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Essay title: Do mixed-methods work?

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1. Introduction

Mixed methods research is a valuable tool to investigate the complexities of social reality. This essay will start by summarising the ontological, epistemological and methodological considerations in social research to provide the necessary philosophical context. It will subsequently focus on existing research in the field of human-computer interaction – in particular, Nicolson et al.'s (2011) study on the usability of websites with information about medicines, Powell and Deetjen's (2019) characterisation of digital health citizens, and Scott et al.'s (2017) analysis of the factors impacting the use of a postoperative mHealth app – to identify opportunities and challenges created by using both quantitative and qualitative approaches in a single study. It will conclude that mixed methods research is a valuable tool to investigate the complexities of social reality and, in particular, the complexities of human-computer interaction, despite the potential challenges created by crossing the methodological divide.

2. Ontological, epistemological and methodological considerations

Every piece of social research is underpinned by philosophical considerations that precede the methodology and represent the basis of the work of social scientists. Ontology and epistemology represent “a skin not a sweater: they cannot be put on and taken off whenever the researcher sees fit” (Marsh and Furlong, 2002, p. 17). While ontological considerations focus on “the nature of social entities” (Bryman, 2012, p. 32), epistemological considerations focus on what is “regarded as acceptable knowledge in a discipline” (Bryman, 2012, p. 27).

On the one hand, researchers who follow a positivist epistemology advocate “the application of the methods of the natural sciences to the study of social reality” (Bryman, 2012, p. 28) and tend to adopt quantitative techniques of data collection and analysis. Quantitative researchers are inclined to use a deductive approach to develop a hypothesis and test an existing theory. On the other hand, the interpretivist epistemology requires researchers to “grasp the subjective meaning of social action” (Bryman, 2012, p. 30) and leads to embracing qualitative research methods. Qualitative methods predominantly employ an inductive approach to recognise patterns in the data and develop a theory.

3. Crossing the methodological divide

Choosing between quantitative and qualitative research methods is a long-lasting divide in the social sciences. While quantitative purists argue that quantitative, hard and generalisable

data is superior, qualitative purists argue that qualitative, deep, rich and observational data is superior (Sieber, 1973, p. 1335). Both sides of the argument “view their paradigms as the ideal for research” (Johnson and Onwuegbuzie, 2004, p. 14) and claim that “compatibility between quantitative and qualitative methods is impossible due to incompatibility of the paradigms that underlie the methods” (Tashakkori and Teddlie, 1998, p. 11).

Unlike the proponents of the incompatibility thesis, many authors emphasise the advantages of combining methods. According to Johnson, Onwuegbuzie and Turner (2007, p. 113), although mixed methods research can be seen from the start of the 20th century in the work of cultural anthropologists, it was only formalised in 1959 by Campbell and Fiske. Since then, the concept has been defined in many different ways. For the purpose of this essay, Johnson and Onwuegbuzie’s (2004) definition is adopted, since it is general enough to encompass the wide variety of research designs and purposes of mixing methods: “Mixed methods research is the class of research where the researcher mixes or combines quantitative and qualitative research techniques, methods, approaches, concepts or language into a single study” (Johnson and Onwuegbuzie, 2004, p. 17).

4. Opportunities and challenges of using mixed methods applied to three research projects in the human-computer interaction field

This section of the essay analyses three research projects conducted in the field of human-computer interaction to highlight the opportunities and challenges created by using mixed methods in a single study. The analysis is structured through the following points of integration: *4.1. Researchers*, *4.2. Research design*, *4.3. Data collection*, *4.4. Data analysis*, and *4.5. Report findings*. While different authors identify different points of integration, this essay uses Guest’s (2012, p. 146) broad definition of point of integration as the “point in a study where two or more research components are mixed or connected in some way”. The characteristics of the three studies used as examples are presented in Table 1.

Table 1 – Characteristics of the three studies used as examples in this essay

Author, year	Nicolson et al., 2006	Powell and Deetjen, 2019	Scott et al., 2017

Main purpose of the study	Examine the usability and readability of websites with information about medicines	Derive a typology for digital health citizens	Analysis of factors impacting use of a postoperative mHealth app
Purpose of mixing¹	Complementarity	Triangulation	Expansion
Prioritised method	Qualitative	Equal	Equal
Points of integration	Researchers, research design, data collection, and data analysis	Research design	Research design, data collection, and report findings
Design type²	Concurrent-sequential	Multiphase	Multiphase
Sources of qualitative data	Observation, record of the participants' online actions, and verbal protocol integration (first part of the study). Semi-structured interviews (second part of the study)	Semi-structured interviews (first part of the study)	Semi-structured interviews (second part of the study)
Sources of quantitative data	User testing (first part of the study)	Oxford Internet Survey (OxIS) (second part of the study). Cluster analysis (third part of the study)	Demographics (first part of the study). System Usability Scale (first and second parts of the study). Charts and app use metrics (third part of the study)

1. Using Greene, Caracelli and Graham's (1989, p. 259) classification of the purposes of using mixed methods

2. Using Creswell and Clark's (2010, pp. 68-70) classification of the major mixed methods designs

4.1. Point of integration: Researchers

According to Read and Marsh (2002, p. 241), the core problem of combining methods is that researchers cannot hold two different ontological or epistemological positions within the same study. For example, positivist researchers should preserve their position even when

conducting qualitative research. At the same time, researchers who advocate the subjective meaning of social action should preserve their interpretivist position even when conducting quantitative research. Although epistemological and ontological positions tend to be associated with certain research methods, this may not always be the case. In fact, social research lacks absolute determinism (Bryman, 2012, p. 614). For example, Nicolson et al.'s (2011) study on the usability and readability of websites with information about medicines emphasises a quantitative research method – the User Test – as the “dominant method of the study” (Nicolson et al., 2011, p. 28). Nevertheless, it appears to be broadly interpretivist in its epistemological orientation: it employs a total of four qualitative methods and only one quantitative method of data collection; it uses post-test interviews to help explain the initial quantitative results, describing itself as an overall “explanatory piece of work” (Nicolson et al., 2011, p. 28); and it argues that the think-aloud protocol, a qualitative method, “was central to the evaluation in the study” (Nicolson et al., 2011, p. 30).

4.2. Point of integration: Research design

According to Creswell and Clark (2010, pp. 68-70), integration of mixed methods at the research design level occurs through a relatively small set of possible combinations: convergent parallel design, explanatory sequential design, exploratory sequential design, embedded design, transformative design, and multiphase design.

Nicolson et al.'s (2011) study introduces a new combination type that adds to Creswell and Clark's typology: a combined concurrent-sequential design. In the first part of the study, four methods were used concurrently: User Test, observation, record of the participants' online actions, and verbal protocol integration. In the second part of the study, post-test interviews were sequentially mixed. The reasons for these methods being mixed this way will be explored later in this essay (5.3. *Point of integration: Data collection*). However, it is worth noting here that the concurrent-sequential design is an example of the many approaches researchers can adopt when designing their mixed studies. As Johnson and Onwuegbuzie (2004, p. 20) state, “the point is for the researcher to be creative and not be limited by the designs”.

Unlike Nicolson et al.'s (2011) study, Powell and Deetjen's (2019) characterisation of digital health citizens (2019) employs a multiphase research design. Researchers started by conducting 43 semi-structured interviews to ascertain participants' motivations to use the internet to solve health-related issues. Then, variables from the OxIS were used to provide a quantitative measure for the motivations previously identified. As an example, the motivation ‘convenience and speed of access at all times’ was measured by the numerical variable ‘internet usefulness’. This design is illustrative of how researchers can sequentially

triangulate findings to “seek convergence, corroboration, and correspondence of results from the different methods” (Johnson, Onwuegbuzie and Turner, 2007, p. 115). The convergence of qualitative and quantitative findings increases the validity of the research and “enhances our belief that the results are not a methodological artifact” (Bouchard, 1976, p. 268). The last method (run sequentially) in this study was a cluster analysis of the numerical variables, from which six types of digital health citizens were identified: *the learners*, *the pragmatists*, *the sceptics*, *the worriers*, *the delegators*, and *the adigitals*.

Similar to Powell and Deetjen’s (2019) study, Scott et al.’s (2017) analysis of the factors impacting the use of a postoperative mHealth app employed a multiphase research design. To summarise, researchers started by collecting demographic data and asking patients to rate the app using the System Usability Scale (SUS). At follow-up, the SUS was repeated and semi-structured interviews were conducted. In the third part of the study, charts and app use metrics were reviewed. Each research method was used with a particular purpose and to evaluate a particular dimension of the phenomenon. For example, the SUS was used to measure the usability of the app, semi-structured interviews were conducted to “extract the most consistent themes” (Scott et al., 2017, p. 3), and app use metrics were employed to have a quantitative measure of how patients were actually using the app. The purpose of using mixing methods in this research project was, using the popular classification introduced by Greene, Caracelli and Graham, expansion. According to the authors, expansion seeks to “extend the scope, breadth, and range of inquiry by using different methods for different inquiry components” (Greene, Caracelli and Graham, 1989, p. 269).

4.3. Point of integration: Data collection

According to Read and Marsh (2002, p. 237), one of the main reasons for combining methods is the fact that frequently, “one method does not allow the researcher to address all the aspects of the research question”. This seems to have been the case in the first part of Nicolson et al.’s (2011) study, when the researchers employed one quantitative method to measure the readability of websites with information about medicines and multiple qualitative methods to evaluate their usability. Readability, an important concept in the field of human-computer interaction, “measures the complexity of the words and sentence structure in a piece of content” (Nielsen, 2015). The core idea behind this concept is that “complex sentences are harder to parse and read than simpler ones” (Nielsen, 2015). Usability, another important concept in the field of human-computer interaction, is a “quality attribute that assesses how easy user interfaces are to use” (Nielsen, 2012). It has five quality components: learnability, efficiency, memorability, errors, and satisfaction.

The first part of Nicolson et al.'s (2011) study employed the following methods simultaneously: (1) User Test, (2) observation, (3) verbal protocol integration, and (4) tracking participants' online actions. During the User Test, participants were individually asked if they could find key information about a medicine in a particular website and if they were able to interpret the information. The User Test was an efficient method to determine whether participants could locate and interpret the information correctly but was insufficient to understand the reasons behind a participant's success or failure in doing so. According to the authors of the study, this was the rationale for "mixing the User Test with concurrent usability methods" (Nicolson et al., 2011, p. 29). The second method used simultaneously was observation. Defined by Marshall and Rossman (1989, p. 79) as "the systematic description of events, behaviours, and artefacts in the social setting chosen for study", observational studies are a good method to examine how people use technologies in their intended settings. The third method used simultaneously was the think-aloud protocol. While researchers observed user behaviour, participants were asked to think aloud while performing their activities. Ericsson and Simon (1984, p. 1) define the think-aloud protocol as the verbalisation of "thoughts and successive behaviours while ... performing cognitive tasks". In the usability field, it has been regularly used to capture users' thoughts that would otherwise have been impossible to realise. The fourth method used simultaneously was tracking participants' online actions. Researchers recorded the actions of the person using the website and tracked events using computer software. This enabled researchers to focus on the User Test, observation and think-aloud protocol and perform further analysis later.

In the second part of the study, post-test interviews were sequentially mixed to gain an understanding of and clarify the initial findings and explore aspects of the research question that quantitative research could not address. Participants had the opportunity to express their opinions about the site and researchers explored the reasons for people acting as they did, focusing on particular aspects identified during the first part of the study, for example "why participants had difficulty finding the information to answer a specific question" (Nicolson et al., 2011, p. 30). The purpose of conducting interviews immediately after the usability study was, using the popular classification introduced by Greene, Caracelli and Graham, complementarity. According to the authors, complementarity can be defined as "seeking elaboration, enhancement, illustration, clarification of the results from one method with results from the other method" (Greene, Caracelli and Graham, 1989, p. 259).

Despite all the potential advantages, using quantitative and qualitative methods in a single study is not without problems. Johnson and Onwuegbuzie (2004, p. 21) argue that it can be "difficult for a single researcher to carry out both qualitative and quantitative research, especially if two or more approaches are expected to be used concurrently". This problem was faced in the initial pilot of Nicolson et al.'s (2011) study, when researchers tried to use

and record four concurrent methods. According to the authors, it “produced cognitive overload because the researcher spent much time writing his observation notes, the answers to the questions, and important verbalisations made by the participants” (Nicolson et al., 2011, p. 46). The solution found was to use computer software to record online actions and verbal expressions, enabling the researcher to “focus on asking the User Test questions and noting his reflections” (Nicolson et al., 2011, p. 46).

As mentioned previously in this essay, Scott et al.’s (2017) research conducted semi-structured interviews with patients regarding the use of a postoperative mHealth app (second part of the study). During interviews, researchers asked both closed-ended and open-ended questions related to app use. While closed-ended questions (e.g. “Did you use the reminders?”) generated quantitative data and helped researchers to find the most common themes, open-ended questions (e.g. “If yes, were the reminders helpful?” and “If no, why not?”) generated qualitative data and helped researchers to understand the reasons behind the patient’s actions or inactions. The use of closed-ended questions followed by open-ended questions about the same subject is a popular pattern in interviews and is widely used in research in the human-computer interaction field.

4.4. Point of integration: Data analysis

The voluminous, unstructured and unwieldy nature of qualitative data (Richie and Spencer, 1994; Bryman and Burgess, 1994) often makes data analysis a challenging and overwhelming task. In these circumstances, researchers might use a process of qualitative data reduction commonly known as coding to identify, categorise and label patterns in data. In the field of human-computer interaction, coding is commonly used to make sense of the data generated by user interviews and to help researchers identify user needs and usability problems. For example, Nicolson et al.’s (2011) study employed content analysis, a popular type of coding, to note “common themes repeatedly raised and themes that emerged less often” (Nicolson et al., 2011, p. 33). Researchers were then able to identify the most common usability problems in the five websites analysed. This study’s use of content analysis to measure the frequency of different themes is an example of how “numbers can be used to add precision to words, pictures, and narrative” (Johnson and Onwuegbuzie, 2004, p. 21).

4.5. Point of integration: Report findings

According to Kidder and Fine (1987, p. 225), “incongruent findings hold promise for greater discovery as researchers develop alternative theoretical explanations to account for the phenomenon”. This seems to be the case in Scott et al.’s (2017) analysis of the use of a postoperative mHealth app. Despite the high quantitative ratings for usability given by

patients during the SUS test (95 out of 100), semi-structured interviews and app use metrics “revealed a more mixed assessment of usability and lower-than-desired use” (Scott et al., 2017, p. 5). In fact, 30% of the patients never used the app after surgery and 10% only used it once. Researchers used this apparent contradiction as an opportunity and concluded that “high usability alone is not sufficient to motivate patients to use smartphone apps in the postoperative period” (Scott et al., 2017, p. 1). Furthermore, researchers recognised the potential of using mHealth apps to improve communication after surgery but emphasised a patient-centred approach to design “with patients’ beliefs and attitudes in mind” (Scott et al., 2017, p. 8).

5. Conclusion

The essay concludes that mixed methods research is a valuable tool to investigate the complexities of social reality and, in particular, the complexities of human-computer interaction despite the potential challenges created by crossing the methodological divide.

After outlining the initial ontological, epistemological and methodological considerations that provided the necessary philosophical context, the essay has briefly described how choosing between quantitative and qualitative research methods is a long-lasting divide in social sciences.

Finally, the essay has used three research projects conducted in the field of human-computer interaction and has identified, for each point of integration, some of the opportunities and challenges created by mixing methods in a single study.

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