

Compare and Contrast Inductive and Deductive
Research Approaches

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Abstract

This discussion paper compares and contrasts *inductive* and *deductive* research approaches as described by Trochim (2006) and Plano Clark and Creswell (2007). It also examines the *exploratory* and *confirmatory* approaches by Onwueghuzie and Leech (2005) with respect to the assumption each holds about the nature of knowledge. The paper starts with an historical overview of the two main types of research commonly used in educational settings. It continues with a discussion of the elements that showcase the differences and similarities between the two major research approaches. The elements discussed include: intent of the research, how literature is used, how intent is focussed, how data are collected, how data are analyzed, the role of the researcher, and how data are validated. In addition, there is a section which addresses the decisions researchers must make in choosing the research methodology that allows them to answer their research question. The focus of the discussion is on how the two types of research methodology can be used effectively in an educational setting. It concludes with a look at how the different methods of research can be used collaboratively to form a more complete picture of a research study.

Introduction

Trochim (2006) refers to two “broad methods of reasoning as the inductive and deductive approaches (p.1). He defines induction as moving from the specific to the general, while deduction begins with the general and ends with the specific; arguments based on experience or observation are best expressed inductively, while arguments based on laws, rules, or other widely accepted principles are best expressed deductively. Creswell and Plano Clark (2007) say that the deductive researcher “works from the ‘top down’, from a theory to hypotheses to data to add to or contradict the theory” (p.23). In contrast, they define the inductive researcher as someone who works from the “bottom-up, using the participants’ views to build broader themes and generate a theory interconnecting the themes” (p. 23). In research, the two main types of analysis typically used are quantitative (deductive) and qualitative (inductive). Though there seems to be some disagreement among researchers as to the best method to use when conducting research and gathering data, these two methods are not mutually exclusive and often address the same question using different methods.

Historical Context

Onwuegbuzie and Leech (2005) suggest that “instructors of quantitative and qualitative research often view themselves as being in competition with each other” (p. 267). The authors go on to argue that “this polarization has promoted . . . ‘uni-researchers’ [who are] namely researchers who restrict themselves either exclusively to quantitative or to qualitative research methods” (p. 268). The reason Onwuegbuzie and Leech give for changing the names dates back to the end of the 19th century when quantitative research was characterized by an implied

objectivity and was considered the only way to conduct research. The beginning of the 20th century marked what they refer to as the second research methodology phase. It was at this time that the qualitative research method emerged. Researchers who followed this scientific method believed that “social reality was constructed and thus was subjective” (p. 269). It was at this point that the polarization of quantitative and qualitative research methods began. In the later part of the 20th century the post-structuralists and post-modernists believed in the “incompatibility thesis” (p.270) which said that the quantitative and qualitative paradigms could not coexist (Onwuegbuzie & Leech, 2005).

The major difference between the two methods is centered on how they view the nature of reality. The quantitative theorists believe “in a single reality that can be measured reliably and validly using scientific principles”, while qualitative theorists “believe in multiple constructed realities that generate different meanings for different individuals, and whose interpretations depend on the researcher’s lens” (Onwuegbuzie & Leech, 2005, p. 270). It is the relationship between the researcher and the participant that characterizes the disciplines. In quantitative research it is believed that researchers should separate themselves from the participants while qualitative researchers are aware that the relationship between the researcher and the participant is important in the understanding of the observable event. In addition, quantitative researchers believe that “research should be value-free,” while the qualitative researcher understands that “the research is influenced to a great extent by the values of the researcher” (Onwuegbuzie & Leech, 2005, p. 271).

Despite the many differences, Onwuegbuzie and Leech (2005) contend that there are many similarities between the two orientations. They propose replacing the terms *qualitative*

and *quantitative* with *exploratory* and *confirmatory* to more clearly reflect the relationship between the two methodologies. The methods may be different but the goals remain the same and Onwuegbuzie and Leech (2005) worry that the separation of the two paradigms can lead students in graduate school to becoming “*one-dimensional* with regards to their knowledge of the research process” (p. 272). They go on to say that “we continue to prepare students for an ‘either-or’ world, a dichotomous world, that no longer exists” (p.272). Onwuegbuzie and Leech (2005) suggest that “those who teach social/behavioural research methodology have to stop identifying themselves as qualitative or quantitative researchers” (p. 276). The method chosen should depend in large part on what the research question was, what one wants to know, and how they determine they will arrive at that knowledge. According to Trochim (2006), the context, purpose, and types of research questions asked will define the methodological foundations of a study. Onwuegbuzie and Leech (2005) point to the fact that both methods include the use of research questions which are addressed through some type of observation. They also note that the observations in either method will lead the researcher to question why what they observed happened. Another similarity is how the two paradigms interpret data. Both use some form of analysis to find the meaning and employ techniques to verify the data.

Compare and Contrast

Quantitative research often translates into the use of statistical analysis to make the connection between what is known and what can be learned through research. Collecting and analyzing data using quantitative strategies requires an understanding of the relationships among variables using either descriptive or inferential statistics. Descriptive statistics are used to draw inferences about populations and to estimate the parameters of those populations (Trochim,

2006). Inferential statistics are based on the descriptive statistics and the assumptions that generalize to the population from a selected sample (Trochim, 2006). With quantitative analysis, it is possible to get visual representations for the data using graphs, plots, charts, and tables. For researchers using quantitative analysis, the conclusions are drawn from logic, evidence, and argument (Trochim, 2006). The interpretation of raw data is guided by the general guidelines presented to evaluate the assertions made and to assess the validity of the instrument. Quantitative analysis also employs protocols to control for, or anticipate, as many threats to validity as is possible.

Qualitative research can be defined as a study which is conducted in a natural setting. The researcher, in effect, becomes the instrument for data collection. It is up to the researcher to gather the words of the participants and to analyze them by looking for common themes, by focusing on the meaning of the participants, and describing a process using both expressive and persuasive language (Creswell, 2005). Creswell (2005) defines qualitative study as:

a type of educational research in which the researcher relies on the view of participants, asks broad, general questions, collects data consisting largely of words (or texts) from participants, describes and analyzes these words for themes, and conducts the inquiry in a subjective, biased manner (p. 39).

Qualitative research is a rigorous approach to finding the answers to questions. It involves spending an extensive amount of time in the field, working in the often complex, time consuming process of data analysis, writing long passages, and participating in a form of social and human science research that does not have firm guidelines or specific procedures.

Conclusions change and evolve continuously as more data is collected. Qualitative research is often said to employ inductive thinking or induction reasoning since it moves from specific observations about individual occurrences to broader generalizations and theories. In making use of the inductive approach to research, the researcher begins with specific observations and measures, and then moves to detecting themes and patterns in the data. This allows the researcher to form an early tentative hypothesis that can be explored. The results of the exploration may later lead to general conclusions or theories (Creswell, 2005).

Creswell and Plano Clark (2007) operate from the assumption that both qualitative research and quantitative research address the same elements in the research process. The differences arise due to the way that the researchers implement each step. For Creswell and Plano Clark (2007), the differences are not opposites but are rather differences on a continuum. As a result of this conclusion, they maintain that no one study is purely quantitative or qualitative and that each method has many of the same elements. The following elements will be discussed to show the differences and similarities between the two major research approaches: intent of the research, how literature is used, how intent is focussed, how data are collected, how data are analyzed, the role of the researcher, and how data are validated.

Intent of the Research

The intent of research is typically expressed in the form of a purpose statement or the guiding objectives of the study. In quantitative research, the intent is usually to test theories deductively searching for evidence to either support or to refute the hypothesis, while qualitative

researchers gather information from individuals to identify themes which allow them to develop theories inductively (Creswell & Plano Clark, 2007).

How Literature is Used

For quantitative researchers the literature review plays a major role in justifying the research and identifying the purpose of the study. The literature can be used to identify the questions to be asked and to inform the hypotheses. Literature reviews in quantitative research are more comprehensive and more detailed than is the case in qualitative research. In qualitative research, the literature review is used to provide evidence for the purpose of the study and to identify the underlying problem that will be addressed by the inquiry. The literature review is typically brief and does not usually guide the research questions to the same extent as literature reviews in quantitative research does. This is done to ensure that the literature does not limit the types of information the researcher will learn from the participants (Creswell & Plano Clark, 2007).

How Intent is Focused

The intent of a study and the literature review help to narrow the hypotheses and research questions. In quantitative research, the intent focuses on pointed, close-ended questions that test specific variables that derive from the hypotheses. The researcher tests these hypotheses in an attempt to support or refute the relationship statements in the theories. In qualitative research, the intent is to learn from the participants. Therefore, the questions tend to be open-ended to permit the complexity of a single idea or phenomenon to emerge from the participants'

perspectives. The researcher often focuses on a single phenomenon to gather as much information as possible about that particular phenomena (Creswell & Plano Clark, 2007).

How Data are Collected

In quantitative research, data can be collected from many participants at many research sites. Researchers rely on gathering information either by sending or administering testing instruments to participants. Data is usually collected through the use of numbers which can be statistically analyzed. In qualitative research, the words and images of a few participants collected at their respective research sites, are recorded by the researcher (Creswell & Plano Clark, 2007).

How Data are Analyzed Quantitatively

Quantitative research makes use of numerical statistical analysis which allows researchers to either reject the hypotheses or to determine the effect size. Analyzing the data involves addressing each one of the research questions or hypotheses individually. Creswell (2005) identifies two types of statistical analysis: descriptive and inferential. He says that researchers need “descriptive statistics that indicate central tendencies in the data (mean, mode, median), the spread of scores (variance, standard deviation, and range), or a comparison of how one score relates to others (z-scores, percentile rank)” (p.181). In addition, he says that analyzing the data might also identify the variables: independent, dependent, control, or mediating.

The second type of statistical analysis depends on the use of inferential statistics. This type of analysis allows the researcher to compare the effect of independent variables on one or

more groups by analyzing changes in the dependent variable (Creswell, 2005). Creswell (2005) says that this allows the researcher to analyze data from a sample and then to draw conclusions about an unknown population. The purpose of this kind of study is to assess whether the differences in groups (their means) or the relationship among variables is much greater or less than what we would expect for the total population (Creswell, 2005).

How Data are Analyzed Qualitatively

Qualitative researchers choose their analysis methods not only by the research questions and types of data collected but also based on the philosophical assumptions underlying the study. Analysis also requires an understanding of how to make sense of text and images so that the researcher can form answers to the research questions (Creswell, 2005). Qualitative researchers look for patterns or themes in the texts or image analysis. They also look for larger patterns of generalizations (Creswell & Plano Clark, 2007). Data are gathered through methods of observation, interviewing, and document analysis. These results cannot be measured exactly, but must be interpreted and organized into themes or categories.

Creswell (2005) discusses six steps commonly used in analyzing qualitative data. The first step is to generate a large consolidated picture from the detailed data (transcriptions or typed notes from interviews) to the more specific: codes and themes. Secondly, it involves analyzing data while still in the process of collecting data. In qualitative research, the data collection and analysis are carried out at the same time. This is different from quantitative research where the collection of data comes before analysis. Thirdly, the phases of research in qualitative research are recursive, where the researcher can move back and forth between collecting data and

analyzing. Fourth, qualitative researchers analyze their data by reading it over several times and conducting an analysis each time. Reviewing the material allows the researcher to continue to explore for more details and patterns related to each common theme. Fifth, there is no single approach to analyze qualitative data although several guidelines exist for the process. It is an eclectic process. Sixth, qualitative research is interpretative: the researcher makes personal assessments of the data in a descriptive format. The researcher then develops the themes that capture the major categories of information thus bringing their own perspective to the interpretations.

Role of the Researcher

The quantitative researcher believes in maintaining an objective approach to the experiment by remaining in the background. Steps are taken to ensure that any preconception is minimized so that the information gathered is not contaminated by the personal beliefs of the researcher. In contrast, qualitative researchers identify their personal stance with regards to how their experiences and backgrounds shape the interpretations they make through the coding and theme process (Creswell & Plano Clark, 2007).

How Data are Validated

It is important to establish validity regardless of which research methodology is employed. Quantitative research relies on using validity procedures based on external standards, such as judges, past research, and statistics. Validity does not rely on the participants as much as it relies on the evidence that supports the interpretation of the test scores. Qualitative researchers are interested in the accuracy of the final report. They use various methods, to ensure accuracy

such as member-checks (where the participants get to review their comments), or the use of many sources to verify a theme. Qualitative validity procedures rely on the participants, the researcher, or the reader (Creswell & Plano Clark, 2007).

Nature of Knowledge

Even though the qualitative and quantitative approaches can be considered as complimentary to one another, there are still some fundamental differences about research that go beyond the level of the data. The differences arise out of the epistemological assumptions about where knowledge is located and whether knowledge is “found”, as is usually assumed in confirmatory research, or “constructed”, as is usually assumed in exploratory research. Trochim (2006) argues that we must dispel the notion that quantitative research is always confirmatory and deductive, or that qualitative research is always exploratory and inductive. Trochim goes on to say that much of quantitative research can be classified as exploratory and, in the same way, much qualitative research can be used to confirm very specific deductive hypotheses.

It could be argued that the differences between the two research paradigms are not methodological but philosophical, with the differences between the two emerging from the difference in the way that each regards the epistemology of learning. Quantitative research is based on a rule, law, principle, or generalization (Trochim, 2006). Research is conducted to test the validity of the rule by using a generalization. This is “especially effective when the generalization is widely accepted, or when there is strong evidence to support it” (Trochim, 2006, p. 1). Onwuegbuzie and Leech (2005) define quantitative research as research in which “mathematical and statistical procedures are utilized to explore, to describe, to explain, to

predict, and to control social and behavioural phenomenon” (p. 269). They go on to say that “social science positivists promoted research studies that were value-free, using rhetorical neutrality that resulted in discoveries of social laws, from which in time and context-free generalizations ensued” (p. 269). Therefore, in researching literacy education, the researcher would attempt to find whether a rule about literacy could be shown to be generalizable to the whole population. The premise is that if the rule holds for a representative portion of the population, then it will hold in the same way for the larger population. For the quantitative researcher, there is a single reality where a valid rule can be assumed to apply in the same way to the general population.

For the qualitative researcher, the “best way to understand any phenomenon is to view it in context” (Trochim, 2006, p. 5). Trochim (2006) states, that in this type of research, the ability to quantify is limited to a small portion of experience. The larger experience cannot be split or unitized without losing the importance of the whole phenomenon. For the qualitative researcher, immersion in the culture or organization is important, as is being flexible in the inquiry of the people in the context. Researchers do not approach a situation with a set of questions already formulated but instead allow the questions to emerge and change as the researchers become familiar with what they are studying. Qualitative researchers do not assume that there is a single reality that exists apart from our perceptions (Trochim, 2006). For the qualitative researcher, each person experiences life from a particular point of view and, thus, each person experiences a different reality. Similarly, each researcher brings a personal bias into their individual perceptions of what they are observing. Onwuegbuzie and Leech (2005) say that “proponents of this school of thought rejected the positivistic use of the traditional scientific

method to study social observations” (p.260). Instead, they believed in the use of the interpretative approach to collecting data. This led them to contend that social reality was constructed and thus was subjective.

Contributions of Quantitative Research

In quantitative research, the epistemological assumption is that knowledge is relatively objective (i.e., most people experience the external world in the same way), thus making it possible to assume that changes observed in experiments derive from changes in variables rather than from individual experiences of the external world. This allows researchers to generalize and draw inferences about the general population from a selected sample (Creswell, 2005). In the case of literacy education, this permits researchers to investigate whether pedagogical practices will be effective in the general populations. The advantage that such research provides is that teaching practices will be guided by evidence rather than by anecdotal observations of individual teachers.

According to Lomax (2004) quantitative research can be classified into two broad categories: experimental and non-experimental. He identifies experimental research as research which “assesses the effect of different treatment conditions (known as an independent variable or factor), on an outcome (dependent variable) rapidly involving multiple groups” (p. 108). In contrast, non-experimental research “assesses the relations among a number of variables without any treatment conditions” (p. 108). Both methods have application in literacy research. The use of experimental quantitative research allows the researcher to discover whether a change in

teaching or environment can affect educational outcomes while the non-experimental research allows investigators to identify conditions without introducing a treatment.

Lomax (2004) further categorizes two types of experimental research: true experiments and quasi-experiments. Lomax defines true experimental studies as randomized studies where random assignment of individuals to groups is conducted. In quasi-experimental studies:

random assignment is not possible, either because random assignment is logically impossible (e.g., we cannot assign individuals to a gender or age group) or because group assignment has already been implemented by someone other than the researcher (e.g., classroom assignments are typically determined by the administration), and thus the groups are intact” (p. 108).

This distinction is particularly important to educational researchers who would not ordinarily have complete control of group selection because the subjects of the studies are students in a natural school setting. Since the primary purpose of a school is not to provide researchers with subjects but to provide students with education, researchers concerns about random selection are generally not the first priority of school administrators.

In conducting experimental research, the method of data collection involves comparison of the means of groups in some way (Lomax, 2004, Creswell, 2005). In education, this is accomplished by “giving one group one set of activities (called an intervention) and withholding the set from another group” (p. 51). Data analysis involves explaining whether an intervention influences an outcome for one group as opposed to another group. As Creswell (2005) says, in

quantitative research, “the investigator seeks to determine whether an activity or materials, make a difference in results for participants” (p. 51).

Researchers would employ quantitative research if they are interested in determining whether one or more variables might influence another variable. For example, quantitative researchers studying emergent literacy might seek to find whether daily read-aloud sessions help children to improve their reading ability. A pre- and post-test would need to be administered so that conclusions could be drawn about the effectiveness of the intervention. The researcher would need to ensure that there were at least two groups, a control group which did not get the treatment, and an experimental group that did get the treatment. This kind of research is fairly common in education as it allows the researcher to draw conclusions about teaching methods.

The principle benefit of quantitative research in education is that it is an approach that allows researchers to compare groups. The comparison of groups allows administrators to generalize about the relative benefits of new or different teaching strategies. In addition, quantitative research can be used with standardized tests to compare the development of an individual to the norm.

Contributions of Qualitative Research

In qualitative research, the epistemological assumption is that each individual has a different view of the world and thus it is difficult to generalize findings and draw inferences simply on the basis of quantitative research. The qualitative research approach allows the researcher to analyze a phenomenon using individuals’ experiences and perceptions of the phenomena. Qualitative research relies on the observations of individuals in a natural setting.

Researchers use those observations to identify themes and patterns that will form the early hypothesis for further exploration (Creswell, 2005).

Qualitative research in education is useful for researchers who want to paint a picture of the phenomenon being researched. Field studies allow the type of close interaction that is needed to understand factors that cannot be measured with tests or surveys. Hillocks (2006) found that “many more studies in recent decades use qualitative or ethnographic methods that are able to provide levels of detail not possible in earlier research. Quantitative studies have not disappeared, but they no longer dominate studies of writing as they once did” (p. 49). He further states that the growth of qualitative research in writing owes its popularity to the researchers’ and teachers’ perceptions of writing as socially situated, and with the work of Vygotsky (1978).

How do Researchers Decide Which Method to use When Conducting Research?

Creswell (2005) points to the importance of considering three factors to determine the method of research that is appropriate for any particular study. These are:

- 1) Match the approach to the research problem: a quantitative approach is best suited to problems in which trends or explanations need to be made. Qualitative problems are those that need to be explored to obtain a deep understanding.
- 2) Fit the approach to the audience: it is important to remember who the intended audience is who will read and possibly use the findings from a study.
- 3) Relate the approach to the researcher’s experiences: the method chosen must relate to the researcher’s personal experiences and training. Conducting research in either method requires skills in conceptualizing research, conducting research,

and writing the study. A quantitative researcher will have taken some courses or training in measurement, statistics, and quantitative data collection approaches such as experimental, correlational, or survey techniques. Qualitative researchers need experience in field studies in which they practice gathering information in a setting, and learn the skills of observing or interviewing individuals. Course work or experience in analyzing text data is also helpful (Creswell, 2005, p. 54).

Conclusion

Onwuegbuzie & Leech (2005) say that the roots for the dichotomy between quantitative and qualitative research lie in the different epistemological beliefs of earlier times. They also argue that the “polarization” (p.268) between the two methodologies should be replaced by a new relationship in which the methodologies are complementary and that “those who teach social behavioural research methodology... [should] stop identifying themselves as qualitative or quantitative researchers” (p. 276). Instead, they suggest that researchers introduce a new terminology that reflects the new relationship, with the word *qualitative* being replaced by the word *exploratory* and the word *quantitative* replaced by the word *confirmatory*. If the terms were replaced, researchers might see the value of allowing the purpose of the research to dictate the methodology. For instance, researchers might begin by exploring a topic that they are interested in through the use of preliminary observations, interviews, open-ended questions, and data gathering (qualitative). At this point, the researcher might use test instruments to provide numbers which could be statistically analyzed. Alternatively, the researcher could test a hypothesis by providing participants with surveys and asking them to answer questions

(quantitative), (Creswell & Plano Clark, 2007). By exploring and confirming researchers can examine an issue more thoroughly.

The debate over the relative value of each research methodology has been ongoing since the start of the 20th century (Onwuegbuzie & Leech, 2005). The gap between the two methodologies may not be as great as we think. While quantitative research typically uses “numbers” to display data and qualitative methods use “words” to show data, the values could be expressed in other ways (Trochim, 2006). Trochim asserts that all qualitative data can be coded quantitatively (p. 1). He believes “that anything that is qualitative can be assigned meaningful numerical values. These values can then be manipulated to help us achieve greater insight into the meaning of the data and to help us examine specific hypotheses” (p.1). Categorizing responses in qualitative research, for example, can be seen as a quantitative method since the same information can be translated into numbers. The quantitative coding allows for a type of analysis (correlation) that could not be done with qualitative coding.

Trochim (2006) also contends that “all quantitative data is based on qualitative judgment” (p. 3). He goes on to say numbers alone can’t be interpreted without understanding the assumptions which underlie them. For him, all numerical information involves numerous judgments about what the number means. For Trochim (2006), all quantitative and qualitative data are virtually inseparable and cannot be considered to exist in a vacuum. In order to do good research, Trochim (2006), believes that researchers need to make use of both qualitative and quantitative.

In addition, as Kamil (2004) and Lomax (2004) point out, the question of methodology should depend on the circumstances. Kamil (2004) further suggests that “progress in reading research will be made by asking different questions (and thus using different methods) at different stages of knowledge about particular research areas” (p. 101). He gives the example of using qualitative research when the researcher’s knowledge is at a minimum. For Kamil (2004), research follows a recursive, spiral approach of gaining knowledge that utilizes both of the methodologies, answering different questions at different stages. He further explains this by saying that once the researcher has gained enough knowledge that allows them to “conceptualize matters, experimental work could be possible. Once results from experiments are obtained, it would be necessary to test out those results in new settings ...” (p. 102). He concludes this discussion by saying that:

the most important notion is that quantitative research can answer some questions and not others. There are times when it is crucial to use observational techniques [qualitative], and there are other times when experimentation [quantitative] is important to determine or verify the locus of effects observed in more naturalistic settings (p. 102).

Lomax (2004) supports the conclusions of Kamil (2004) in his own discussion of the methods of quantitative data analysis in literacy. For Lomax (2004), the examination of one or two variables at a time is appropriate when the researcher wants to *explore* “procedures for the investigation of a new area of inquiry, where very little is known due to limited research, and where identification of the most important variables is still at an early stage” (p. 108). Once the variables have been identified, Lomax (2004) recommends using experimental and nonexperimental research [quantitative]. Thus, both Kamil (2004) and Lomax (2004) favour

using both methods of research dependent on the questions asked and the amount of knowledge available to answer the questions.

It appears that choosing one methodology over another severely limits the scope of any study. As Creswell and Plano Clark (2007) observe, one method alone cannot answer all the questions that will emerge in the course of researching a topic. In order to facilitate a more comprehensive study of a topic, researchers should have access to all available research tools. The dichotomy therefore should be reconsidered and researchers should become proficient in both methodologies.

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