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Abstract

The purpose of this paper is to discuss the development of research questions in mixed methods studies. First, we discuss the ways that the goal of the study, the research objective(s), and the research purpose shape the formation of research questions. Second, we compare and contrast quantitative research questions and qualitative research questions. Third, we describe how to write mixed methods research questions, which we define as questions that embed quantitative and qualitative research questions. Finally, we provide a framework for linking research questions to mixed methods data analysis techniques. A major goal of our framework is to illustrate that the development of research questions and data analysis procedures in mixed method studies should occur logically and sequentially.

Keywords

Mixed Methods, Quantitative Research Questions, Qualitative Research Questions, and Mixed Methods Data Analysis

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Linking Research Questions to Mixed Methods Data Analysis Procedures[1]

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The purpose of this paper is to discuss the development of research questions in mixed methods studies. First, we discuss the ways that the goal of the study, the research objective(s), and the research purpose shape the formation of research questions. Second, we compare and contrast quantitative research questions and qualitative research questions. Third, we describe how to write mixed methods research questions, which we define as questions that embed quantitative and qualitative research questions. Finally, we provide a framework for linking research questions to mixed methods data analysis techniques. A major goal of our framework is to illustrate that the development of research questions and data analysis procedures in mixed method studies should occur logically and sequentially. Key Words: Mixed Methods, Quantitative Research Questions, Qualitative Research Questions, and Mixed Methods Data Analysis

Setting the Scene

Conducting mixed methods research involves collecting, analyzing, and interpreting quantitative and qualitative data in a single study or in a series of studies that investigate the same underlying phenomenon. As noted by Johnson and Onwuegbuzie (2004, p. 17), "its logic of inquiry includes the use of induction (or discovery of patterns), deduction (testing of theories and hypotheses), and abduction (uncovering and relying on the best of a set of explanations for understanding one's results)." Because of its logical and intuitive appeal, providing a bridge between the qualitative and quantitative paradigms, an increasing number of researchers are utilizing mixed methods research to undertake their studies.

As conceptualized by Collins, Onwuegbuzie, and Sutton (2006), mixed methods research can be conceptualized as comprising the following 13 distinct steps:

1. determining the goal of the study
2. formulating the research objective(s),
3. determining the research/mixing rationale,

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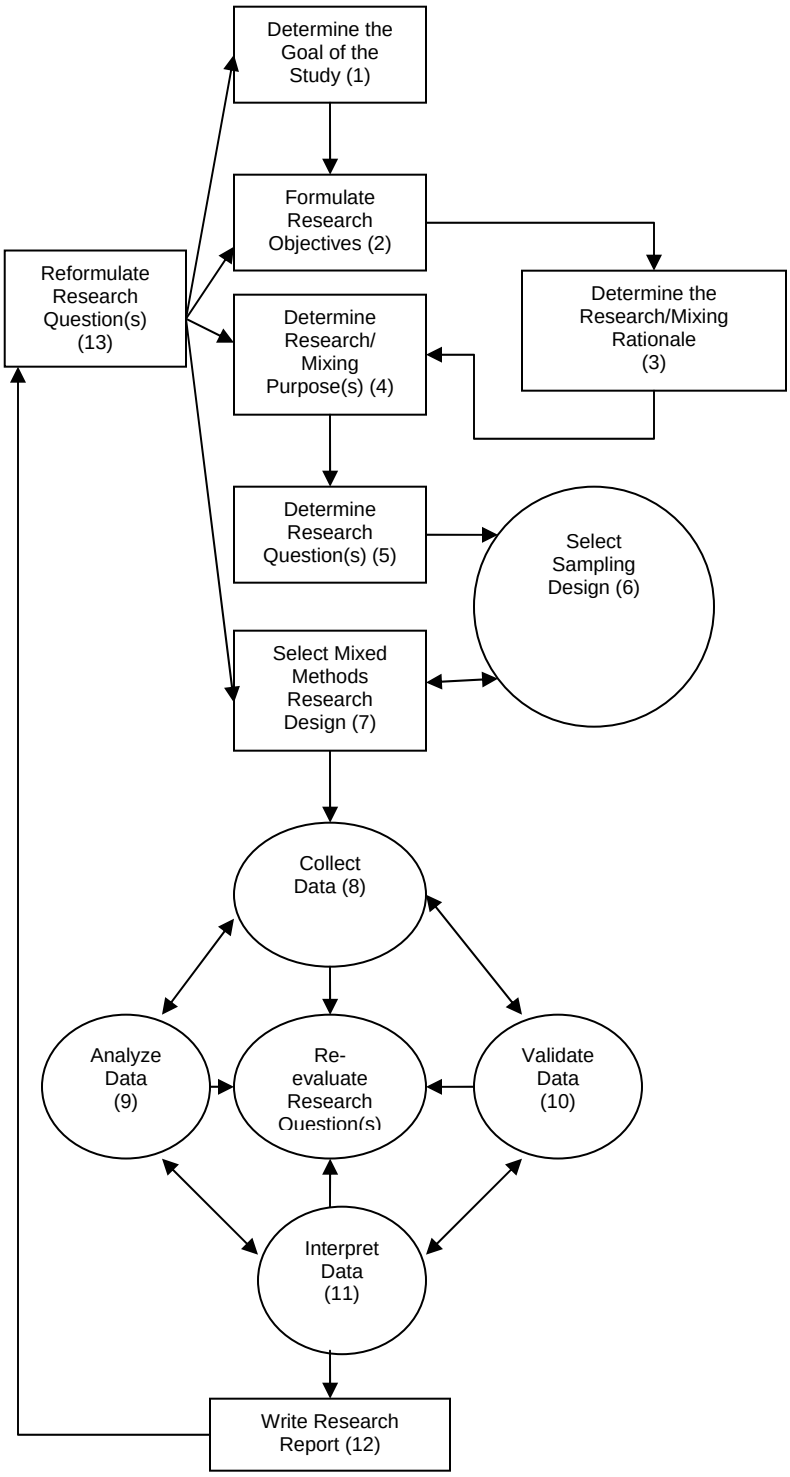
4. determining the research/mixing purpose,
5. determining the research question(s),
6. selecting the sampling design
7. selecting the mixed methods research design,
8. collecting the data,
9. analyzing the data,
10. validating/legitimating the data,
11. interpreting the data,
12. writing the mixed methods research report, and
13. reformulating the research question(s).

This process is illustrated in Figure 1.

The Importance of Questions

Determining the research question(s) is an extremely important step in both the quantitative research process and the qualitative research process because these questions narrow the research objective and research purpose to specific questions that researchers attempt to address in their studies (Creswell, 2005; Johnson & Christensen, 2004). However, research questions are even more important in mixed methods research because mixed methods researchers make use of the pragmatic method and system of philosophy. As such, in mixed methods studies, research questions drive the methods used (Newman & Benz, 1998; Tashakkori & Teddlie, 1998). Moreover, research questions in mixed methods studies are *vitally* important because they, in large part, dictate the type of research design used, the sample size and sampling scheme employed, and the type of instruments administered as well as the data analysis techniques (i.e., statistical or qualitative) used.

Figure 1. Steps in the mixed methods research process.



Unfortunately, forming research questions is much more difficult in mixed methods studies than in monomethod (i.e., quantitative or qualitative) investigations because it involves the formation of both quantitative and qualitative research questions within the same inquiry. Thus, it is surprising that an extensive review of the literature revealed no guidance as to how to write research questions specifically in mixed methods studies. The leading textbook in mixed methods research, *Handbook of Mixed Methods in Social and Behavioral Research* (Tashakkori & Teddlie, 2003), covers virtually all aspects of inquiry, including the research purpose (Newman, Ridenour, Newman, & DeMarco, 2003), research designs (Creswell, Plano Clark, Guttmann, & Hanson, 2003; Maxwell & Loomis, 2003), sampling (Kemper, Stringfield, & Teddlie, 2003), data collection (Johnson & Turner, 2003), data analysis (Bazeley, 2003; Onwuegbuzie & Teddlie, 2003), making inferences (Erzberger & Kelle, 2003; Miller, 2003), and report writing (Sandelowski, 2003). However, this book does not provide any significant discussion of research questions in mixed methods research. In fact, nowhere in this 768 page, 26-chapter edited book is the concept of mixed methods research question either defined or described. In Chapter 11, written by Johnson and Turner, the authors state that "authors of the previous chapters in this handbook have discussed many of the issues surrounding mixed methods research, including…writing research questions" (p. 297). Unfortunately, this is not the case. Interestingly, in Chapter 6 of the *Handbook of Mixed Methods in Social and Behavioral Research*, written by Newman et al. (p. 168), the authors reveal the following,

> Our original goal in writing this chapter was to present a typology of research questions. Pursuing that goal led us through several winding pathways to an unintended end result: not a typology of research *questions* but rather a typology of research *purposes.* [emphasis in original]

Other leading introductory-level research methodology textbook authors who devote whole chapters to mixed methods research (e.g., Creswell, 2005; Johnson & Christensen, 2004) also are guilty of this important oversight.

With this in mind, the purpose of this paper is to discuss the development of research questions in mixed methods studies. First, we discuss the role that the goal of the study, the research objective(s), the research/mixing rationale, and research/mixing purpose have on the formation of research questions. Second, we compare and contrast quantitative research questions and qualitative research questions. Third, we describe how to write mixed methods research questions, which we define as questions that embed quantitative and qualitative research questions.

Although frameworks exist for linking quantitative research questions (e.g., Leech, Barrett, & Morgan, 2005) and qualitative research questions (e.g., Leech & Onwuegbuzie, 2005) to data analysis procedures, no such framework exists for mixed methods studies. Thus, fourth, we provide a framework for linking research questions to mixed methods data analysis techniques. In so doing, we utilize Onwuegbuzie and Teddlie's (2003) seven-stage conceptualization of the mixed methods data analysis process. Finally, we outline the types of research questions that are pertinent for each of these seven steps of the mixed methods data analysis process. A major goal of our

framework is to illustrate that the development of research questions and data analysis procedures in mixed method studies should occur logically and sequentially.

Antecedents of Research Questions

In general, research questions reflect the problem that the researcher wants to investigate. More specifically, research questions are interrogative statements that represent "an extension of the statement of the purpose of the study in that it specifies exactly the question that the researcher will attempt to answer" (Johnson & Christensen, 2004, p. 77). Research questions can be formulated based on theories, past research, previous experience, or the practical need to make data-driven decisions in a work environment. Thus, they serve as signposts for the reader, foreshadowing the specific details of the study.

Research questions have several roles. In particular, they provide a framework for conducting the study, helping the researcher to organize the research and giving it relevance, direction, and coherence, thereby helping to keep the researcher focused during the course of the investigation. Research questions also delimit the study, revealing its boundaries. Additionally, research questions give rise to the type of data that are eventually collected. As can be seen from Figure 1, research questions occupy a place in the mixed methods research process that is central, interactive, emergent, and evolving. Not only does the development of research questions occur at the fourth step of the process, but these questions are re-evaluated during the data analysis (i.e., Step 9), data legitimation (i.e., Step 10), and/or data interpretation (i.e., Step 11) steps. That is, any of these steps might lead to the research questions being modified and/or to additional research questions being addressed. Once the research report has been written (i.e., Step 12), the role of the research question does not end. Rather, this step leads to the research question(s) being reformulated (Step 11), which, in turn, might lead to a reformulation of the research goal (i.e., Step 1), research objective (i.e., Step 2), research/mixing rationale (i.e., Step 3), and/or research/mixing purpose (i.e., Step 4). Alternatively, the research goal, research objective, research/mixing rationale, and research/mixing purpose may stay intact, in which case the reformulation of the research question directly leads to a reformulation of the mixed methods sampling design (i.e., Step 6) and mixed methods research design (i.e., Step 7).

Figure 1 also indicates that the goal of the study, research objective, research mixing/rationale, and research/mixing purpose precede the research question(s). Determining the goal of the study, which represents the first step of the mixed methods research process, involves making a decision about what the overall, long-term aim of the study is. Here, we can use Newman et al.'s (2003) framework. These authors identified the following nine types of goals[2]: (a) predict; (b) add to the knowledge base; (c) have a

2 Newman et al. (2003) used the word purposes rather than goals to label these nine categories. Unfortunately, the word "purpose" has many uses. Traditionally, this word has been used to denote the direction or focus for the study (see for example, Creswell, 2005). Conversely, Newman et al. (2003) conceptualize their typology of research purposes as representing "an iterative flow of ideas" (p. 184) that maps the researcher's thinking process. The terms "direction" and "focus" do not have the same meaning as "ideas." Thus, we believe that Newman et al.'s use of the term "research purpose" conflicts with its traditional usage. Indeed, the word "ideas" represents a higher level of abstraction than do the terms

personal, social, institutional, and/or organizational impact; (d) measure change; (e) understand complex phenomena; (f) test new ideas; (g) generate new ideas; (h) inform constituencies; and (i) examine the past[3].

The research goal leads naturally to the research objective, the second step of the mixed methods research process. In determining the research objective, the researcher should determine which of the following five major standard research objectives are pertinent for the quantitative and qualitative phases of the study: (a) exploration, (b) description, (c) explanation, (d) prediction, and/or (e) influence (Johnson & Christensen, 2004). Specifically, exploration involves using primarily inductive methods to explore a concept, construct, phenomenon, or situation in order to develop tentative hypotheses or generalizations. Description involves identifying and describing the antecedents, nature, and etiology of a phenomenon. Explanation represents developing theory for the purpose of elucidating the relationship among concepts or phenomena and determining reasons for occurrences of events. Prediction refers to using pre-existing knowledge or theory to forecast what will occur at a later point in time. Finally, influence relates to the manipulation of the setting or variable to produce a desired outcome. Both the qualitative and quantitative phases of each mixed methods research study can be linked to one or more of these five research objectives.

Once the research goal and objective(s) have been determined, the next step in the mixed research process is to determine the research mixing/rationale. This not only involves determining the rationale of the study (i.e., why the study is needed), but also identifying the rationale for mixing quantitative and qualitative approaches. Collins et al. (2006) have identified the following four major rationales for mixing quantitative and qualitative approaches: participant enrichment (i.e., the mixing of quantitative and qualitative techniques for the rationale of optimizing the sample; such as increasing the number of participants), instrument fidelity (i.e., maximizing the appropriateness and/or utility of the instruments used in the study, whether quantitative or qualitative; for e.g., via a pilot study), treatment integrity (i.e., mixing quantitative and qualitative techniques in order to assess the fidelity of interventions, treatments, or programs), and significance enhancement (i.e., mixing quantitative and qualitative techniques in order to maximize researchers' interpretations of data).

"direction" and "focus"---hence our relabeling of Newman et al.'s "research purpose" into the phrase "research goal."

3 It should be noted that epistemological stances or theoretical foundation choices might enter into the decisions made about the goal of the study, which, ultimately, can affect the nature of the mixed methods research questions composed. In particular, epistemological, ontological, axiological, methodological, and/or rhetorical beliefs might drive the type of research questions that are addressed. For example, a researcher with a stance that is subjectivist (i.e., epistemological belief) and relativist (ontological belief), who believes in value-bound research (i.e., axiological beliefs), and who takes a dialectical, dialogical, or a hermeneutical perspective (i.e., methodological belief) likely would pose different mixed methods research questions (e.g., research questions that are more constructivist in nature versus research questions that represent theory testing, respectively) than would a researcher with a stance that is objectivist (i.e., epistemological belief) and realist (ontological belief), who believes in value-free research (i.e., axiological beliefs), and who utilizes deductive reasoning in which time- and context-free generalizations are desirable and possible, and wherein real causes to social scientific outcomes can be determined reliably and validly (i.e., methodological belief). For an in-depth discussion of epistemological, ontological, axiological, methodological, and/or rhetorical differences among researchers, see for example, Guba and Lincoln (2005), Johnson and Onwuegbuzie (2004), Johnson, Onwuegbuzie, and Turner (2005), and Risjord, Moloney, and Dunbar (2001).

Alongside determining the research/mixing rationale, the researcher should identify the research/mixing purpose, which is the next step in the mixed research process. Collins et al. (2006) have identified 65 purposes for mixing quantitative and qualitative approaches. Each of these purposes falls under one of the four major rationales (i.e., participant enrichment, instrument fidelity, treatment integrity, and significance enhancement). Also, we recommend that researchers use Greene, Caracelli, and Graham's (1989) framework. These authors identified the following five general purposes of mixed-methods studies: (a) triangulation (i.e., seeking convergence and corroboration of findings from different methods that study the same phenomenon); (b) complementarity (i.e., seeking elaboration, illustration, enhancement, and clarification of the results from one method with results from the other method); (c) initiation (i.e., discovering paradoxes and contradictions that lead to a re-framing of the research question/questions); (d) development (i.e., using the results from one method to help inform the other method); and (e) expansion (i.e., seeking to expand the breadth and range of the investigation by using different methods for different inquiry components). As documented by Greene et al., every mixed methods study can be classified as having one or more of these five purposes. Identifying the research purpose helps the researcher to develop appropriate research questions. For example, if the purpose of the research is triangulation, then both the quantitative and qualitative set of research questions should lead most likely to an investigation of the same outcome or phenomenon. If the purpose of the research is initiation or development, then the quantitative research question should be conditional on the qualitative research question, or vice versa.

Types of Research Questions

In mixed methods research studies, researchers typically must develop at least one qualitative research question and at least one quantitative research question. Although both quantitative research questions and qualitative research questions give direction and focus to their respective components of the mixed methods study, they differ somewhat with respect to their structures (Johnson & Christensen, 2004). These differences are highlighted below.

Quantitative Research Questions

Quantitative research questions, unlike their qualitative counterparts, tend to be very specific in nature. Moreover, most quantitative research questions fall into one of three categories: (a) descriptive, (b) comparative, and (c) relationship.[4] This typology is presented in Figure 2.

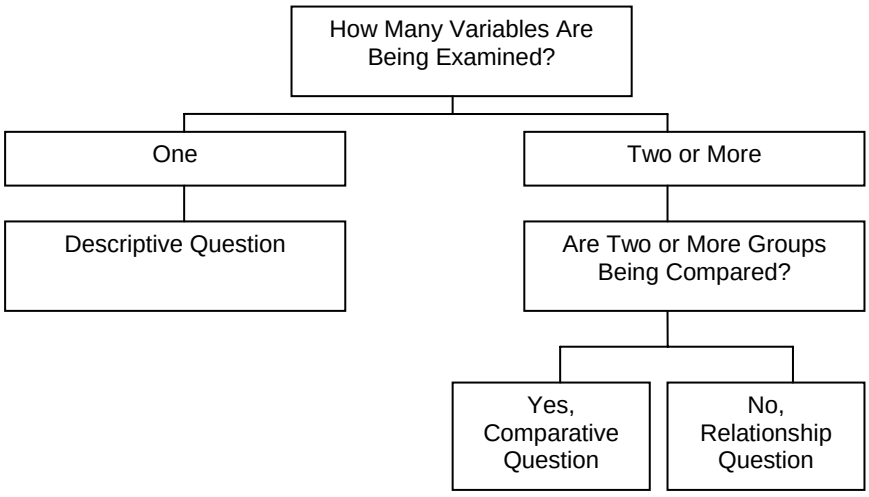
Descriptive questions simply seek to quantify responses on one or more variables. These questions often can begin with the words "What is…" or "What are…" Examples of a descriptive research question are "What are the reasons that graduate students give for enrolling in a distance education course?" "What is the graduation rate of doctoral

4 In addition to being descriptive, correlational, and comparative, quantitative research questions also can be historical. This occurs if the research question is written using the past tense. However, historical questions are not included in our typology in Figure 2 because they are relatively rare in educational research.

students in a distance education program?" and "What is the average grade point average score of students enrolled in a doctoral-level distance education program?"

Comparative questions seek to compare two or more groups on some outcome variable (i.e., dependent variable). These questions often use words such as "differ" and "compare." Comparative questions involving two groups usually can be written using the following form: "What is the difference in _____ (dependent variable) between _____ (Group 1) and _____ (Group 2)?" This question can easily be extended for three or more groups by replacing the word "between" with "among." Examples of comparative research questions for the two-group case include the following: "What is the difference in attitudes towards mathematics between first-grade and third-grade students?" and "What is the difference in levels of statistics anxiety between undergraduate male and female students?" Comparative questions also can be causal in nature such as the following: "What is the effect of cooperative learning techniques on the academic achievement of middle school students?" Such causal questions are implicitly comparative in nature (e.g., comparing middle school classes in which cooperative learning techniques are used versus middle school classes in which cooperative learning techniques are not used).

Figure 2. Typology of quantitative research questions.



Finally, relationship questions are concerned with trends between (or among) two (or more) variables. These questions often use words such as "relate," "relationship," "association," and "trend." Relationship questions involving two variables usually can be written using the following form: "What is the relationship between _____ (independent variable) and _____ (dependent variable) among _____ (population)?" This question can easily be extended for three or more variables by replacing the word "between" with "among." Examples of relationship research questions include the following: "What is the relationship between age and job satisfaction among registered nurses?" and "What is the relationship between parental educational levels and levels of depression among high school students?" Thus, from the quantitative research

question, one can drive the quantitative research designs (i.e., historical, descriptive, correlational, causal-comparative/quasi-experimental, experimental). This link from research question to research design is illustrated in Figure 1.

Good quantitative questions should identify the population and dependent variable(s), whether they represent descriptive, comparative, or relationship research questions. If they represent comparative or relationship research questions, then the independent variable(s) also should be identifiable. Researchers should avoid starting a quantitative research question with the words, "Do," "Does," "Is," or "Are" because they motivate "yes/no" responses, which, in turn, place undue emphasis on null hypothesis significance tests, possibly to the exclusion of indices of practical significance. Unfortunately, many research methodology textbooks cannot avoid using this form of quantitative research question.

Qualitative Research Questions

Conversely, qualitative research questions are "open-ended, evolving, and non-directional" (Creswell, 1998, p. 99). These questions tend to seek, to discover, to explore a process, or describe experiences. They typically attempt to obtain insights into particular educational, familial, and social processes and experiences that exist within a specific location and context (Connolly, 1998). As such, qualitative research questions typically describe, rather than relate variables or compare groups, avoiding the use of words such as "affect," "influence," "compare," and "relate." More specifically, qualitative research questions tend to address "what" and "how" questions. As noted by Creswell (1998), qualitative research questions can take the form of grand tour questions (i.e., representing broad or central questions) or specific subquestions. The latter can comprise (a) issue subquestions, which address the major concerns and complexities to be resolved (e.g., "What does it mean to teachers to win a teaching award?") and (b) topical subquestions, which arise from a need for information for the description of the case (e.g., "What do qualitative researchers do?").

As is the case for quantitative research questions, qualitative research questions drive the research design (e.g., historical, case study, ethnography, phenomenology, grounded theory, autoethnography). For example, a central research question such as "How do gang leaders select gang members?" would indicate an ethnographic study. A central research question such as "What are the constructions of survival and coping by men who survive prostrate cancer?" would indicate a grounded theory study. A central research question such as "What are the experiences of students diagnosed with attention deficit hyperactivity disorder?" would indicate a phenomenological study. A central research question such as "What are the implications of the No Child Left Behind Act on high school principals from Duval County?" would indicate a case study. A central research question such as "What events led to the Brown versus Board of Education ruling?" would indicate a historical study. Finally, a central research question such as "How has my attitude toward mixed methods research evolved as I completed my doctoral program?" would indicate an autoethnographical study.

As is the case in quantitative research, qualitative research questions also can be comparative in nature. As noted by Onwuegbuzie and Leech (2005), first, qualitative researchers can compare study participants in a pairwise manner, leading to what they

termed *pairwise sampling designs*. A research question that could lead to pairwise sampling designs might be "To what extent are the experiences during breast cancer treatment consistent across all study participants?"

Second, researchers also could compare two or more subgroups, culminating in what they referred to as *subgroup sampling designs*. A research question that could lead to subgroup sampling designs might be "To what extent are the perceptions of women regarding the level of mentorship at graduate school similar for male and female graduate students?" Third, qualitative researchers can compare two or more members of the same subgroup, wherein one or more members of the subgroup represent a sub-sample of the full sample. This would lead to what Onwuegbuzie and Leech (2005) called *nested sampling designs*. For example, a qualitative researcher might be interested in comparing the voices of key informants, who are selected from the overall set of research participants, to the voices of the other non-informant sample members. A research question that could lead to nested sampling designs in this instance might be "To what extent are the voices of the key informants regarding their level of distrust of their local politicians similar to the voices of the non-informant sample members?" Finally, qualitative researchers can compare two or more subgroups that are extracted from different levels of a study. For instance, a qualitative researcher might be interested in comparing the perceptions of students regarding standardized tests to those of their teacher(s). Such comparisons would lead to what these methodologists (Onwuegbuzie & Leech, 2005) termed *multilevel sampling designs*. A research question that could lead to multilevel sampling designs might be "To what extent are perceptions of students regarding standardized tests similar to those of their teachers?"

Although comparative research questions could be specified before the qualitative inquiry begins, most often, these questions emerge at some point during the study. This is a major difference between quantitative and qualitative research: Research questions tend to be developed a priori in quantitative research studies whereas research questions tend to be developed either a posteriori or iteratively in qualitative research studies.

Mixed Methods Research Questions

Surprisingly, an extensive review of the research literature revealed no article in which mixed methods research questions had been defined or described. Thus, what follows appears to be a first attempt to provide such a discussion. Generally speaking, mixed methods research questions are questions that embed both a quantitative research question and a qualitative research question within the same question. That is, mixed methods research questions combine or mix both the quantitative and qualitative research questions. Moreover, a mixed methods research question necessitates that both quantitative data and qualitative data be collected and analyzed either concurrently, sequentially, or iteratively before the question is addressed.

Mixed Methods Research Questions for Descriptive Research Designs

Mixed methods research questions for concurrent designs. An example of a mixed methods research question for concurrent mixed methods research designs is "What is the relationship between graduate students' levels of reading comprehension and their

perceptions of barriers that prevent them from reading empirical research articles?" In order to answer this question information about both the levels of reading comprehension (quantitative, independent variable) and the perceived barriers to reading empirical research articles (qualitative, dependent variable) must be obtained. Specifically, levels of reading comprehension would be gleaned from the quantitative component of the mixed methods study, whereas perceived barriers to reading empirical research articles would be extracted from the qualitative portion of the inquiry. For instance, in the quantitative phase, a reading comprehension test could be administered to a relatively large sample of graduate students. The quantitative research design then would be descriptive in nature, assuming that no purely quantitative research questions were of interest. In the qualitative phase, the same sample of students could be interviewed and asked about their perceptions of barriers that prevent them from reading empirical research articles. Alternatively, they could be asked to complete a survey containing one or more open-ended questions that tap these perceptions. Either way, the qualitative research design then would be phenomenological in nature. The overall mixed methods research design would be concurrent because the quantitative phase of the study did not inform or drive the qualitative phase or vice versa.

Mixed methods research questions for sequential designs. Alternatively, the above mixed methods research question could have been reframed as the following, "What is the difference in perceived barriers to reading empirical research articles between graduate students with low levels of reading comprehension and those with high levels of reading comprehension?" Here, the quantitative research component would still generate the independent variable (i.e., levels of reading comprehension), and the qualitative research element would still generate the dependent variable (i.e., phenomenon), namely perceived barriers to reading empirical research articles. The quantitative research design then would be descriptive in nature and the qualitative research design most likely would be phenomenological. However, the overall mixed methods research design most likely would be sequential instead of concurrent because the quantitative phase of the study would inform the qualitative phase. That is, the researcher would administer a test of reading comprehension, rank these comprehension scores, and then purposively select (i.e., extreme sampling; Miles & Huberman, 1994; Patton, 1990) students who attained scores that were in the top third and bottom third, say, of the score distribution. These students would then be interviewed and asked about their perceptions of barriers that prevent them from reading empirical research articles, or they could be asked to complete a survey containing one or more open-ended questions that tap these perceptions. The overall mixed methods research design also could be concurrent if the students' levels of reading comprehension (i.e., low versus high) were known before the mixed methods study began.

Mixed Methods Research Questions for Causal-Comparative Research Designs

A mixed methods question also could be designed such that it embeds a quantitative research question that leads to a causal-comparative/quasi-experimental research design. For instance, a researcher could pose the following mixed methods research question, "What is the difference in perceived atmosphere of classroom between male and female graduate students enrolled in a statistics course?" Such a question would

generate a causal-comparative research design for the quantitative phase, in which the researcher would purposively select male and female students enrolled in the statistics course. These students would then be interviewed and asked about their perceptions of the classroom climate, or they could be asked to complete a survey containing one or more open-ended questions that tap these perceptions. The perceptions of the male graduate students would then be compared to the perceptions of the female graduate students. The overall mixed methods research design would be concurrent in nature. In the reading comprehension example presented earlier, if the students' levels of reading comprehension (i.e., low versus high) were known before the mixed methods study begun, then the quantitative research design would be causal-comparative. Similarly, the following mixed methods research question would lead to a quasi-experimental design for the quantitative phase of the inquiry, "What is the difference in experiences in graduate school between students who are assigned a mentor at the beginning of their graduate program and those who are not assigned a mentor?" Here, the qualitative phase could be represented by a case study research design, a phenomenological research design, an ethnographic research design, or a grounded theory research design.

Mixed Methods Research Questions for Experimental Research Designs

A mixed methods question also could be designed such that it embeds a quantitative research question that leads to an experimental research design. For example, a researcher could pose the following mixed methods research question, "What side effects do the new medication for depression cause among adolescents?" In order to address such a question, the researcher would randomize study participants into either the experimental group (i.e., receives depression medication) or control group (i.e., receives placebo). These participants would then be interviewed and asked the side effects that they experienced. These experiences for the experimental group would then be compared to the experiences for the control group. The overall mixed methods research design would be concurrent in nature. Here, the qualitative phase could be represented by a case study research design, a phenomenological research design, an ethnographic research design, or a grounded theory research design.

Mixed Methods Research Questions for Qualitative Comparative Designs

Mixed methods question also could be designed such that it embeds a qualitative research question that involves comparison (i.e., pairwise sampling designs, subgroup sampling designs, nested sampling designs, multilevel sampling designs). For example, a researcher could pose the following mixed methods research question, "What is the difference in levels of statistics performance between freshmen whose negative experiences while enrolled in the statistics course were extreme and freshmen whose negative experiences while enrolled in the statistics course were not extreme?" In order to address such a question, the researcher would use qualitative techniques (e.g., interviews, focus groups, observations) to examine the experiences of freshmen enrolled in a statistics course. On finding that the negative experiences of some of the study participants are extreme, relative to other members of the class, the researcher then might decide to compare statistically scores on the final statistics examination between these

two sets of students. The overall mixed methods research design would be sequential in nature. Here, the qualitative phase could be represented by a case study research design, a phenomenological research design, an ethnographic research design, or a grounded theory research design. The quantitative research phase would represent a descriptive, correlational, or causal-comparative research design.

Alternatively, a researcher could pose the following mixed methods research question, "What are the characteristics of participants who do not fit the emergent theory?" In order to address such a question, the researcher would use qualitative techniques (e.g., interviews, focus groups, observations) to collect and analyze qualitative data until theoretical saturation is reached. From the emergent theory, the researcher may find that some cases do not fit (i.e., negative cases). The researcher then might decide to compare negative cases and non-negative cases with respect to one or more sets of existing quantitative scores, or collect new quantitative data and compare these two groups with regard to these data. The overall mixed methods research design would be sequential in nature. Here, the qualitative phase could be represented by a case study research design, a phenomenological research design, an ethnographic research design, or a grounded theory research design. The quantitative research phase would represent a descriptive, correlational, or causal-comparative research design.

Most Compatible Mixed Methods Research Questions

The quantitative and qualitative research questions are most aligned or compatible with respect to underlying paradigm and methods used when both questions are open-ended and non-directional in nature, and they both seek to discover, explore, or describe a particular participant(s), setting, context, location, event, incident, activity, experience, process, and/or document. In such instances, the quantitative research question leads to a descriptive research design, whereas the qualitative research question can lead to any of the qualitative research designs (e.g., historical, case study, ethnography, phenomenology, grounded theory, autoethnography). For example, a mixed methods research question such as "What are the implications of the No Child Left Behind Act on parents?" could lead to a descriptive research design for the quantitative component of the study and a case study design, ethnographic design, phenomenological design, or grounded theory design for the qualitative portion of the investigation. Alternatively, the overall design could be a (collective) case study that subsumes a mixed methods research design.

Linking Research Questions to Mixed Methods Data Analysis Techniques

Quantitative Research Questions

One of the greatest difficulties that students and beginning researchers face when conducting research is attempting to link research questions to quantitative data analyses. At graduate school, students learn to conduct an array of descriptive and inferential analyses. Indeed, in the United States, virtually all students are required to take at least one statistics course as a necessary part of their degree programs (Mundfrom, Shaw, Thomas, Young, & Moore, 2003; Onwuegbuzie & Wilson, 2003). Students who take one

course are generally exposed to the most common descriptive analysis techniques including learning how to compute measures of central tendency (e.g., mean, median, mode), measures of variability/dispersion (range, standard deviation), measures of position/location (e.g., percentile rank, *z*-score), and measures of distributional shape (i.e., skewness, kurtosis). In addition, as documented by Mundfrom et al., in these introductory statistics courses, students learn how to perform the most basic inferential analyses that represent the lowest members of the general linear model (Cohen, 1968; Henson, 2000; Knapp, 1978), such as correlation coefficient, *t*-tests, one-way analyses of variance (ANOVA), and simple linear regression. Students who enroll in a second statistics course usually are exposed to other major univariate statistical procedures such as factorial ANOVA, analysis of covariance (ANCOVA), and multiple regression. Students who enroll in a third course tend to learn how to utilize multivariate procedures such as multiple analyses of variance (MANOVA) and descriptive/predictive discriminant analyses. Subsequent statistics courses tend to be specialized such as a course in structural equation modeling (SEM) and hierarchical liner modeling (HLM).

Even students who successfully complete several courses in statistics find it difficult to determine the most appropriate statistical analysis to conduct, given the research question. This difficulty occurs because (a) statistics courses tend to be taught as a series of routine steps, instead of a holistic, comprehensive, integrative, and reflective process (Kerlinger, 1960; Newman & Benz, 1998; Onwuegbuzie & Leech, 2003a); (b) some statistics instructors promote various inaccurate and misleading "mythologies" about the nature of research (Daniel, 1997; Kerlinger); and (c) there has been an increasing proportion of statistics instructors who are unqualified to teach statistics courses (Onwuegbuzie & Leech, 2003b). Further, virtually all research methodology textbook authors (e.g., Ary, Jacobs, & Razavieh, 2002; Creswell, 2005; Fraenkel & Wallen, 2003; Gall, Borg, & Gall, 2003; Gay & Airasian, 2003; Johnson & Christensen, 2004; McMillan & Schumacher, 2001; Wallen & Fraenkel, 2001) present their discussions of statistical analyses in separate chapters from their discussions of research design. As such, in these statistics analysis chapters, there tends to be little or no reference to research questions, giving the impression that statistical analyses occur in a vacuum. Thus, for the remainder of this section, we will discuss the major links between research questions and statistical analyses.

In quantitative research, numbers are used to provide information about our world. However, contrary to the beliefs of logical positivists, numbers do not naturally exist, waiting to be discovered, rather they represent social constructs. That is, researchers turn data into numbers, and by imposing structure of the number system on the data they bring structure to empirical data (Punch, 1999). Yet, the structure that they impose is socially constructed (e.g., use of $\forall = .05$ instead of $\forall = .06$). Thus, researchers are not compelled to represent empirical data with numbers. This only should occur if using such numeric structure provides useful information.

As noted by Punch (1999), the following two types of operations produce numbers: counting and scaling. Counting involves determining the frequency of things (e.g., individuals, events, incidents, activities, experiences). When researchers count they do so with respect to some component of interest, which helps to give meaning to the counting. Conversely, scaling involves measuring a trait of interest along an artificial (i.e., constructed) continuum or scale, such that different places along that continuum

represent different amounts of this trait. These two types of number-producing operations lay at the foundation of all descriptive and inferential statistical analyses.

As described earlier, quantitative research questions usually represent one of the following three types: descriptive, correlational, or comparative. Knowledge of the type of quantitative research question can help researchers select an appropriate statistical analysis. Although data can be coded in a way that any member of the general linear model (GLM) family (e.g., multiple regression) can be used to undertake an analysis that can be conducted by a GLM member that is lower down the chain (e.g., *t*-test), interpretations are facilitated when the selected GLM member is at the same level as the data type. Thus, for example, when comparing three racial groups (e.g., African American, White, Hispanic) on a quantitative dependent variable that represents an interval-scaled or ratio-scaled measure, such as income, researchers should find it easier to interpret the results of an ANOVA than to interpret the results of a multiple regression analysis, in which income was the dependent variable and race was the independent variable in the model. Indeed, in this particular example, an inexperienced researcher might inadvertently forget to transform the independent variable (i.e., race) into an appropriate form (i.e., dummy code) and thus obtain spurious findings.

Descriptive research questions

When the quantitative research question is descriptive in nature, the researcher should select from the arsenal of descriptive statistics (i.e., measures of central tendency, measures of variability/dispersion, measures of position/location). For example, a question such as "What is the drop out rate among ninth graders?" would necessitate that a proportion (i.e., measure of central tendency) be computed.

Correlational research questions

When the quantitative research question is correlational, then one of the correlational analyses would be most appropriate. Correlational analyses include the following: correlation coefficient (if there is only one independent variable and one dependent variable both lying on a continuum), regression (if there are at least two independent variables that are continuous and/or dichotomous and one dependent variable that lies on a continuum), discriminant analysis or logistic regression (if there are at least two independent variables and one dependent variable that is categorical), and canonical correlation analysis (if there are at least two independent variables and at least two dependent variables, both sets of variables either are continuous and/or dichotomous). It should be noted that in order for any of these analyses to be justified the model assumptions should be met. Also, it should be noted that this list is not exhaustive.

Comparative research questions

When the quantitative research question is comparative, then an analysis is needed that allows the direct comparison of groups. All of the above procedures are particularly pertinent here, such as the following: *t*-test (if there is one independent variable with exactly two levels and one dependent variable that lies on a continuum),

ANOVA (if there is one independent variable with three or more levels and one dependent variable that lies on a continuum; or two or more categorical independent variables and one dependent variable that lies on a continuum), analysis of covariance (ANCOVA) (if there is one independent variable with exactly two levels, one dependent variable that lies on a continuum, and one covariate that lies on a continuum; or two or more categorical independent variables, one dependent variable that lies on a continuum, and one covariate that lies on a continuum), MANOVA (if there is one independent variable with three or more levels and two or more dependent variables that all lie on a continuum; or two or more categorical independent variables and two dependent variables that both lie on a continuum), and multiple analysis of covariance (MANCOVA) (if there is one independent variable with three or more levels, two or more dependent variables that all lie on a continuum, and one covariate that lies on a continuum; or two or more categorical independent variables, two or more dependent variables that all lie on a continuum, and one covariate that lies on a continuum). Again, it should be noted that the model assumptions of any of these analyses must hold to justify use, and that this list is not exhaustive.

Qualitative Research Questions

As much as researchers have difficulty matching research questions to appropriate data analytical procedures in quantitative research, it could be argued that the situation is even more problematic in qualitative research. As contended by Leech and Onwuegbuzie (2005),

> In qualitative research, discussion of analysis clearly is not as common as is the case for quantitative research. In fact, many schools of education offer only one qualitative research course (Leech & Goodwin, 2004), and the one course offered commonly does not include much information about data analysis. With such little focus on analysis, we believe many qualitative researchers believe that there is only one way to analyze qualitative data, through the method of constant comparative or constant comparison analysis (Glaser & Strauss, 1967). For example, recently, in an informal poll of school of education faculty at a large university one question was, "how can qualitative data be analyzed?" More than 80% of the participants responded with "constant comparison analysis" (Leech, 2004). We contend that using a one-size-fits-all approach (i.e., constant comparison analysis) to analyzing qualitative data, at least sometimes, will lead to interpretations that are not consistent with the underlying data-thereby affecting legitimation via components such as interpretive validity and theoretical validity (Maxwell, 1992, 2005).
>
> One way this incorrect assumption that constant comparative analysis is the only available qualitative data analysis tool is promoted is through textbooks. There are many texts available to understand qualitative research (e.g., Eisner, 1998; Glesne & Peshkin, 1992) and

> how to write about qualitative research (e.g., Emerson, Fretz, & Shaw, 1995; Richardson & St. Pierre, 2005; Wolcott, 2001). Yet, the majority of available texts for qualitative research include at most only one chapter, if any, on data analysis (e.g., Berg, 2004; Bogdan & Biklen, 2003; Creswell, 1998; Schram, 2003; Shank, 2002)...Many other leading qualitative research textbooks (e.g., Lincoln & Guba, 1985; Maxwell, 1996) also do not provide explicit details as to how to analyze qualitative data.
>
> One text, Miles and Huberman (1994), does focus on qualitative data analyses. Since then, several more textbooks dealing with qualitative data analyses have been published. However, many of these textbooks focus on one data analysis technique (e.g., discourse analysis; Phillips & Jorgensen, 2002). Thus, these books do not provide a comprehensive treatment of qualitative data analysis techniques; therefore, several textbooks have to be included by qualitative research instructors in order for their students to be exposed to a repertoire of analytical tools.
>
> As such, we believe many...researchers do not realize that there are many tools available for analyzing qualitative data.... (pp. 10-12)

Subsequently, Leech and Onwuegbuzie (in press) described several qualitative data analysis techniques, including the following: method of constant comparison, keywords-in-context, word count, classical content analysis, domain analysis, taxonomic analysis, and componential analysis. In addition to these qualitative data analyses there is a class of data analytical tools known as cross-case analyses (cf. Miles & Huberman, 1994). A cross-case analysis involves analyzing data across the cases (Schwandt, 2001). Moreover, it represents a thematic analysis across cases (Creswell, 1998). Cross-case analytical techniques include the following: partially ordered meta matrix, conceptually ordered displays, case-ordered descriptive meta-matrix, case-ordered effects matrix, case-ordered predictor-variable matrix, and causal networks. We recommend that qualitative researchers familiarize themselves with as many of these procedures as possible.

Unfortunately, it is not possible to match each qualitative research question to its most appropriate data analysis tool. This is because the same qualitative research question can be analyzed in multiple ways. Indeed, Leech and Onwuegbuzie (in press) recommend that researchers analyze their data using at least two procedures in order to triangulate their findings and interpretations (i.e., data-analysis triangulation). Nevertheless, one general rule can be proffered, specifically, qualitative researchers who are interested in addressing comparative research questions, as outlined earlier, should, at some point, utilize one or more of the cross-case analytical techniques.

Mixed Methods Research Questions

Onwuegbuzie and Teddlie (2003) conceptualized that when analyzing quantitative and qualitative data within a mixed methods framework, researchers undergo at least some of the following seven stages: (a) data reduction, (b) data display, (c) data transformation, (d) data correlation, (e) data consolidation, (f) data comparison, and (g)

data integration. This seven-stage model is presented in Figure 3. According to Onwuegbuzie and Teddlie, *data reduction* involves reducing the dimensionality of the qualitative data (e.g., via exploratory thematic analysis, memoing) and quantitative data (e.g., via descriptive statistics, exploratory factor analysis, cluster analysis). *Data display* involves describing pictorially the qualitative data (e.g., matrices, charts, graphs, networks, lists, rubrics, and Venn diagrams) and quantitative data (e.g., tables, graphs). This is followed (optionally) by the *data transformation* stage, wherein quantitative data are converted into narrative data that can be analyzed qualitatively (i.e., *qualitized*; Tashakkori & Teddlie, 1998) and/or qualitative data are converted into numerical codes that can be represented statistically (i.e., *quantitized*; Tashakkori & Teddlie, 1998). *Data correlation* involves quantitative data being correlated with qualitized data or qualitative data being correlated with quantitized data. This is followed by *data consolidation*, wherein both quantitative and qualitative data are combined to create new or consolidated variables or data sets. The next stage, *data comparison* involves comparing data from the qualitative and quantitative data sources. *Data integration* is the final stage, whereby both quantitative and qualitative data are integrated into either a coherent whole or two separate sets (i.e., qualitative and quantitative) of coherent wholes.

Figure 3. Steps in the mixed methods data analysis process.

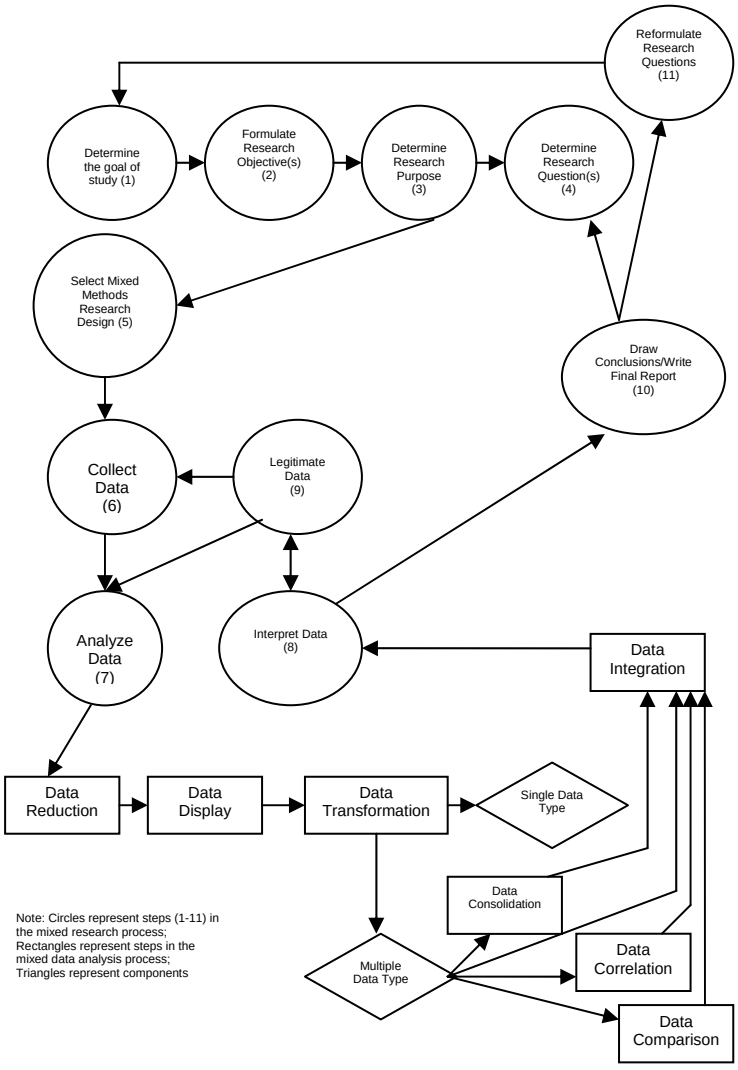
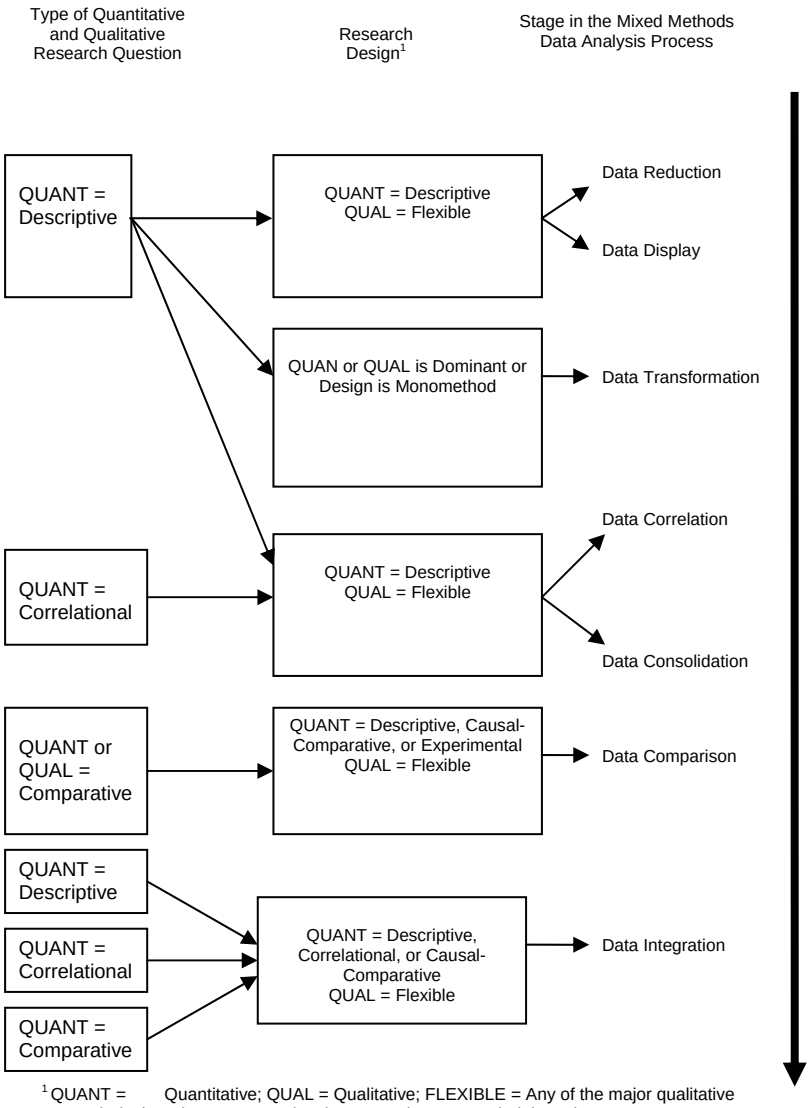


Figure 4 provides a framework for linking mixed methods research questions to the appropriate steps of Onwuegbuzie and Teddlie's (2003) mixed methods data analysis process. For example, for the mixed research question for descriptive research designs presented earlier, namely, "What is the relationship between graduate students' levels of reading comprehension and their perceptions of barriers that prevent them from reading empirical research articles?," for each student, each emergent barrier (i.e., presence versus. absence) could be correlated with the corresponding reading comprehension score to yield a series of point-biserial correlations. Onwuegbuzie and Teddlie refer to this as data correlation, which is the fourth step of their seven-step mixed methods data-analytic model.

Figure 4. Relationships among research questions, research design, and mixed methods data analyses.



[1] QUANT = Quantitative; QUAL = Qualitative; FLEXIBLE = Any of the major qualitative research designs (e.g., case study, phenomenology, grounded theory)

As noted previously, for the mixed research question that embedded a descriptive research question, namely, "What is the difference in perceived barriers to reading empirical research articles between graduate students with low levels of reading comprehension and those with high levels of reading comprehension?" the researcher could administer a test of reading comprehension, rank these scores, purposively select the highest- and lowest-scoring students, and then compare their perceptions of barriers that prevent them from reading empirical research articles. In this case because the themes (i.e., perceived barriers) emerging from students with lowest levels of reading comprehension would be compared to those with the highest levels, rather than necessitating data correlation, the mixed methods data analysis would be what

Onwuegbuzie and Teddlie (2003) termed as data comparison, which is the sixth step in their seven-step model. Even if the students' levels of reading comprehension (i.e., low versus high) were known before the mixed methods study began, the mixed methods data analysis stage would still represent data comparison.

Figure 4 also shows that when the mixed methods research question embeds a quantitative correlational research question, then the quantitative research design would be descriptive, and the qualitative research design could be one of several types (e.g., case study, ethnography, phenomenology, grounded theory), which would lead to data comparison being the appropriate mixed methods data analysis procedure. Further, if the mixed methods research question embeds either a quantitative or qualitative comparative research question, then the quantitative research design would be descriptive, and the appropriate mixed methods data analysis stage would be data comparison. Thus, using this figure, researchers could determine when it is most appropriate to use each of the seven mixed methods data analysis techniques, given the mixed methods research question.

Conclusion

Although in recent years, there has been an increase in the number of methodological articles, book chapters, and books devoted to mixed methods research to date, these published works have been devoid of any discussion of research questions. Thus, the purpose of this article was to take the lead in this area. First, we discussed the role that the goal of the study, the research objective(s), and the research purpose have on the formation of research questions in mixed methods studies. Second, we compared and contrasted quantitative research questions and qualitative research questions. Third, we described how to write mixed methods research questions, which we defined as questions that embed quantitative and qualitative research questions. Finally, we provided a framework for linking research questions to mixed methods data analysis techniques. Specifically, we outlined the types of research questions that are pertinent for each of the seven steps of the mixed methods data analysis process. A major goal of our framework is to illustrate that the development of research questions and data analysis procedures in mixed method studies should occur logically and sequentially.

An important tenet of mixed methods studies is that the research questions drive the methods used (Newman & Benz, 1998; Tashakkori & Teddlie, 1998). It is therefore surprising that little or no guidance has been provided as to how the research question drives the data analytic procedures in mixed methods research. Thus, we hope that our present framework represents a first small step in this direction.

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