whilst not part of the literature review study, we also consulted the outline details, abstracts and contents lists of a number of sources in languages other than English. We put brief notes about after each source. Each source, unless specifically noted, adhered to similar binary treatment of quantitative and qualitative methods and approaches as the English language sources outlined above.

German

Blandz, M. (2021) *Forschungsmethoden und Statistik für die Soziale Arbeit: Grundlage und Anwendungen*. 2nd. edit. Stuttgart: Kohlhammer Verlag. – this is a multidisciplinary source that focuses mostly on quantitative and mixed methods. It follows the suggestion that a qualitative study can be a preliminary study for the main quantitative study.

Caspari, D; Klippel, F; Legutke, M. & Schram, K. (2022) *Forschungsmethoden: in der Fremdsprachendidaktik; Ein Handbuch*. Tübingen: Narr Franke Altempo Verlag. [Focused on foreign language teaching, details quantitative, then qualitative and then mixed; all separately]

Döring, N. (2023) *Forschungsmethoden und Evaluation in den Sozial- und Humanwissenschaften*. 6.th edit. Berlin: Springer. [Focused on the Social Sciences and humanities; as with the previous source it has separate chapters on quantitative and qualitative and a section on mixed, and contains some critical commentary]

Frankenberger, N. (Ed.) (2022) *Grundlagen der Politikwissenschaft: Forschungsmethoden und Forschendes Lernen*. Stuttgart: Kohlhammer Verlag. [Political science focused and based around distinctions between quantitative and qualitative approaches, each of which is elaborated with different methods; there is no obvious section on mixed methods]

Hussy, W; Schiener, M; Echterhoff, G. (2013) *Forschungsmethoden in Psychologie und Sozialwissenschaften für Bachelor*. Berlin: Springer. [This book is focused on psychology and social sciences for undergraduates. It has separate parts to focus on quantitative and on qualitative and then a chapter on mixed, identifying mixed methods as an emerging trend]

Niederberger, M. & Finne, E. (Eds.) (2021) *Forschungsmethoden in der Gesundheitsförderung und Prävention*. Berlin: Springer. [Focused on Health and wellbeing; develops the roles of quantitative, qualitative and mixed (in combinations) in multidisciplinary, interdisciplinary and transdisciplinary research. Notes much research is exclusively quantitative and that social sciences are more qualitative or mixed. Makes the argument that the quantitative versus qualitative divide was sur-

passed by ‘post-positivist’ versus ‘combined’ thinking and that integrated approaches are now widely accepted]

Spanish

Campos-Arenas, A. (2014) *Métodos mixtos de investigación*. Bogota: Magisterio Editorial. [Social science focused; devoted to mixed or combined approaches in Latin American contexts]

Hernandez-Sampieri, R. & Mendoza Torres, C. P. (2018) *Metodología de investigación: Las rutas cuantitativa, cualitativa y mixta*. Mexico: McGrw-Hill. [Social science focused with an introduction and conclusion focused on ‘three routes to research’ that are exceptionally and thoroughly elaborated; quantitative given 8 chapters; qualitative 3 and mixed just one]

Léon-García, O. G. & Carda-Celay, I. M. (2020) *Métodos de investigación en psicología y educación: Las tradiciones cuantitativas y cualitativas*. 5.th edit. Barcelona: McGraw-Hill, España. [Psychology and education focused; based on relatively clearly cut distinctinos between ‘the two traditions’ of quantitative and qualitative]

Molina Marin, G. (Ed.) (2020) *Integración de métodos de investigación: Estrategias metodológicas u experiencias en salud pública*. Bogotá: Universidad de Antioquia. [Public health focused; gives most attention to multi-method combinations and asks questions about the epistemological integrity of integrating different approaches]

Ortega-Sanchez, D, (Ed.) (2023) *¿Como investigar en didáctica de las ciencias sociales? Fundamentos metodológicos, técnicas e instrumentos de investigación*. Barcelona: Octaedro. [Education, research, pedagogy of teaching social sciences; focused on quantitative, qualitative and mixed methods in Spanish contexts]

Páramo-Reales, D. (2020) *Métodos de investigación caulitativa: Fundamentos y aplicaciones*. Bogota: Editorial Unimagdalena. [Social sciences: basic applications of qualitative approaches in Latin America]

Ponce, O. A. (2014) *Investigación de métodos mixtos en educación*, 2.nd edit. San Jaun: Publicaciones Puertorriqueñas. [Education and Pedagogy; Puerto Rican context and entirely about mixed methods]

Vasilachis de Giradino, I. (Ed.) (2009) *Estrategias de investigación cauitativa*. Barcelona: Editorial Gedisa. [Social sciences; much detail on research design; focus exclusively on qualitative methods in Spanish contexts]

French

Bouchard, S. & Cyr, C. (Eds.) (2005) *Reserche psychosocial pour harmoniser reserche st pratique*. Quebec: Prese de la Université de Quebec. [Focused on psychology and sociology. Despite its title about ‘harmonizing’ research it is mainly focused on quantitative approaches, with a small section on qualitative and nothing on mixed approaches]

Corbière, M. & Lamviere, N. (2021) *Méthodes quantitatives, qualitatives et mixtes, dans la reserche en sciences humaines et de la santé*. 2.nd edit. Quebec: PU Quebec. [Focused on Humanities and health care; highlights the division between quantitative, qualitative and mixed methods]

- Devin, G. (Ed.) (2016) *Méthodes de recherche en relations internationales*. Paris: Sciences Po. [Focused on politics and international relations; mostly wholly focused on quantitative; only a little on qualitative]
- Gavard-Perret, M.L; Gotteland, D; Haon, C. & Jolibert, A. (2018) *Methodologie de la recherche en sciences de gestion: Réussir son mémoire ou sa these*. Paris: Pearson. [Business and management focused and geared towards thesis research; notes clear distinctions between quantitative and qualitative approaches with nothing on mixed]
- Komu, S. C. S. (2020) *Le recueil des méthodes en sciences sociales: Méthodologies en recherche*. Manitoba: Sciences Script. [Social sciences focused; mostly quantitative methods with some attention to focus groups and participatory research]
- Lepillier, O; Fournier, T; Bricas, N. & Figuié, M. (2011) *Méthodes d'investigation de l'alimentation et des mangeurs*. Versailles: Editions Quae. [Focused on nutrition, health studies and diet; details quantitative and qualitative methods and has very little on mixed]
- Millette, M; Millerand, F; Myles, D. & Latako-Toth, T. (2021) *Méthodes de recherches en contexte humaine, une orientation qualitative*. Montreal: PU Montreal. [Humanities focused; outlines quantitative and qualitative methods and, unusually, attends to 'qualitative investigations in numerical contexts' in Canada]
- Moscarda, J. (2018) *Faire parler les données: Méthodologies quantitatives et qualitatives*. Caen: Editions EMS. [Has a multidisciplinary focus on 'let the data talk'; deals with quantitative methods and then qualitative methods and also mixed]
- Vallerand, R. J. (2000) *Méthodes de recherche en psychologie*. Quebec: Gaetan Morin. [Focused on psychology; emphasis on quantitative research; brief section on qualitative; Canadian contexts]

Appendix 2: Interview study schedule

Understandings of 'qualitative' and 'quantitative'

This research project is exploratory and intends to delve into understandings of the specific terms 'quantitative' and 'qualitative' as they are perceived, used, and interpreted by researchers in very different fields. Such research is intended to shed light on the fields of quantitative and qualitative research. The idea for the research arises from a previous project where the researcher interviewed quantitative focused researchers and saw the use of qualitative and quantitative being used and interpreted very differently to how the terms are presented and understood in the research methods literature. It is expected that exploring these understandings further will add to the field by shedding light on the subtleties of how they are used and also in turn help researchers make informed decisions about the optimum approaches and methods to use in their own research.

Interview questions

What are your understandings of:

'qualitative' and 'quantitative'

How are they used and approached in your research and field?

I suppose I would be thinking about overall approaches, about specific methods, about understandings and also about approaches to analysis.

Informed Consent Form (informed consent part II)

[Understandings of 'qualitative' and 'quantitative']

Edinburgh Napier University requires that all persons who participate in research studies give their written consent to do so. Please read the following and sign it if you agree with what it says.

1. I freely and voluntarily consent to be a participant in this research to be conducted by [xxxxxxx], who is a staff member in xxxxxx who will work on the project with a co-author xxxxx emeritus professor at Warwick University who... I have worked on a number of projects with over the years.
2. I have been informed of the broad goal of this research study. I have been told what is expected of me and that the study should take no longer than [2 years] to complete.
3. I have been told that my responses will be anonymised. My name will not be linked with the research materials, and I will not be identified or identifiable in any report subsequently produced by the researcher. I have been told that these data are for **may be submitted for publication** (delete one alternative).
4. I also understand that if at any time during the [interview]. If I feel unable or unwilling to continue, I am free to leave. That is, my participation in this study is completely voluntary, and I may withdraw from it at any time without negative consequences.
5. In addition, should I not wish to answer any particular question or questions, I am free to decline.
6. I have been given the opportunity to ask questions regarding the [interview] and my questions have been answered to my satisfaction.
7. I have read and understand the above and consent to participate in this study. My signature is not a waiver of any legal rights. Furthermore, I understand that I will be able to keep a copy of this consent form for my records.

Participant's Signature

Date

I have explained and defined in detail the research procedure in which the respondent has consented to participate. Furthermore, I will retain one copy of the informed consent form for my records.

Researcher's Signature

Date

Author contributions All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Nick Pilcher and Martin Cortazzi. The first draft of the manuscript was written by NP along with MC and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Funding The authors declare that no funds, grants, or other support were received during the preparation of this manuscript.

Declarations

Conflict of interest The authors have no relevant financial or non-financial interests to disclose.

Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

References

- Aspers, P., Corte, U.: What is qualitative in qualitative research. *Qual. Sociol.* **42**(2), 139–160 (2019)
- Atkinson, K.M., Koenka, A.C., Sanchez, C.E., Moshontz, H., Cooper, H.: Reporting standards for literature searches and report inclusion criteria: making research syntheses more transparent and easy to replicate. *Res. Synth. Methods* **6**(1), 87–95 (2015)
- Autran, D., Bassel, G.W., Chae, E., Ezer, D., Ferjani, A., Fleck, C., Wolf, S.: What is quantitative plant biology? *Quant. Plant Biol.* (2021). <https://doi.org/10.1017/qpb.2021.8>
- Bakhtin, M.: *The dialogic imagination*. University of Texas Press, Austin (1981)
- Bakhtin, M. M. Speech genres and other late essays. In: Trans. Vern W. McGee; Ed. Caryl Emerson and Michael Holquist. University of Texas Press, Austin, (1986)
- Barone, T.: A return to the gold standard? Questioning the future of narrative construction as educational research. *Qual. Inq.* **13**(4), 454–470 (2007)
- Bell, J., Waters, S.: *Doing your research project: a guide for first-time researchers* (6th edit.). McGraw-Hill Education, London, (2014)
- Bird, C.M.: How I stopped dreading and learned to love transcription. *Qual. Inq.* **11**(2), 226–248 (2005)
- Bloch, M.: A discourse that disciplines, governs, and regulates: The national research c report on scientific research in education. *Qual. Inq.* **10**(1), 96–110 (2004)
- Bloor, M., Wood, F.: *Keywords in qualitative methods: A vocabulary of research concepts*. Sage, London (2006)
- Braun, V., Clarke, V.: Using thematic analysis in psychology. *Qual. Res. Psychol.* **3**(2), 77–101 (2006). <https://doi.org/10.1191/1478088706qp063oa>
- Braun, V., Clarke, V.: To saturate or not to saturate? Questioning data saturation as a useful concept for thematic analysis and sample-size rationales. *Qualit. Res. Sport Exer. Health* **13**(2), 201–216 (2021)
- Cambridge: *Cambridge Dictionary. English Dictionary*. Available at: <https://dictionary.cambridge.org/dictionary/english/> Last Accessed January 2023. (2022)
- Chan, E.S., Okumus, F., Chan, W.: What hinders hotels' adoption of environmental technologies: a quantitative study. *Int. J. Hosp. Manag.* **84**, 102324 (2020)
- Charmaz, K.: Grounded theory. Objectivist and constructivist methods. In W. Luttrell (Ed.), *Qualitative educational research: Readings in reflexive methodology and transformative practice* (pp. 183–207). Routledge, New York. (2010)
- Christians, C.G.: Ethics and politics in qualitative research. In: Denzin, N.K., Lincoln, Y.S. (eds.) *The Sage handbook of qualitative research*, pp. 61–80. Sage, Thousand Oaks, CA (2011)
- Cortazzi, M., Pilcher, N., Jin, L.: Language choices and 'blind shadows': investigating interviews with Chinese participants. *Qual. Res.* **11**(5), 505–535 (2011)
- Cortazzi, M., Jin, L.: The doctoral viva: questions for, with and to candidates (or supervisors). *Int. J. Educat. Lit. Stud.* **9**(4), 2–15 (2021)

- Creswell, J.W.: *Research design: Qualitative & quantitative approaches*. Sage, Thousand Oaks, CA (1995)
- Davies, M.B., Hughes, N.: *Doing a successful research project: Using qualitative or quantitative methods*. Macmillan International Higher Education, London (2014)
- Dawson, C.: *Introduction to Research Methods: A Practical Guide for Anyone Undertaking a Research Project*, 5th edn. Robinson, London (2019)
- De Gregorio, E.: Bridging “quality” and “quantity” in the study of criminal action. *Qual. Quant.* **48**(1), 197–215 (2014)
- Denzin, N.K., Lincoln, Y.S. (eds.): *The landscape of qualitative research: Theories and issues*. Sage, Thousand Oaks (1998)
- Denzin, N.K., Lincoln, Y.S. (eds.): *The SAGE handbook of qualitative research* (4th edit). Sage, Thousand Oaks (2011)
- Flyvbjerg, B.: Five misunderstandings about case-study research. *Qual. Inq.* **12**(2), 219–245 (2006)
- Francis, J.J., Johnston, M., Robertson, C., Glidewell, L., Entwistle, V., Eccles, M.P., Grimshaw, J.M.: What is an adequate sample size? Operationalising data saturation for theory-based interview studies. *Psychol. Health* **25**(10), 1229–1245 (2010)
- Goertz, G., Mahoney, J.: *A tale of two cultures*. Princeton University Press, New Jersey (2012)
- Golafshani, N.: Understanding reliability and validity in qualitative research the qualitative report, vol. 8 no. 4 597–607. (2003). <http://www.nova.edu/ssss/QR/QR8-4/golafshani.pdf>
- Grix, J.: *The undations of research*. Palgrave Macmillan, New York (2004)
- Guba, E.G., Lincoln, Y.S.: Competing paradigms in qualitative research. In: Denzin, N.K. Lincoln, Y.S. (eds.) *Handbook of qualitative research*, pp. 105–117. Sage, Thousand Oaks, 1994
- Guest, G., Bunce, A., Johnson, L.: How many interviews are enough? An experiment with data saturation and variability. *Field Methods* **18**(1), 59–82 (2006)
- Hammersley, M.: *What is qualitative research?* Bloomsbury Academic, London (2013)
- Hanson, B.: Wither qualitative/quantitative? Grounds for methodological convergence. *Qual. Quant.* **42**, 97–111 (2008)
- Heyvaert, M., Maes, B., Onghena, P.: Mixed methods research synthesis: definition, framework, and potential. *Qual. Quant.* **47**(2), 659–676 (2013)
- Howe, K.R.: Against the quantitative–qualitative incompatibility thesis or dogmas die hard. *Educ. Res.* **17**(8), 10–16 (1988)
- Johnson, R.B., Onwuegbuzie, A.J., Turner, L.A.: Toward a definition of mixed methods research. *J. Mixed Methods Res.* **1**(2), 112–133 (2007)
- Kumar, R.: *Research methodologies: a step-by-step guide for beginners*. Sage, London (1996)
- Levitt, H.M., Bamberg, M., Creswell, J.W., Frost, D.M., Josselson, R., Suarez-Orozco, C.: Journal article reporting standards for qualitative research in psychology: The APA publications and communications board task force report. *Am. Psychol.* **73**(1), 26–46 (2018)
- Lincoln, Y.S., Guba, E.G.: *Naturalistic inquiry*. Sage, Thousand Oaks (1985)
- Marsh, C.: Problems with surveys: method or epistemology? *Sociology* **13**(2), 293–305 (1979)
- Marsh, D., Furlong, P.: A skin, not a sweater: ontology and epistemology in political science. *Theory Methods Polit. Sci.* **2**(1), 17–41 (2002)
- Mason, J.: Mixing methods in a qualitatively driven way. *Qual. Res.* **6**(1), 9–25 (2006)
- Miles, M. B., Huberman, A. M., Saldaña, J.: *Qualitative data analysis: A methods sourcebook* (4th edit.). Sage, Los Angeles, (2018)
- Miles, M.B., Huberman, A.M.: *Qualitative data analysis: An expanded sourcebook*. Sage, Thousand Oaks (1994)
- Moore, N.: *How to do research: a practical guide to designing and managing research projects*, 3rd edn. Facet, London (2006)
- Morse, J.M.: Approaches to qualitative–quantitative methodological triangulation. *Nurs. Res.* **40**(2), 120–123 (1991)
- Olssen, M.: Radical constructivism and its failings: anti-realism and individualism. *Br. J. Educ. Stud.* **44**(3), 275–295 (1996)
- Onwuegbuzie, A.J., Leech, N.L.: Taking the “Q” out of research: teaching research methodology courses without the divide between quantitative and qualitative paradigms. *Qual. Quant.* **39**(3), 267–295 (2005)
- Pilcher, N., Cortazzi, M.: Dialogues: QUANT researchers on QUAL methods. *Qual. Report* **21**(3), 450–473 (2016)
- Punch, K.: *Introduction to social research quantitative and qualitative approaches*. Sage, Thousand Oaks (2005)
- Saunders, B., Sim, J., Kingstone, T., Baker, S., Waterfield, J., Bartlam, B., Jinks, C.: Saturation in qualitative research: exploring its conceptualization and operationalization. *Qualit. Quant.* **52**(4), 1893–1907 (2018)

- Seale, C.: Quality in qualitative research. *Qual. Inq.* **5**, 465–478 (1999a)
- Seale, C.: *The Quality of Qualitative Research*. Sage, London (1999b)
- Sharma, G.: Pros and cons of different sampling techniques. *Int. J. Appl. Res.* **3**(7), 749–752 (2017)
- St Pierre, E.A.: Refusing alternatives: a science of contestation. *Qual. Inq.* **10**(1), 130–139 (2004)
- Tashakkori, A., Teddlie, C., Teddlie, C.B.: *Mixed methodology: Combining qualitative and quantitative approaches*. Sage, Thousand Oaks (1998)
- Teddlie, C., Tashakkori, A. Mixed methods research. *Contemporary Issues in an emerging Field*. In Denzin, N.K., Lincoln, Y.S. (eds.) *The Sage handbook of qualitative research* (4th edit.), pp. 285–300. Sage, Thousand Oaks, (2011)
- Trafford, V., Leshem, S.: Starting at the end to undertake doctoral research: predictable questions as stepping stones. *High. Educ. Rev.* **35**(1), 31–49 (2002)
- Uher, J.: Functions of units, scales and quantitative data: fundamental differences in numerical traceability between sciences. *Qual. Quant.* **56**(4), 2519–2548 (2022)
- Merriam Webster: Definition of 'semi'. (2022). Available at <https://www.merriam-webster.com/dictionary/semi>

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.