

Real science
is not about
certainty
but about
uncertainty.

CHAPTER 2

Research Approaches in Education

INSTRUCTIONAL OBJECTIVES

After studying this chapter, the student will be able to:

- 1 Identify the major research methodologies used in educational investigations.
- 2 Describe the main differences between quantitative and qualitative research.
- 3 List the specific types of research that fall into the broad categories of quantitative and qualitative research.
- 4 Give an example of a research problem that might be investigated by a mixed methods approach.
- 5 Identify the research methodology used in given examples of both quantitative and qualitative research.
- 6 List the steps involved in the research process.
- 7 Distinguish between the characteristics of basic and applied research.
- 8 Explain the terms *concept*, *construct*, and *variable*.
- 9 Distinguish among types of variables: categorical versus continuous and independent versus dependent.
- 10 Distinguish between constitutive and operational definitions and explain the importance of the latter in research.

Educational research is typically classified into two broad categories: quantitative and qualitative research. Each approach has its own methodology and terminology. **Quantitative research** uses objective measurement to gather numeric data that are used to answer questions or test predetermined hypotheses. It generally requires a well-controlled setting. **Qualitative research**, in contrast, focuses on understanding social phenomena from the perspective of the human participants in natural settings. It does not begin with formal hypotheses, but it may result in hypotheses as the study unfolds.

Quantitative and qualitative research stem from different philosophical assumptions that shape the ways researchers approach problems and collect and analyze data. Quantitative research originated in **positivism**, a philosophic view formulated in Europe in the 19th century. Positivists believe that general principles or laws govern the social world as they do the physical world and that through objective procedures researchers can discover these principles and apply them to understand human behavior. The positivists, such as Francis Bacon (recall the anecdote in Chapter 1), stressed observation as the primary source of dependable knowledge. Positivism is often considered the traditional scientific method, which involves hypothesis testing and objective data gathering to arrive at findings that are systematic, generalizable, and open to replication by other investigators.

Qualitative research is based on a different philosophical approach, which sees the individual and his or her world as so interconnected that essentially the one has no existence without the other. It sees social reality as unique; thus, researchers can only understand human behavior by focusing on the meanings that events have for the people involved. You must look not only at what people do but also at how they think and feel, and you must attempt to understand their reality. The intended result of a qualitative research study is a narrative report so rich and comprehensive that you can understand the social reality experienced by the participants. Furthermore, because researchers do not know in advance how naturally occurring events will unfold or what variables may be important, they do not begin a study with hypotheses.

Historically, the quantitative approach has dominated education research. In the late 20th century, however, scholars began to call for an alternative to the quantitative approach in educational research (Guba & Lincoln, 1988). They believed that using quantitative methods in highly controlled settings ignored the participants' perspectives and experiences. Qualitative research was the alternative. For a time, the relationship between quantitative and qualitative researchers was somewhat adversarial, but gradually there was a trend toward rapprochement as researchers began to see quantitative and qualitative methodology as complementary. Pring (2004) wrote, "The distinctions within the so-called paradigms are often as significant as the distinctions between them" (p. 48). A new methodology in which the same study uses both quantitative and qualitative approaches is called **mixed methods research**. The end result of mixed methods research is findings that may be more dependable and provide a more complete explanation of the research problem than either method alone could provide. All of these approaches are discussed in greater detail in later chapters.

As an example, assume you want to know the impact of a newly instituted dress code in an inner-city high school. Depending on exactly what you want to find out, you might choose either a quantitative or a qualitative approach alone or a mixed methods approach. In a quantitative study, you could measure subsequent attendance, frequency of violations of the code, and/or the number of school suspensions for failure to comply. You might administer a survey that assesses students' attitudes toward the new policy or one that asks teachers about the policy's effect on the incidence of disciplinary problems in the school. Numerical data would be gathered and analyzed. In a qualitative study, you might observe

PICTURE THIS

Qualitative Quantitative



Joe Rocco

student behavior in classes and also interview groups of students to obtain in-depth information on how the new dress code has affected their motivation and learning in the classroom, their self-image, and their general attitude toward school. One might interview parents to assess their reaction to the dress code and how they think it has affected their children. The result could be a rich, verbal description of the personal and social meaning that the new policy has for students. Combining these approaches in a mixed methods study would provide the most complete information on the effect of the dress code.

Whether researchers choose quantitative, qualitative, or mixed methods depends not on their preference for one or another but on the suitability of the particular method for what they are studying and what they want to find out. One uses what will work to provide the type of data that are appropriate for answering the research question. As Johnson and Onwuegbuzie (2004) wrote, "What is most fundamental is the research question—research methods should follow

Table 2.1 Comparison of Quantitative and Qualitative Research

	Quantitative	Qualitative
Purpose	To study relationships, cause and effect	To examine a phenomenon as it is, in rich detail
Design	Developed prior to study	Flexible, evolves during study
Approach	Deductive; tests theory	Inductive; may generate theory
Tools	Uses preselected instruments	The researcher is primary data collection tool
Sample	Uses large samples	Uses small samples
Analysis	Statistical analysis of numeric data	Narrative description and interpretation

research questions in a way that offers the best chance to obtain useful (and the most thorough) answers” (pp. 17–18).

A caveat is in order, however. It may be more difficult to carry out a mixed methods study because one must have knowledge and an understanding of both quantitative and qualitative methodology. A mixed methods study also typically involves more extensive data collection and analysis and thus will require more time and effort to complete. We discuss mixed methods research in Chapter 19. The reader is referred to Creswell and Plano Clark (2006) for in-depth discussion of the mixed methods approach in research. Table 2.1 summarizes briefly the major characteristics of the quantitative and qualitative research approaches.

Think About It 2.1

A study was conducted to determine the effect on student performance of implementing a block schedule in high schools. Two high schools in a district were selected to implement block scheduling, and two other high schools continued with traditional scheduling. At the conclusion of the 2-year study, student performance on state tests (adjusted for prechange performance) was compared across the high schools. The results puzzled the researchers. One high school with block scheduling had much higher scores than the control schools, but the other high school with block scheduling had notably lower scores than the control schools. The researchers believed no valid conclusions about the benefits of block scheduling could be drawn and that further research was necessary. How would quantitative and qualitative researchers differ in their approach?

Answer

The quantitative researcher would suggest an experimental study to try to determine the impact of block scheduling and other demographic variables on student performance. The qualitative researcher would suggest in-depth case studies of the two block scheduling schools to determine what differences in the social context of the schools could account for the different results. Data could be collected through observation and focus groups.

We next discuss specific types of research included in the broad categories of quantitative and qualitative research.

■ QUANTITATIVE RESEARCH

Quantitative research may be further classified as either experimental or nonexperimental.

EXPERIMENTAL RESEARCH

Researchers study variables, which are characteristics that take on different values across people or things. **Experimental research** involves a study of the effect of the systematic manipulation of one variable(s) on another variable. The manipulated variable is called the **experimental treatment** or the **independent variable**. The observed and measured variable is called the **dependent variable**. For example, assume a university researcher wanted to investigate the effect of providing online feedback to students immediately following course examinations. Using two sections of economics taught by the same professor, the researcher using a random procedure would select one section to receive immediate online feedback about their performance on test questions; the other section would receive feedback during their next class session (independent variables). The researcher would compare the two sections' exam scores and their final grades in the course (dependent variables). If test scores and final grades were higher than could be accounted for by chance in the section receiving online feedback, the researcher could tentatively conclude that there is evidence the online feedback (treatment or independent variable) contributed to greater learning than the in-class feedback.

In experiments, you seek to control all other variables that might influence the dependent variable. In the foregoing example, the researcher would attempt to make sure that both groups had the same instructor; that both sections met at the same time of day but on different days; that lecture notes, readings, and exams were the same; and so forth. The researcher might also check the ability level and background of the students in the two sections to make sure one section was not superior or better prepared than the other.

To have a “true” experiment, researchers must use a random process such as a coin toss to assign available subjects to the experimental treatments. With random assignment, each subject has an equal and independent chance of being assigned to any group; thus, the assignment is independent of the researcher's personal judgment or the characteristics of the subjects themselves. Sometimes, however, researchers cannot randomly assign subjects to experimental treatments for a study. Instead, as in the preceding example, the experimenter must use already assembled groups such as classes. In this case, the research is called **quasi-experimental**. We discuss experimental research more thoroughly in Chapters 10 and 11.

NONEXPERIMENTAL RESEARCH

In **nonexperimental quantitative research**, the researcher identifies variables and may look for relationships among them but does not manipulate the variables. Major forms of nonexperimental research are relationship studies including *ex post facto* and correlational research and survey research.

Ex post facto research is similar to an experiment, except the researcher does not manipulate the independent variable, which has already occurred in the natural course of events. The researcher simply compares groups differing on the preexisting independent variable to determine any relationship to the

dependent variable. Because there is no manipulation or control of the independent variable, one must be very careful regarding the conclusions that are drawn about any observed relationship. The variables in this type of research differ in kind rather than in amount. Later, we refer to these as **categorical variables**. For example, to answer the question, “What is the effect of part-time work on school achievement of high school students?” one would use the ex post facto method. The researcher would not manipulate the lives of high school students by having some take part-time jobs and others not; instead, the researcher would identify students who already work part-time and compare their achievement with that of students who do not work. Because researchers lack control over many factors, they must be especially careful in interpreting the results of ex post facto investigations. They do not establish a simple causal relationship among the variables of a study. We discuss ex post facto research in detail in Chapter 12.

Correlational research gathers data from individuals on two or more variables and then seeks to determine if the variables are related (correlated). *Correlation* means the extent to which the two variables vary directly (positive correlation) or inversely (negative correlation). The degree of relationship is expressed as a numeric index called the *coefficient of correlation*. Correlational research might ask about the relationship between the quality of writing samples produced by incoming college freshmen and their academic performance during the freshman year. Also, one might investigate the relationship between performance on a language aptitude test and success in a high school foreign language course.

Both ex post facto and correlational research investigate relationships between variables. The major distinction between the two is that in ex post facto research one categorizes the participants into at least two groups on one variable and then compares them on the other variable. In correlational research, a researcher deals with one group of individuals measured on at least two continuous variables. We discuss correlational research in Chapter 13.

Think About It 2.2

A study investigated the difference in French grammar performance between high school freshmen taught by two different methods.

1. (a) What is the independent variable in this study? (b) What is the dependent variable? (c) What is not a variable?
2. What would the researcher have to do to make the study a true experiment?
3. How would the study be classified if intact classes were assigned to receive teaching method A or B?
4. How would the study be classified if it compared the French grammar performance of students who had already been taught using method A with the performance of those who had already been taught using method B?

Answers:

1. (a) teaching method, (b) French grammar performance, (c) grade level of participants
2. Randomly assign students to teaching method A or B
3. Quasi-experimental research
4. Ex post facto

Survey research (also called **descriptive research**) uses instruments such as questionnaires and interviews to gather information from groups of individuals. Surveys permit the researcher to summarize the characteristics of different groups or to measure their attitudes and opinions toward some issue. Researchers in education and the social sciences use surveys widely. For example, an educational

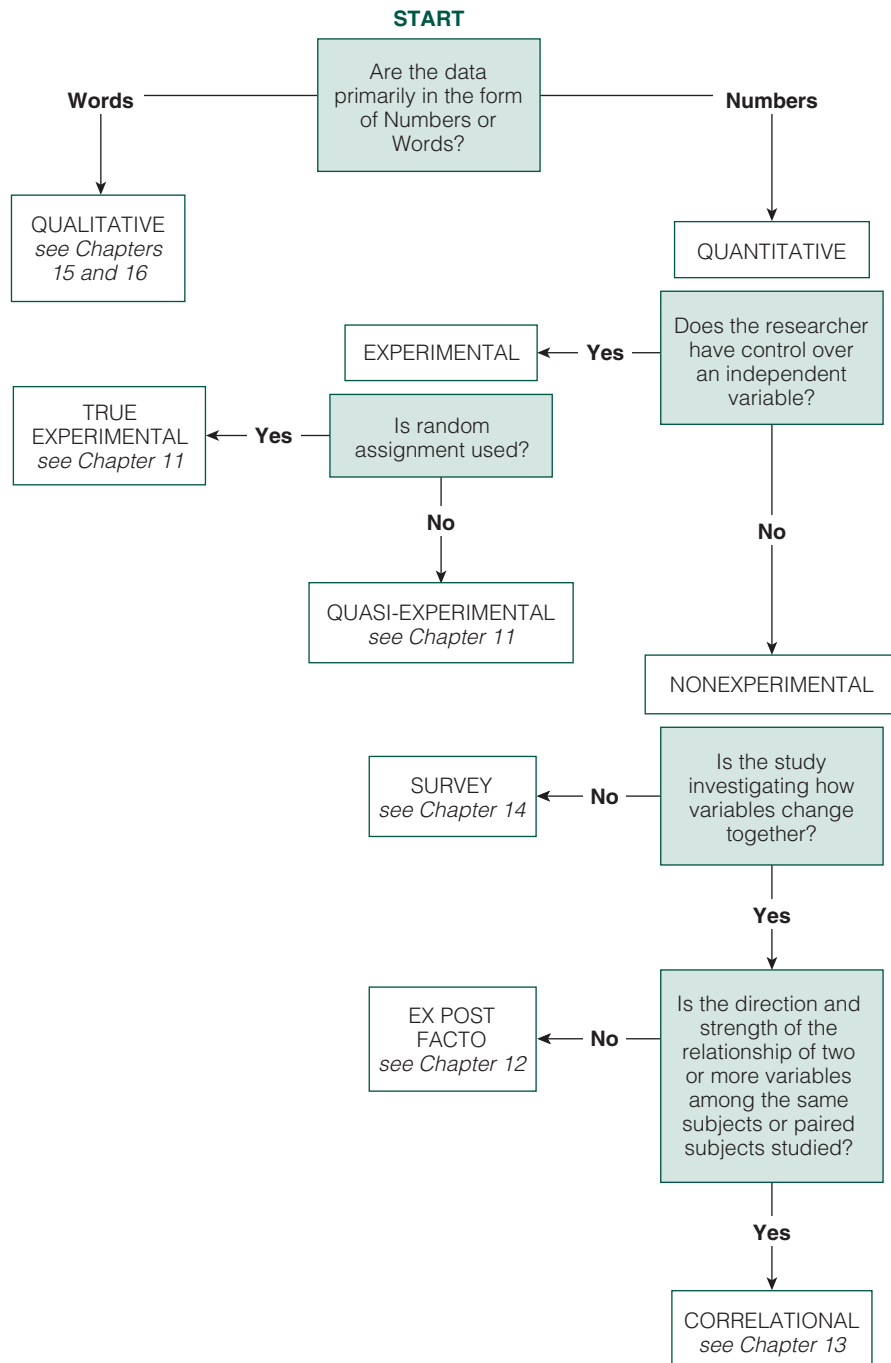


Figure 2.1 Major Types of Quantitative Educational Research

researcher might ask a group of parents about what kind of sex education program, if any, they believe schools should provide for middle school students. A survey of teachers could reveal their perceptions of giftedness in schoolchildren. Opinion polls are surveys that researchers conduct to determine whom people are likely to vote for or what positions they take on certain issues. We discuss surveys in Chapter 14. Figure 2.1 summarizes the major types of quantitative research.

QUALITATIVE RESEARCH

Qualitative researchers seek to understand a phenomenon by focusing on the total picture rather than breaking it down into variables. The goal is a holistic picture and depth of understanding rather than a numeric analysis of data. For example, social scientists have long observed that differences in educational background alone do not seem to account for the difficulties black students encounter in a predominantly white university. Researchers could explore the question “How do black students perceive their academic experience in a white university?” using qualitative methodology. Researchers would focus on a few black students and study them in great detail through observation and in-depth interviews. There are many different types of qualitative research; we consider briefly eight of the most widely used approaches: basic interpretative studies, case studies, document or content analysis, ethnography, grounded theory, historical studies, narrative inquiry, and phenomenological studies. We discuss qualitative research more extensively in Chapters 15 and 16.

BASIC INTERPRETATIVE STUDIES

A **basic interpretative study** provides descriptive accounts targeted to understanding a phenomenon using data that might be collected in a variety of ways, such as interviews, observations, and document review. The purpose is to understand the world or experience of another. These are the most simple and most common qualitative studies. Describing how teachers perceive their role in selecting curriculum is an example.

CASE STUDIES

A **case study** is a type of ethnographic research study that focuses on a single unit, such as one individual, one group, one organization, or one program. The goal is to arrive at a detailed description and understanding of the entity (the “case”). In addition, a case study can result in data from which generalizations to theory are possible. Freud, for example, used the case study extensively in building his theory of personality. Case studies use multiple methods, such as interviews, observation, and archives, to gather data. Education and psychology researchers have used the case study widely. For example, you might conduct a case study of an inner-city school in which the students have achieved at a high level on standardized tests.

DOCUMENT OR CONTENT ANALYSIS

Content analysis focuses on analyzing and interpreting recorded material to learn about human behavior. The material may be public records, textbooks, letters, films, tapes, diaries, themes, reports, or other documents. Content analysis

usually begins with a question that the researcher believes can best be answered by studying documents. For example, what was the employment situation like for married women teachers in the early 20th century? Content analysis is sometimes quantitative, such as when one investigates middle school science textbooks to determine the extent of coverage given to the achievements of minority scientists.

ETHNOGRAPHY

Ethnography is an in-depth study of naturally occurring behavior within a culture or social group. Social scientists sometimes call ethnography field research because it is conducted in a natural setting or “field.” The researcher observes group behavior as it occurs naturally in the setting, without any simulation or imposed structure. Ethnography requires a variety of data-gathering procedures, such as prolonged observation of the setting, interviewing members of the culture, and studying documents and artifacts. Researchers interpret the data in the context of the situation in which they gathered the data.

Ethnography is rooted in anthropology. Educational researchers use ethnography, for example, to learn how the educational experience in suburban schools differs from that in inner-city schools.

GROUNDING THEORY

Grounded theory research is designed to develop a theory of social phenomena based on the field data collected in a study. Experience with the data generates insights, hypotheses, and questions, which researchers pursue with further data collection.

From an inductive analysis of the data, the researcher constructs concepts. He or she then forms a theory by proposing plausible relationships among the concepts. The theory is thus said to be grounded in the data. For example, a researcher interested in mainstreaming in elementary school could observe a number of classrooms and conduct interviews with teachers and students. Analysis of the data could lead to a theory about mainstreaming in the elementary school.

HISTORICAL RESEARCH

Historical research analyzes documents, and artifacts and/or uses interviews with eyewitnesses to gain insight into past events. The success of historical research depends on the accuracy and completeness of the source material. The researcher must establish the authenticity of the documents used, as well as the validity of their contents.

An educational researcher might want to investigate the trends in kindergarten education in a particular school district from its beginnings to the present. Also, one might investigate the methods used to teach reading in the past or study school practices and policies such as grade retention.

Some of the data collected in historical research might be quantitative, such as when an investigator compares a school district’s reading achievement scores when one teaching method was used with the scores obtained when another method was in vogue.

Table 2.2 Types of Qualitative Research

Type	Major Question
Basic interpretive studies	How are events, processes, and activities perceived by the participant?
Case study	What are the characteristics of this individual, organization, or group?
Document analysis	What can be learned about this phenomenon by studying certain documents?
Ethnography	What are the culture and perspectives of this group of people in its natural setting?
Grounded theory	What theory can be derived inductively about a phenomenon from the data collected in a particular setting?
Historical studies	What insights or conclusions can be reached about this past event?
Narrative inquiry	What insights and understandings about an issue emerge from examining life stories?
Phenomenological study	What does this experience mean for the participants in the experience?

NARRATIVE INQUIRY

In **narrative inquiry**, researchers examine the stories people tell about their lives and co-construct a narrative analysis of those stories. The researcher and those telling their stories have an equal voice in determining the meanings attributed to the experiences. Narrative analysis has also been referred to using terms such as life stories. A researcher investigating teacher reflection or teacher pathways into teaching might use narrative inquiry approaches.

PHENOMENOLOGICAL STUDIES

Phenomenological studies begin with the assumption that multiple realities are rooted in subjects' perspectives. Thus, an experience has different meanings for each person. Through unstructured interviews, the investigator explores the subject's thoughts and feelings to elicit the essence of an individual's experience. A phenomenological study might be conducted to answer the questions, "What is the relationship like between a beginning teacher and his or her mentor?" and "What does the experience mean to the beginning teacher?"

Table 2.2 summarizes the major types of qualitative research.

TYPICAL STAGES IN RESEARCH

All researchers engage in a number of activities regardless of the particular methodology chosen for the research. We focus on these activities in greater detail in later chapters; here, we briefly summarize the steps involved.

1. *Selecting a problem.* The first step is to select the problem to investigate. The problem should be consequential enough to warrant investigation. Also, the answer to the problem is not already available, but the means for finding answers are available. Quantitative researchers typically state the problem in the form of a specific question about the relationship between variables. For example, "Do children who are taught reading through the whole-language approach score higher on reading achievement than children who

are taught reading through phonics?” or “What do teachers know about attention deficit/hyperactivity disorder?” Qualitative researchers begin with a general topic of interest. The problem statement may ask the “why” or “how” of certain phenomena. For example, “How do elementary classroom teachers deal with aggressive children?” or “How do high school students become alienated from their peers?”

2. *Reviewing the literature on the problem.* Researchers should thoroughly review the relevant literature to gain more understanding and insight into the problem and to determine what research may already have been done. The beginning researcher will likely turn to the literature for help in locating and formulating a researchable problem.
3. *Designing the research.* The investigator next plans how to conduct research to answer the question. The design is the researcher’s plan for the study, which includes the method to be used, what data will be gathered, where, how, and from whom. Quantitative researchers maintain that once this research plan is set forth, it must be followed. Unhypothesized observed relationships among variables may be reported and proposed as topics for future research, but they should not replace the original intent of the study. In qualitative research, the design is flexible and may change during the investigation if appropriate. The design of qualitative research is thus often described as “emergent.”
4. *Collecting the data.* The next step involves executing the research plan. Quantitative researchers use a wide variety of instruments to gather data, including tests, questionnaires, ratings, and attitude scales. Qualitative researchers also have a toolbox of data-gathering techniques, including in-depth interviewing, participant observation, and document analysis.
5. *Analyzing the data.* The data collected in research must be analyzed. Quantitative data are usually in the form of numbers that researchers analyze using various statistical procedures. Even verbal data, such as compositions written by high school students, would be converted through the scoring process to a numerical form. The analysis of the numerical data in quantitative research provides evidence that supports or fails to support the hypothesis of the study. Qualitative data generally take the form of words (descriptions, observations, impressions, recordings, and the like). The researcher must organize and categorize or code the large mass of data so that they can be described and interpreted. Although the qualitative researcher does not deal with statistics, analyzing qualitative data is not easy. It is a time-consuming and painstaking process.
6. *Interpreting the findings and stating conclusions.* The researcher next tries to interpret the findings in terms of the research problem. The quantitative researcher typically makes statements about the probability that such a finding is due to chance and reaches a conclusion about the hypothesis. Qualitative researchers present their interpretations and explanations in narrative form. They do not talk about probability but try to emphasize the *trustworthiness* and *credibility* of the findings (see Chapter 16).
7. *Reporting results.* Researchers must make their procedures, findings, and conclusions available in a form intelligible to others who may be interested.

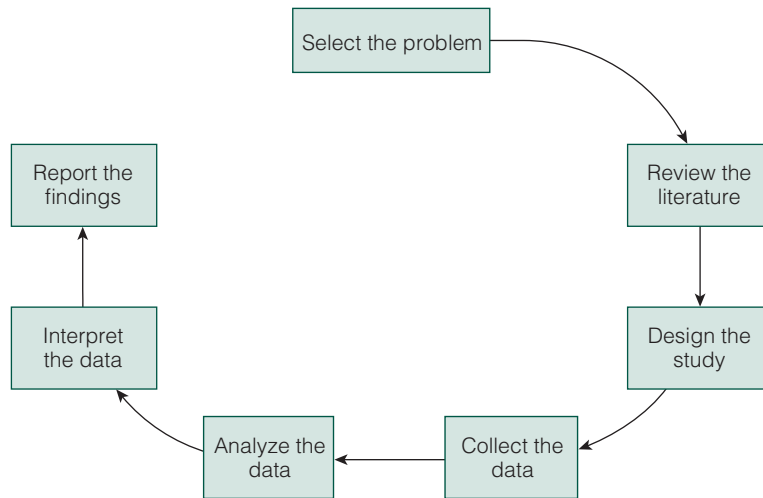


Figure 2.2 Stages in the Research Process

This involves clearly and concisely presenting the steps in the study in sufficient detail so that another person can replicate it.

We discuss in detail each of the foregoing stages of a research study in later chapters. It is probably rare for researchers to follow precisely the sequence as we have described in the preceding discussion. These activities often overlap, and researchers may move back and forth from one stage to another. These steps are shown in Figure 2.2.

QUESTIONS THAT EDUCATIONAL RESEARCHERS ASK

The specific question chosen for research, of course, depends on the area that interests the researchers, their background, and the particular problem they confront. However, we may classify questions in educational research as theoretical (having to do with fundamental principles) or as practical (designed to solve immediate problems of the everyday situation).

THEORETICAL QUESTIONS

Questions of a theoretical nature are those asking “What is it?” or “How does it occur?” or “Why does it occur?” Educational researchers formulate “what” questions more specifically as “What is intelligence?” or “What is creativity?” Typical “how” questions are “How does the child learn?” or “How does personality develop?” “Why” questions might ask “Why does one forget?” or “Why are some children more achievement-oriented than other children?”

Research with a theoretical orientation may focus on either developing new theories or testing existing theories. The former involves a type of study in which researchers seek to discover generalizations about behavior, with the goal of clarifying the nature of relationships among variables. They may believe that certain variables are related and thus conduct research to describe the nature of

the relationship. From the findings, they may begin to formulate a theory about the phenomenon. Theories of learning have thus been developed because investigators have shown the relationships among certain methods, individual and environmental variables, and the efficiency of the learning process.

Probably more common in quantitative educational research are studies that aim to test already existing theories. It may be overly ambitious, especially for beginning researchers in education, to take as a goal the development of a theory. It is usually more realistic to seek to deduce hypotheses from existing theories of learning, personality, motivation, and so forth, and to test these hypotheses. If the hypotheses are logical deductions from the theory, and the empirical tests provide evidence that supports the hypotheses, then this evidence also provides support for the theory.

PRACTICAL QUESTIONS

Many questions in educational research are direct and practical, aimed at solving specific problems that educators may encounter in everyday activities. These questions are relevant for educational research because they deal with actual problems at the level of practice and lead to an improvement in the teaching-learning process. Slavin (2004) writes that “enlightened educators look to education research for well-founded evidence to help them do a better job with the children they serve” (p. 27). Some academic researchers, however, criticize practitioner research as not being sufficiently rigorous. But Anderson (2002) also argues for a research continuum for doctoral students in education that includes practitioner research. Such practical questions are, for example, “How effective is peer tutoring in the elementary school classroom?” “How does teaching children cognitive strategies affect their reading comprehension?” “What is the relative effectiveness of the problem discussion method as compared with the lecture method in teaching high school social studies?” or “What are the most effective means of providing remediation to children who are falling behind?” The answers to such questions may be quite valuable in helping teachers make practical decisions in the classroom.

These practical questions can be investigated just as scientifically as the theoretical problems. The two types of questions differ primarily on the basis of the goals they hope to achieve rather than on the study’s level of sophistication.

BASIC AND APPLIED RESEARCH

Another system of classification concerns whether research is basic or applied. **Basic research** is research aimed at obtaining empirical data used to formulate and expand theory. Basic research is not oriented in design or purpose toward the solution of practical problems. Its essential aim is to expand the frontiers of knowledge without regard to practical application. Much early psychological investigation of reinforcement was basic research. Later, social scientists found that the reinforcement theory resulting from that research had educational applications.

Applied research aims to solve an immediate practical problem. It is research performed in relation to actual problems and under the conditions in which they appear in practice. Through applied research, educators can often solve

their problems at the appropriate level of complexity—that is, in the classroom teaching–learning situation. Although applied research may solve some specific question, it may not provide the general knowledge to solve other problems. For example, an elementary school teacher may study the effect of a new method of teaching fractions. She or he conducts the research to answer a practical question, not necessarily to make broad generalizations or to help develop a theory.

This classification of research is not always distinct, however, because there are varying degrees on the basic–applied continuum. Research along this basic–applied dimension is usually classified on the degree to which the findings are directly applicable to solving a practical problem. Basic research often has practical benefits in the long term. For example, advances in the practice of medicine depend on basic research in biochemistry, microbiology, and genetics. Likewise, progress in educational practice is related to progress in discovering general laws through basic psychological, educational, and sociological research.

Actually, in recent years basic and applied research has tended to merge in education and psychology. The trend has been for basic research to move more toward classroom studies because the findings of applied research may help basic researchers complete theoretical formulations. Researchers developing general theories of learning, for example, often go into classrooms because to understand how children learn investigators must consider variables such as context and social structure that are not present in the artificial environments of the laboratory. Once the theories are formulated, they can be tested through further research in the classroom.

LANGUAGE OF RESEARCH

Any scientific discipline needs a specific language for describing and summarizing observations in that area. Scientists need terms at the empirical level to describe particular observations; they also need terms at the theoretical level for referring to hypothetical processes that may not be subject to direct observation. Scientists may use words taken from everyday language, but they often ascribe to them new and specific meanings not commonly found in ordinary usage. Or perhaps they introduce new terms that are not a part of everyday language but are created to meet special needs. One of these terms is *construct*.

CONSTRUCTS

To summarize their observations and to provide explanations of behavior, scientists create constructs. **Constructs** are abstractions that cannot be observed directly but are useful in interpreting empirical data and in theory building. For example, people can observe that individuals differ in what they can learn and how quickly they can learn it. To account for this observation, scientists invented the construct called *intelligence*. They hypothesized that intelligence influences learning and that individuals differ in the extent to which they possess this trait. Other examples of constructs in educational research are motivation, reading readiness, anxiety, underachievement, creativity, and self-concept.

Defining constructs is a major concern for researchers. The further removed constructs are from the empirical facts or phenomena they are intended to

represent, the greater the possibility for misunderstanding and the greater the need for precise definitions. Constructs may be defined in a way that gives their general meaning, or they may be defined in terms of the operations by which they will be measured or manipulated in a particular study. The former type of definition is called a *constitutive definition*; the latter is known as an *operational definition*.

Constitutive Definition

A **constitutive definition** is a formal definition in which a term is defined by using other terms. It is the dictionary type of definition. For example, intelligence may be defined as the ability to think abstractly or the capacity to acquire knowledge. This type of definition helps convey the general meaning of a construct, but it is not precise enough for research purposes. The researcher needs to define constructs so that readers know exactly what is meant by the term and so that other investigators can replicate the research. An operational definition serves this purpose.

Operational Definition

An **operational definition** ascribes meaning to a construct by specifying operations that researchers must perform to measure or manipulate the construct. Operational definitions may not be as rich as constitutive definitions but are essential in research because investigators must collect data in terms of observable events. Scientists may deal on a theoretical level with such constructs as learning, motivation, anxiety, or achievement, but before studying them empirically, scientists must specify observable events to represent those constructs and the operations that will supply relevant data. Operational definitions help the researcher bridge the gap between the theoretical and the observable.

Although investigators are guided by their own experience and knowledge and the reports of other investigators, the operational definition of a concept is to some extent arbitrary. Often, investigators choose from a variety of possible operational definitions those that best represent their own approach to the problem.

Certainly an operational definition does not exhaust the full scientific meaning of any concept. It is very specific in meaning; its purpose is to delimit a term, to ensure that everyone concerned understands the particular way a term is being used. For example, a researcher might state, "For this study, intelligence is defined as the subjects' scores on the Wechsler Intelligence Scale for Children." Operational definitions are considered adequate if their procedures gather data that constitute acceptable indicators of the constructs they are intended to represent. Often, it is a matter of opinion whether they have achieved this result.

Operational definitions are essential to research because they permit investigators to measure abstract constructs and permit scientists to move from the level of constructs and theory to the level of observation, on which science is based. By using operational definitions, researchers can proceed with investigations that might not otherwise be possible. It is important to remember that although researchers report their findings in terms of abstract constructs and relate these to other research and to theory, what they have actually found is a relationship between two sets of observable and measurable data that they

selected to represent the constructs. In practice, an investigation of the relation between the construct creativity and the construct intelligence relates scores on an intelligence test to scores on a measure of creativity.

VARIABLES

Researchers, especially quantitative researchers, find it useful to think in terms of variables. A **variable** is a construct or a characteristic that can take on different values or scores. Researchers study variables and the relationships that exist among variables. Height is one example of a variable; it can vary in an individual from one time to another, among individuals at the same time, among the averages for groups, and so on. Social class, gender, vocabulary level, intelligence, and spelling test scores are other examples of variables. In a study concerned with the relation of vocabulary level to science achievement among eighth-graders, the variables of interest are the measures of vocabulary and the measures of science achievement. There are different ways to measure science achievement. The researcher could use a standardized achievement test, a teacher-made test, grades in science class, or evaluations of completed science projects. Any of these measures could represent the variable “science achievement.”

Types of Variables

There are several ways to classify variables. Variables can be categorical, or they can be continuous. When researchers classify subjects by sorting them into mutually exclusive groups, the attribute on which they base the classification is termed a categorical variable. Home language, county of residence, father’s principal occupation, and school in which enrolled are examples of categorical variables. The simplest type of categorical variable has only two mutually exclusive classes and is called a **dichotomous variable**. Male–female, citizen–alien, and pass–fail are dichotomous variables. Some categorical variables have more than two classes; examples are educational level, religious affiliation, and state of birth.

When an attribute has an infinite number of values within a range, it is a **continuous variable**. As a child grows from 40 to 41 inches, he or she passes through an infinite number of heights. Height, weight, age, and achievement test scores are examples of continuous variables.

The most important classification of variables is on the basis of their *use* within the research under consideration, when they are classified as independent variables or dependent variables. Independent variables are antecedent to dependent variables and are known or are hypothesized to influence the dependent variable, which is the outcome. In experimental studies, the treatment is the independent variable and the outcome is the dependent variable. In an experiment in which freshmen are randomly assigned to a “hands-on” unit on weather forecasting or to a textbook-centered unit and are then given a common exam at the end of the study, the method of instruction (hands-on versus textbook) antecedes the exam scores and is the independent variable in this study. The exam scores follow and are the dependent variable. The experimenter is hypothesizing that the exam scores will partially depend on how the students were taught weather forecasting. In this case, freshman status is a constant.

In nonexperimental studies, it is often more difficult to label variables as independent or dependent. We call the variable that inevitably precedes another one in time the independent variable. In a study of the relationship between teacher experience and students' achievement scores, teacher experience would be considered the independent variable. Not only does it precede student achievement but also it would be illogical to say that student achievement influenced teacher experience.

In some other cases, it is not possible to tell which variable is antecedent and which follows. In a study of the relationship between self-confidence and popularity in high school students, either variable could be considered independent or dependent. It is possible for a variable to be an independent variable in one study and a dependent variable in another. Whether a variable is independent or dependent depends on the purpose of the study. If you investigate the effect of motivation on achievement, then motivation is the independent variable.

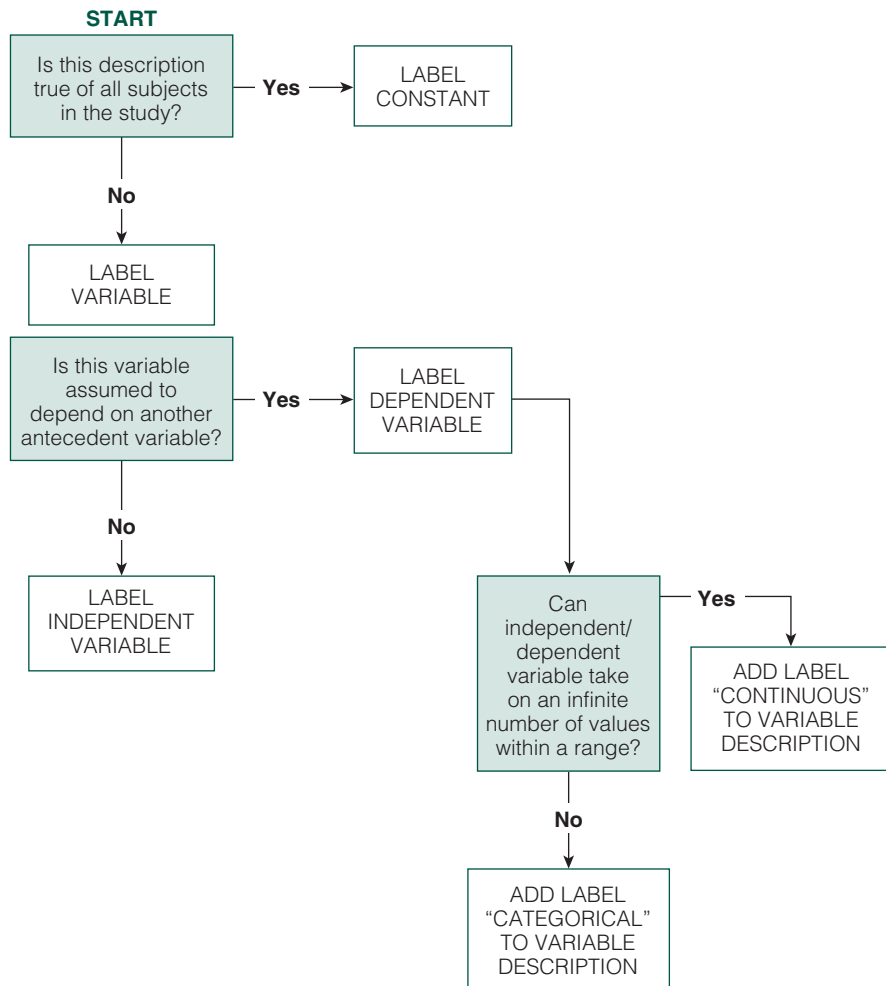


Figure 2.3 Flow Chart for Classifying Variables and Constants

However, if you wish to determine the effect of testing procedures, classroom grouping arrangements, or grading procedures on students' motivation, then motivation becomes the dependent variable. Intelligence is generally treated as an independent variable because educators are interested in its effect on learning, the dependent variable. However, in studies investigating the effect of preschool experience on the intellectual development of children, intelligence is the dependent variable.

CONSTANTS

The opposite of variable is **constant**. A constant is a fixed value within a study. If all subjects in a study are eighth-graders, then grade level is a constant. In a study comparing the attitudes toward school of high school girls who plan professional careers with those who do not plan professional careers, high school girls constitute a constant; whether they plan professional careers is the independent variable, and their attitudes constitute the dependent variable. Figure 2.3 illustrates a process for classifying variables and constants.

SUMMARY

The two broad research methodologies in education are quantitative and qualitative. Quantitative research deals with questions of relationship, cause and effect, or current status that researchers can answer by gathering and statistically analyzing numeric data. It can be further classified as experimental and non-experimental. Qualitative research focuses on understanding social phenomena and providing rich verbal descriptions of settings, situations, and participants. The qualitative approach includes a number of different methods, such as ethnography, case study, naturalistic observation, focused interviews, and historical studies. Researchers may also choose a mixed methods design, which combines quantitative and qualitative approaches in a single study. Both qualitative and quantitative methodologies are important in educational research. One chooses the method that will provide the data to answer the research question.

The typical steps in educational research are (1) selecting a problem; (2) reviewing the literature; (3) selecting a research strategy and developing instruments; (4) collecting, analyzing, and

interpreting data; and (5) communicating the findings by reporting the results of the study.

Based on the objective, educational research can be classified into two major categories: basic and applied. The primary concern of basic research is to expand the frontiers of knowledge and to discover general laws. The main goal of applied research is to solve immediate practical problems.

At a theoretical level, educational scientists use terms such as *intelligence*, *creativity*, *problem-solving ability*, and *motivation*, which are abstractions from observation of certain behaviors. These are referred to as *constructs*. In quantitative research, constructs are quantified and take on different values. Thus, they are referred to as *variables*. There are two major types of variables: independent and dependent. If a variable is antecedent to another variable, it is called an *independent variable*, but if it is the consequence of another variable, it is the *dependent variable*.

In quantitative research, operational definitions are used to specify how variables will be measured in the study.