chapter 1

The Nature of Research in Education



LEARNING OBJECTIVES

After studying this chapter, you will be able to:

- **1-1** List five major sources of knowledge that people use.
- **1-2** List the steps in the scientific method.
- **1-3** List some of the attitudes and assumptions characteristic of researchers.
- **1-4** Understand the history of educational research.
- **1-5** Define evidence-based research and discuss its contribution to the improvement of educational practice.
- **1-6** Know the limitations involved in conducting educational research as compared with research in the natural sciences.
- **1-7** Define common terms such as *construct, variables,* and *constants* that make up the language of research.
- **1-8** Distinguish between quantitative and qualitative methodologies in educational research, define mixed methods research, and classify educational research according to purpose as basic, applied, and action.

Photo above by Marlene Somsak

Real science is not about certainty but about uncertainty.

As educators, we must continuously make decisions about the teaching–learning situation and the effectiveness of practices we follow. These decisions affect people and must be based on the best available information. In this chapter, we will first look at the various sources of knowledge that have been used throughout history.

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1-1 Sources of Knowledge

How do educators know? How do they acquire reliable information needed to make valid professional decisions about the teaching–learning situation and the effectiveness of practices they follow? Throughout history, people have used various sources of knowledge. They learned through *personal experience* or through *observation of others' experiences.* People *gained information in the form of stories about people and events*. But it's difficult or often impossible to learn what we need by personal experience. In this case, people often turn to an *authority*; that is, they seek knowledge from someone who is recognized as having expertise in a particular field. A classroom teacher might turn to another teacher who has been successful using a particular teaching method. This source can be effective, but often experts give answers that represent opinion and not fact or the answer does not fit the particular situation. Closely related to authority is *tradition (or custom)*. When faced with a problem, we ask "How has this been done in the past?" One may learn something from these sources, although it might not be reliable or adequate for making a decision in a new or somewhat different situation.

1-1a Deductive Reasoning

The ancient Greek philosophers made perhaps the first significant contribution to the development of a systematic approach for gaining knowledge. Aristotle introduced the use of **deductive reasoning**, which is a thinking process in which one proceeds from general to specific knowledge through logical argument.

deductive reasoning A thinking process in which one proceeds from general to specific knowledge through logical argument.

A major type of deductive reasoning is the syllogism. A syllogism consists of a major premise and a minor premise followed by a conclusion. For example, "All men are mortal" (major premise); "The king is a man" (minor premise); "Therefore, the king is mortal" (conclusion). In deductive reasoning, if the premises are true, the conclusion is necessarily true.

Deductive reasoning has its limitations. To arrive at true conclusions, one must begin with true premises. Because it is difficult to establish the universal truth of many statements dealing with phenomena of interest, deductive reasoning is not sufficient as a source of new knowledge. For example, in the Middle Ages, people substituted dogma for true premises. Thus, they reached invalid conclusions. Francis Bacon (1561–1626) was the first to call for a new approach to knowing.

1-1b Inductive Reasoning

inductive reasoning Reaching a conclusion by generalizing from examples of the whole class or category.

scientific approach A way of seeking knowledge that involves both inductive and deductive reasoning to develop hypotheses that are then subjected to rigorous and objective testing.

theory A set of interrelated propositions or hypotheses that presents an explanation of some phenomenon.

hypothesis A tentative proposition suggested as a solution to a problem; a statement of the researcher's expectations about the relationship among the variables of a study.

Bacon believed that investigators should not accept premises handed down by the Church Fathers as absolute truth. Rather, investigators should establish conclusions based on facts gathered through direct observation. In Bacon's system, an investigator made observations on particular events in a class or category, and then made inferences about the whole class or category on the basis of the observations.

This approach is called **inductive reasoning**. It is the reverse of deductive reasoning. Exclusive use of induction resulted in the accumulation of isolated facts and information that made little contribution to the advancement of knowledge. In the 19th century, scholars began to integrate the most important aspects of the inductive and deductive methods into a new technique, namely the inductive-deductive method, or the **scientific approach**.

Charles Darwin (1809–1882) is generally recognized as the first to apply this method in the pursuit of knowledge in developing his **theory** of evolution. His procedure, involving only induction, was not very productive until he thought to add a **hypothesis** to explain the facts that he had gathered through observation.

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scientific method A way of seeking knowledge that uses both inductive and deductive reasoning to develop hypotheses that are then subjected to objective testing.

He then proceeded to test the hypothesis by making deductions from it and gathering additional data to determine whether these data would support the hypothesis. This method was endorsed by John Dewey (1938) and became known as the **scientific method**.

1-2 The Scientific Method

The scientific method is a method of acquiring knowledge in which researchers move inductively from their observations to hypotheses and then deductively from the hypotheses to the logical implications of the hypotheses. That is, they deduce the consequences that would follow if the hypothesis is valid. If the deduced implications are compatible with the organized body of knowledge, researchers test them by gathering more empirical data. Based on the evidence they find, they accept or reject the hypothesis.

1-2a An Example of the Scientific Method

Following is a brief example of a study that used the scientific approach (Retelsdorf, Schwartz, & Asbrock, 2015):

> According to expectancy-value theory, the gender stereotypes of significant others such as parents, peers, or teachers affect students' competence beliefs, values, and achievement-related behavior. Stereotypical gender beliefs about reading favor girls. The aim of this study was to investigate whether teachers' gender stereotypes in relation to reading—their belief that girls outperform boys—have a negative effect on the reading self-concept of boys but not girls. The hypothesis was that teachers' gender stereotypes about reading would have a negative relationship with boys' reading self-concepts. The sample consisted of 54 teachers and 1,358 students.
>
> A longitudinal study involving data collection at two points in time, toward the beginning of Grade 5 (T1) and in the second half of Grade 6 (T2), was conducted. Researchers controlled for T1 reading self-concept, reading achievement, and school track. Analysis of the data showed a negative relationship between teachers' gender stereotypes at T1 and boys' self-concepts at T2, as the hypothesis predicted. There was not a significant relationship for girls. They concluded that the results provided empirical support for the idea that gender differences in reading self-concept may be due to the stereotypical beliefs of teachers as significant others.

1-2b Steps in the Scientific Method

The example presented in Section 1-2a illustrates the steps followed in the scientific method:

1. *Identification of the problem.* The problem may involve a question about something, a discrepancy in findings, or a gap in knowledge.
2. *Statement of the problem.* The investigator clarifies and states more precisely the nature and scope of the problem.
3. *Formulation of hypotheses.* The investigator formulates hypotheses about possible solutions of the problem. The hypothesis is really a prediction about the results of the observations. A review of related research helps one to formulate the hypothesis.
4. *Prediction of consequences.* The investigator next predicts the consequences of each hypothesis; that is, what should result if the data support the hypothesis.
5. *Testing of hypotheses.* The researcher gathers objective data to evaluate the adequacy of each hypothesis in **hypothesis testing**. If the data support the hypothesis, it is accepted as a reasonable explanation. If the data do not support the hypothesis, it is rejected.

hypothesis testing Collection of observations to determine whether these observations confirm or fail to confirm a hypothesized relationship.

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1-3 Assumptions and Attitudes of Researchers

In addition to the steps researchers follow as they seek reliable knowledge, there are certain attitudes and assumptions characteristic of one conducting research.

1-3a Assumptions

Two fundamental assumptions researchers make are the following:

universal determinism The belief that all natural phenomena have antecedent factors.

1. *Researchers assume that the events they investigate are lawful or ordered, not capricious.* Science is based on the assumption of **universal determinism**, the belief that all natural phenomena have antecedent factors. Scientists do not look to supernatural explanations of events but depend on the observation of nature itself to provide answers.
2. *Researchers assume that reliable knowledge can derive only from empirical evidence.* This assumption that knowledge is based on observation is referred to as empiricism.

Thus, it follows that only phenomena that are subject to observation lie within the realm of systematic investigation.

1-3b Attitudes

Researchers exhibit certain characteristic attitudes as they pursue their work:

1. *Researchers are essentially doubters and are skeptical of research findings until they can be verified by further investigation by themselves or others*. Verification occurs when repeated observations yield the same or similar results. Thus, the researcher makes the research design, measurements, and conclusions known so that others may replicate the study and verify, or fail to verify, the findings.
2. *Researchers are objective and impartial*. They take care to observe and collect data in such a way that their personal biases do not influence their observations, and they accept the findings even when the findings are contrary to their own opinions. It has happened, however, that some researchers, being human, have reported only findings that agreed with their contention or have even fabricated data to support their belief. A few years ago, a respected British medical journal published a paper by a physician, A. Wakefield, that reported finding a link between standard vaccines and autism in children (Wakefield et al., 1998). A decade of research by other scientists found several examples of questionable and unethical procedures in the study. They concluded that Wakefield's data did not support a link between vaccines and autism. Without verification by other investigators the journal officially retracted the paper (Wallis, 2010).
3. *Researchers deal with facts, not values*. They do not indicate the potential moral implications of their findings. They provide the data concerning the relationship among events, but one must go beyond the study to make a decision about whether a certain consequence is desirable.

1-4 Educational Research

When the scientific method is applied to the investigation of educational questions, it is called educational research. Educational research asks a question, formulates a hypothesis, gathers appropriate data, analyzes the data, and reaches a conclusion about the original question. Educational research is the process whereby we acquire dependable and useful information about the educative process. Figure 1.1 shows the steps in the research process.

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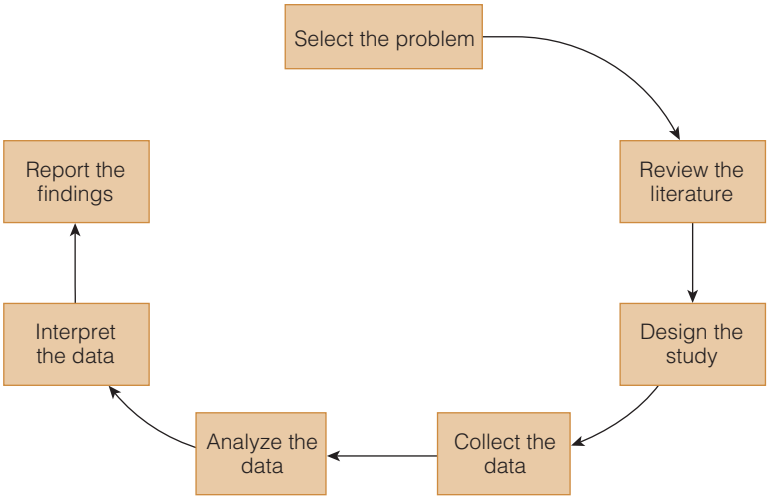


Figure 1.1 Stages in the Research Process

1-4a A Brief History of Educational Research

The acceptance of the scientific method in education lagged far behind its acceptance in the physical sciences. In 1897, J. M. Rice, a pioneer in educational research, asked the educators attending the annual meeting of the National Education Association's Department of Superintendence if it would be possible to determine whether students who are given 40 minutes of spelling each day learn more than students given 10 minutes each day. Rice (1912) reported:

> To my great surprise, the question threw consternation into the camp. The first to respond was a very popular professor engaged in training teachers in the West. He said, in effect, that the question was one which could never be answered; and he gave me a rather severe drubbing for taking up the time of such an important body of educators in asking them silly questions. (17–18)

Rice did, in fact, collect empirical data on his question and found that the differences in achievement between those spending 10 minutes a day and those spending 40 minutes a day were negligible. He also pointed out that many words children were required to learn had little practical value. His work led other investigators, such as Edward L. Thorndike, to use **documentary analysis** to determine the frequency of use of words in the English language. Their work, in turn, led to improvements in language arts texts and curricula.

documentary analysis The systematic examination of documents to investigate specific topics or themes.

Educational research had its origins in the early 20th century when the eminent American philosopher, John Dewey, recommended it as the best way to obtain objective and reliable answers to educational questions. Educational research has grown tremendously in recent decades partly due to the development of new technology and advanced statistical tests that facilitate the handling and analysis of large amounts of data. Two major issues in the 21st century have influenced the growth of educational research and the way it is conducted. The first is the federal No Child Left Behind (NCLB) legislation of 2001, which requires schools and districts that do not make adequate progress toward certain goals to implement programs and interventions that research indicates are effective in raising achievement. The federal government will provide money for the programs but only if the interventions are consistent with "scientifically based research." This research is also called evidence-based research.

The second factor influencing educational research is standards-based reform, which aims to provide accurate information about national content standards for math,

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science, and other subject areas. Supporters of standards say that they improve student achievement, indicate the degree of student progress toward expectations, and equalize student opportunities.

For example, research reported in Fall 2016 investigated students' performance on the National Assessment of Educational Progress (NAEP) science test, which measures students' knowledge in the areas of physical science, life science, earth, and space science in Grades 4, 8, and 12. Results showed that the average scores for students in both fourth and eighth grades went up from 2009 to 2015. The average scores for high school seniors have remained flat since 2009. The gap between the performance of African American students and their white peers decreased at the fourth- and eighth-grade levels but not at the high school level. At the fourth-grade level, there were no significant differences between the average scores of girls and boys. In eighth grade, boys scored an average of 3 points higher than girls. There were no significant differences at the twelfth-grade level. The findings of this type of research are useful to educational practitioners and policymakers. They can see where achievement scores have improved and where additional emphasis needs to be placed.

Two other developments in 2002 had an influence on educational research. The president signed the Education Scientific Reform Act, which led to the development of the Institute of Education Sciences (IES) whose purpose is to provide reliable knowledge about education at all levels from early childhood through postsecondary to parents, educators, researchers, policymakers, and the general public. Also, in 2002 the National Research Council published *Scientific Research in Education*, which provides a list of principles to guide educational research and for judging the quality of empirical studies.

The emphasis is now on the importance of evidence-based research to provide reliable knowledge about education.

1-5 Evidence-Based Research

One conducts a research study by following a sequence of steps. A researcher in need of knowledge in a particular area states a specific question that can be investigated empirically. Next, the researcher selects the method appropriate for gathering the necessary data. The data are then analyzed and interpreted. The researcher draws conclusions that provide an answer to the research question.

1-5a Steps in Evidence-Based Research

The steps in evidence-based research are:

1. Select a significant question that can be investigated empirically. An empirical question is one that can be answered by evidence gathered through systematic research.
2. Review the literature to gain more insight into the question and to determine what has already been reported on the question.
3. Choose a research method that is appropriate for gathering the data.
4. Analyze the data.
5. Interpret the findings, and state the conclusions.
6. Report the results.

It is probably rare for researchers to follow precisely the sequence we have described in the preceding discussion. These activities often overlap, and researchers move back and forth from one stage to another. Each of these steps is discussed at length in later chapters of this text.

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1-6 Difficulties Encountered in Conducting Scientific Research in Education and Other Social Sciences

Difficulties encountered in educational research include the complexity of subject matter, difficulties in observation and replication, interaction of observer and subjects, difficulties in control, and measurement problems.

1-6a Complexity of Subject Matter

Research in education and the social sciences differs from research in the natural sciences. Several limitations hinder the application of the scientific method in the social sciences. A major obstacle is the complexity of the subject matter. Educational researchers don't study physical or inert objects but rather human beings engaged in complex behavior. We study their behavior as individuals with different characteristics and personalities and also their behavior as members of groups. A group of first-graders in one situation will not behave like first-graders in another situation. It can be risky to make generalizations from one study to another because the data gathered from one group might not have validity for a different group.

1-6b Difficulties in Observation

Observation in the social sciences is often less objective because it requires interpretation on the part of observers. People's motives, values, and attitudes are not open to inspection; observers must make subjective interpretations when they decide that the behavior observed indicates a particular motive or attitude.

1-6c Difficulties in Replication

A chemist can observe the reaction between two chemicals in a test tube and the findings reported to others who can easily replicate the observation. Replication is much more difficult to achieve in education and other social sciences. An American educator cannot reproduce the conditions of a French educator's experimental teaching method with the same precision as an American chemist could replicate a French chemist's experiment. Social phenomena are singular events and cannot be totally repeated for purposes of observations.

1-6d Interaction of Observer and Subjects

Another problem is that mere observation of social phenomena may produce changes that might not have occurred otherwise. Researchers may think that X is causing Y, when in fact their observation of X may cause Y. For example, you may remember from Psychology 101 the well-known Hawthorne experiments in which changes in worker productivity resulted not from the varying working conditions under investigation but from the mere fact that the workers knew they had been singled out for observation. One must always consider that the presence of researchers as observers may change the behavior of your human subjects.

1-6e Difficulties in Control

The range of possibilities for controlled experiments on human subjects is much more limited than in investigations in the natural sciences. Educational researchers must deal with many variables simultaneously and must work under less precise conditions. They try to identify and control as many variables as possible, but it's sometimes very difficult. Without control it's impossible to evaluate unambiguously the effects of an experimental treatment.

1-6f Measurement Problems

Measurement of the variables is very important in a research study. The tools for measurement in the social sciences are much less perfect and precise than the tools used in

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chemistry or physics. In the social sciences we measure only those variables that are present at the time of measurement; factors that have influenced human behavior in the past are not measurable in the present. Because of the problems listed earlier, it is difficult to make broad generalizations from a study. Fortunately, we can conduct several studies in a particular area before making generalizations. If the studies consistently confirm the initial findings, then researchers can be more confident in reporting their generalizations.

1-6g Ethical and Legal Considerations

Because educational research involves mainly human subjects, the researcher is ethically responsible for protecting the rights and safety of the participants in a study. There are federal laws and regulations from one's institution that must be followed in the conduct of a study to ensure a lack of risk to subjects, their right to privacy, and confidentiality of the data collected. These regulations sometimes influence the kind of studies that can be conducted.

1-7 Language of Research

Before we look at educational research methodology, it is important that we introduce some of the language that researchers use to describe and summarize their observations in an area. Researchers may use words from everyday language but often ascribe new and specific meanings to them. Or they use new terms that are not a part of everyday language. One of these terms is *construct*.

1-7a Constructs

construct Abstractions that cannot be observed directly but only by their effects, such as creativity, anxiety, or intelligence.

Constructs are abstractions that cannot be observed directly but are useful in interpreting empirical data and building theories. For example, one 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.* Other examples of constructs are motivation, anxiety, reading readiness, underachievement, creativity, and self-efficacy.

constitutive definition A definition in which a word is defined by using other words.

operational definition A definition that specifies the procedure or operation to be followed in producing or measuring a concept.

In order to avoid misunderstanding, it is important that researchers provide precise definitions for the constructs. Constructs may be defined in two ways: (1) a **constitutive definition**, which gives their general meaning, like a dictionary type of definition. Intelligence might be defined as the ability to think abstractly or the capacity to acquire knowledge; (2) an **operational definition** gives meaning to a construct by specifying the operations that researchers would perform to measure or manipulate the construct. In research, investigators collect data in terms of observable events. An operational definition ensures that everyone concerned understands the specific way the term is being used. An operational definition defines a variable by specifying the operations used to measure or manipulate it. For example, a researcher investigating the relationship between intelligence and creativity might state, "For this study, intelligence is defined as the subjects' scores on the Wechsler Intelligence Scale for Children."

1-7b Variables

variable A representation of a construct that takes on a range of values.

Researchers, especially quantitative researchers, study variables and the relationships that exist among them. A **variable** is a construct or a characteristic that can take on different values or scores across people or things. Height, weight, intelligence, vocabulary scores, and gender are examples of variables. For example, assume one wants to determine the relationship between science aptitude scores and science achievement scores. The variables in this case are science aptitude scores and science achievement scores.

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

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groups, the attribute on which they base the classification is called a categorical variable. Home language, father's occupation, marital status, state of birth, and school within which one is enrolled at the university are examples of categorical variables.

dichotomous variable A categorical variable that has only two classes.

The simplest type of categorical variable has only two mutually exclusive classes and is called a **dichotomous variable**. Pass–fail, citizen–immigrant, in-state or out-of-state resident are examples of dichotomous variables. When a variable has an infinite number of values within a range, it is a continuous variable. Height, weight, age, and achievement test score are examples of continuous variables.

Another important classification is whether the variable in a study is the independent variable or a dependent variable. The independent variable is the antecedent variable that an investigator manipulates in order to determine its effect on another variable called the dependent variable. The dependent variable is the variable we observe and measure.

1-7c Constants

The opposite of variable is constant. A constant is a fixed value within a study. If all subjects in a study are sixth graders, then grade level is a constant. In a study comparing the attitudes toward school of high school seniors who plan professional careers with those who do not plan professional careers, high school senior level is a constant; whether they plan professional careers is the independent variable, and their attitudes toward school constitute the dependent variable. Figure 1.2 illustrates a process for classifying variables and constants.

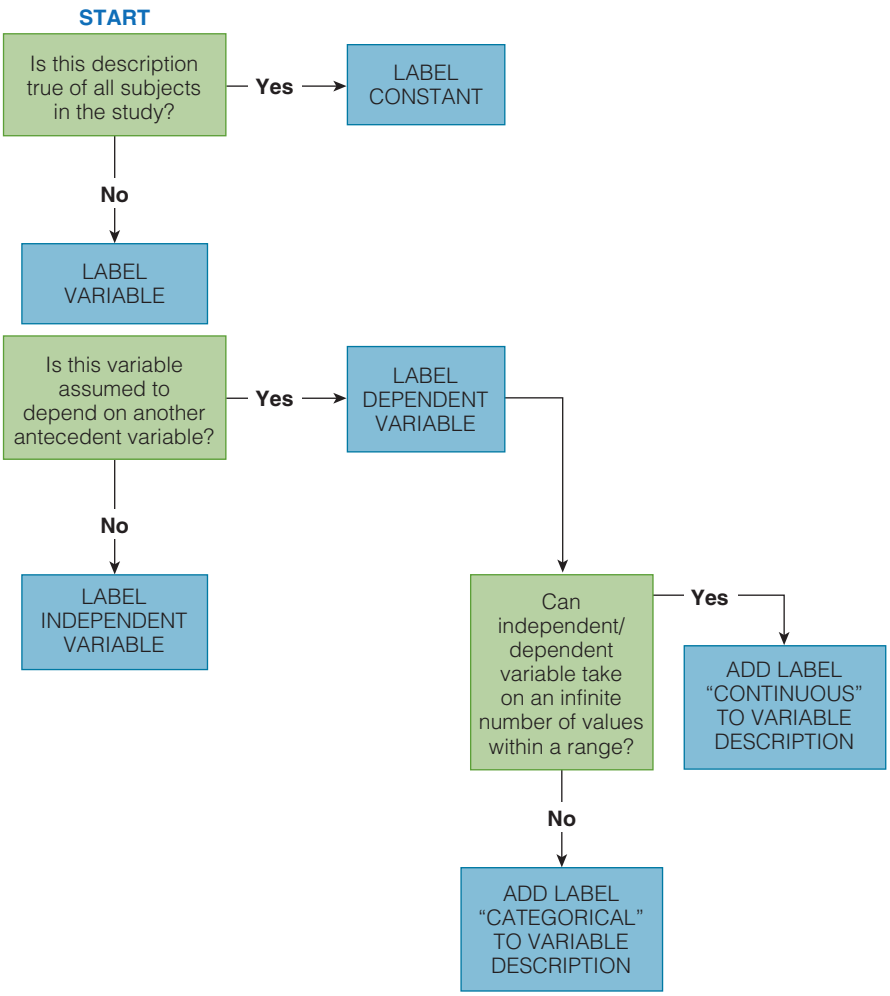


Figure 1.2 Flow Chart for Classifying Variables and Constants

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1-8 Educational Research Methods

quantitative research Research that gathers numeric data through controlled procedures and analyses to answer predetermined questions or test hypotheses.

qualitative research A generic term for a variety of research approaches that generally gather nonnumeric data to study phenomena, without predetermined hypotheses.

mixed methods research Combining quantitative and qualitative research in different ways with each approach adding something to the understanding of the phenomenon.

Educational research uses a variety of methodological approaches, which are typically classified as *quantitative* or *qualitative*. **Quantitative research** uses objective measurement in a controlled setting to gather numeric data that are used to answer questions or test predetermined hypotheses. **Qualitative research**, in contrast, uses different forms of inquiry that focus on understanding social phenomena from the perspective of human participants in natural settings. It does not begin with formal hypotheses, but it may result in hypotheses as the study unfolds.

Historically, research in education has used the quantitative approach. In the late 20th century, however, scholars began to call for an alternative to the quantitative approach in educational research (Guba & Lincoln, 1988). They wanted an alternative that considered the participants' perspectives and experiences. For a time, researchers engaged in a "paradigm debate" that viewed the two approaches as being directly opposed. Gradually, researchers began to see the two methodologies as complementary rather than adversarial and a new methodology called **mixed methods research** was introduced. As the name indicates, this method combines both quantitative and qualitative approaches in the same investigation with each approach contributing to the understanding of the research question. Proponents believe that the mixed methods approach may provide a more complete explanation of the research findings than either method alone could provide. Whether researchers choose quantitative, qualitative, or mixed methods should be determined not by philosophical preference, but by determining which method is most appropriate and likely to provide the data that will answer the research question. You simply use what will work.

We should note that 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 methodologies. A mixed methods study also typically involves more extensive data collection and analysis and thus may require more time and effort to complete.

To take an example of a mixed methods study, assume a researcher wants to know the impact of a newly instituted dress code at an inner-city middle school. Depending on exactly what kind of data the researcher wants, a quantitative, qualitative, or mixed methods approach could be used. In a quantitative approach, one could measure subsequent attendance, frequency of violations of the code, and/or the number of suspensions for failure to comply. One 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. The numerical data would be gathered and analyzed. In a qualitative study, one might observe 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. Parents might be interviewed 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 approaches in a mixed methods study would provide the most complete information on the effect of the dress code. Table 1.1 compares the quantitative and qualitative approaches.

Quantitative and qualitative research can be classified according to the design for conducting the investigation. The design refers to the researcher's plan for conducting the investigation. Let us first consider quantitative research, which can be further classified as using experimental or nonexperimental designs.

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Table 1.1 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

1-8a Quantitative Research

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

Experimental Research

experimental research Research in which the investigator manipulates one or more independent variables (the treatment) and observes the effect on one or more dependent variables.

independent variable A variable that is antecedent to the dependent variable.

dependent variable A variable that is a consequence of or dependent on an antecedent (independent) variable.

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 **independent variable** or the experimental treatment. The observed and measured variable is called the **dependent variable**. In a *true experiment*, subjects are randomly assigned to an experimental group, which receives the treatment, and to at least one control group, which does not receive the treatment. This type of research, which uses random assignment and a control group, is often referred to as the "gold standard" of methodology. For example, assume a university professor wants to investigate the effect of providing online feedback to students immediately following the course examinations (independent variable). With two sections of economics taught by the same professor, the researcher would use a random procedure (a coin toss) to select one section to receive immediate online feedback about their test performance. Of course, the test was multiple choice and graded by machine; students' test scores were put online and could be accessed almost immediately. The other section would receive feedback two or three days later during their next class session. The researcher would compare the two sections' exam scores and students' final course grades (dependent variable). 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 that the online feedback contributed to greater learning than did the delayed in-class feedback.

In experimental research, the researcher seeks to control all other variables (extraneous variables) that might influence the dependent variable. In the foregoing example, the researcher would make sure that both sections had the same instructor; that both sections met at the same time of day but on different days; that lecture notes, readings, and the exams were the same; and so on. The researcher might also check the ability level and background of the students in the two sections to make sure that one section was not a superior group.

To ensure a "true" experiment, the researcher must use a random process to assign the 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 preference or judgment or the characteristics of the subjects themselves.

Sometimes, however, it is not feasible for a researcher to randomly assign subjects to experimental groups for a study. In the preceding example, the economics professor would not draw a random sample from the total number of students enrolled in an

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economics course. Instead, the researcher would randomly use two already assembled classes and randomly designate one the experimental group and the other the control group. In this case, the research is called quasi-experimental. Experimental research is discussed in Chapter 10.

Nonexperimental Research

ex post facto research A type of research that attempts to determine the causes for, or the consequences of, differences that already exist in groups of individuals.

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. For example, assume a researcher wants to investigate the question, "What is the effect of part-time work on the school achievement of high school students?" The researcher would not manipulate the lives of high school students by having some take part-time jobs and a comparable group that would not and then compare their grade point average. Instead, the researcher would identify a group of students who already work part-time and compare their achievement with a comparable group of students who do not work. Because many factors are not controlled in an ex post facto investigation, one must be careful in interpreting the results. We discuss ex post facto in detail in Chapter 11.

Correlational Research

correlational research Research that attempts to determine the extent and the direction of the relationship between two or more variables.

Correlational research investigates the relationship (correlation) between two or more variables. The investigator gathers data from a group of individuals on two (or more) variables and then seeks to determine if the variables are related (correlated). The question might ask, "Is there a relationship between scores on a language aptitude test and success in a foreign language course?" The relationship between the variables is expressed by a statistic called the coefficient of correlation. Its size and direction show the nature of the relationship between the two variables. A positive correlation shows that high values on one variable are associated with high values on the other (aptitude scores and achievement scores). A negative correlation means that high scores on one variable are associated with low scores on the other variable (days absent from school and achievement test scores). The strength of the relationship is expressed by the size of the correlation coefficient. It can range from +1.00 (perfect positive) through 0 indicating no relationship to −1.00, a perfect negative relationship. We discuss correlational research in detail in Chapter 12.

Survey Research

Surveys use instruments such as questionnaires and interviews to gather data from groups of individuals. Researchers in education and the social sciences use surveys widely. For example, a group of citizens in a community might be surveyed to determine support for a referendum that calls for a small tax increase for the schools. A survey of teachers could reveal their attitudes toward a number of reforms recommended by the school superintendent. 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 13.

Figure 1.3 summarizes the major types of quantitative research.

1-8b Qualitative Research

Qualitative research seeks a deeper understanding of a phenomenon by focusing on the total picture rather than breaking it down into variables and analyzing it numerically. For example, social scientists have long observed that differences in educational

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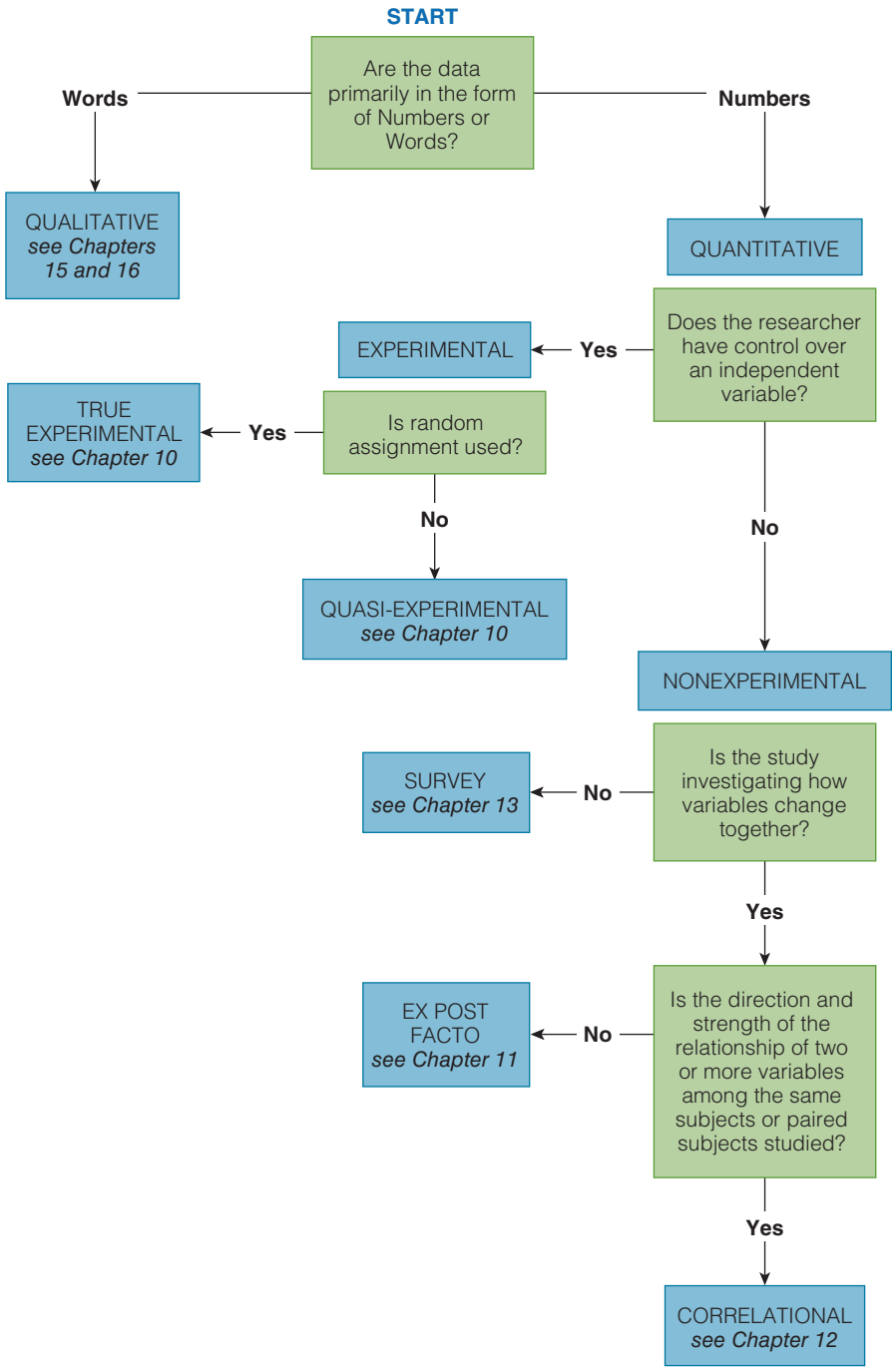


Figure 1.3 Major Types of Quantitative Educational Research

background do not account for the difficulties black students often encounter in a predominantly white university. A question for qualitative research to explore is "How do black students perceive their academic experience in a white university?" The study would focus on a relatively few black students who would be studied in great detail through observation, in-depth interviews, or case studies.

There are many different types of qualitative research. Eight of the most widely used are: basic interpretative studies, case studies, document (or content) analysis, ethnography, grounded theory, historical studies, narrative inquiry, and phenomenological studies. Each of these is discussed in greater detail in later chapters.

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Basic Interpretative Studies

A basic interpretative study is the most simple and most common qualitative study. This type of 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. Describing how teachers perceive their role as disciplinarians in a middle school classroom is an example.

Case Studies

case study A qualitative examination of a single individual, group, event, or institution.

A **case study** is a type of ethnographic 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"). Case studies use multiple methods, such as interviews, observations, and documents, to gather data. For example, one might conduct a case study of a particular inner-city school to learn why its students have achieved at a high level on standardized tests when other inner-city schools are struggling.

Content Analysis

content analysis A research method applied to written or visual materials to analyze characteristics of the material.

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

Ethnography

ethnography A form of qualitative research that aims for a holistic picture of a cultural group; it uses in-depth interviewing and prolonged participant observation.

Ethnography is an in-depth study of naturally occurring behavior within a culture or social group. Ethnography is sometimes called field research because it is conducted in a natural setting or "field." The researcher observes group behavior as it occurs naturally without any simulation or imposed structure. It uses a variety of data-gathering procedures, such as prolonged observation of the setting, interviews with members of the culture, and studying documents. An example might be an investigation of the drug culture in a small county in Appalachia.

Grounded Theory

grounded theory Theory derived inductively from the data collected rather than from a priori ideas or theories.

Grounded theory research is designed to develop a theory of social phenomena based on the field data collected in a study. An examination of the data generates insights, hypotheses, and questions, which leads to further data collection. From an inductive analysis of the data, the researcher forms a theory by proposing plausible relationships among concepts. The theory is said to be "grounded" in the data. For example, a researcher interested in mainstreaming in elementary school could observe a number of classrooms, conduct interviews with teachers and students, analyze the data, and come up with a theory about mainstreaming in the elementary school.

Historical Research

historical research A systematic attempt to establish facts and arrive at conclusions about the past.

Historical research analyzes documents and artifacts and/or uses interviews with eyewitnesses to gain insight into past events. The researcher must establish the authenticity of the documents as well as the validity of their contents. An educational researcher might want to investigate the trends in preschool education in a particular school district from its beginnings to the present.

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Narrative Inquiry

narrative inquiry A form of qualitative research, also called *biography, life stories,* and *life narratives*, that provides accounts of a person's experiences.

In **narrative inquiry**, researchers examine the stories people tell about their lives and co-construct a narrative analysis of those stories, also referred to as life stories. The researcher and those telling their stories have an equal voice in determining the meanings attributed to the experiences.

Phenomenological Studies

phenomenological studies Qualitative research that focuses on understanding the meaning events have for individuals in particular situations.

Phenomenological studies are based on 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 an individual's experience. The question, "What is the relationship like between a beginning teacher and his or her mentor?" could be answered through a phenomenological study.

1-8c Similarities Across Quantitative and Qualitative Research

We have examined a number of quantitative and qualitative designs used in educational research. It is important to remember, however, that there are underlying characteristics common to all these approaches. Bachman (2009) identifies four fundamental commonalities in all approaches to research in education:

1. Empirical research is aimed at creating new knowledge.
2. Research creates knowledge by observing phenomena.
3. All the entities of interest (like attitudes, motives, and learning) can only be inferred from observing what people do or say in a given setting.
4. All researchers are concerned about generalizability; that is, they desire to find meaning for the research results beyond a particular study.

1-8d Research Classified According to Purpose

Another system of classification is based on the purpose of the research with respect to how the new findings will be used. A basic-applied continuum exists, and classification depends on the extent to which the research findings are applicable to solving a practical problem. **Basic research** is aimed at obtaining data used to formulate theory and expand knowledge; it is not concerned with the solution of a practical problem. However, the knowledge gained from basic research can have many practical applications. The findings from basic research in molecular biology, neuroscience, genetics, and biochemistry have been valuable to the practice of medicine and even education. For example, brain and cognitive scientists, using functional magnetic resonance imaging (fMRI), have discovered which parts of the brain are most active when doing certain tasks, like processing numbers and letters (Delazer et al., 2003). The findings of this research are now being used to understand the development of arithmetic skills. Brain research is also providing insight into how the brain responds to performance pressure, especially in math (math anxiety). With the increased focus on standardized test performance in the public schools, the basic research on anxiety has a great deal of interest to educators.

basic research Research that aims to obtain empirical data that can be used to formulate, expand, or evaluate a theory rather than to solve a practical problem.

applied research Research that aims to solve an immediate practical problem.

Applied research aims to find a solution to a specified practical problem under the conditions in which it appears in practice. It is concerned with the application of research-based knowledge about that practice. Through applied research, investigators focus on general problems associated with a given field, such as engineering,

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medicine, social work, and education. Although applied research may solve some specific problems, it does not aim to provide general knowledge to solve other problems.

action research A form of research conducted by practitioners to study a particular context and use findings to change practice.

Action research is a type of applied research that has become popular in recent years. Mertler (2016) describes action research as research done *by* educators *for* themselves. According to Mertler, there are three essential characteristics of action research: (1) the research is situated in a local context and focused on a local issue; (2) the research is conducted by and for the practitioner; and (3) the research results in an action or a change implemented by the practitioner.

Action research begins, like other research, with a problem to be solved. It uses the same methods and procedures as in quantitative, qualitative, or mixed methods research. What distinguishes action research is its purpose, which is to solve a local problem or to improve practice. An action research study focusing on the effectiveness of a method to teach math concepts might be conducted by a single classroom teacher or a team of teachers in the math department. Action research is discussed in depth in Chapter 20.

RESEARCH IN THE PUBLIC EYE

In September 2016, *The Indianapolis Star* published an article on bias in preschool teachers (Toppo, 2016). The study conducted by the Yale Child Study Center investigated preschool teachers' sometimes unconscious attitudes about student behaviors. The research focused on the question: Are preschool teachers implicitly biased against African American students—boys in particular—as early as preschool? Previous research conducted at Yale a decade earlier had found that preschool boys were expelled 4.5 times more often than girls. Black students in state-funded prekindergarten programs were about twice as likely to be expelled as white or Latino classmates.

In the 2016 study, researchers set up two experiments with teachers. In one, teachers were asked to watch videos of preschoolers and to watch for "challenging" student behaviors (misbehavior). They told the teachers that they were interested in learning how quickly and accurately they could detect misbehavior in preschoolers. The researchers tracked where teachers' eyes went. Teachers were not told that all the preschoolers in the video were actors assisting in the study and that no challenging behaviors were depicted in the videos. Teachers watched a total of 12 clips, each featuring a black boy, a black girl, a white boy, and a white girl. When told to detect bad behavior, teachers gazed longer at the black children, especially boys.

In a second experiment, teachers read descriptions of fictional misbehaving preschoolers, to which researchers had attached fictitious names based on 2011 U.S. Census data of the most popular boys' and girls' names for both black children (DeShawn and Latoya) and white children (Jacob and Emily). When asked to rate the severity of each child's misbehavior, teachers rated children with white-sounding names more severely. Yet most teachers did not suggest suspension or expulsion at higher rates for the misbehaving black students. The only teachers who suggested firmer discipline were themselves black. These teachers believed more strongly than their white cohorts that black students should be suspended for more days for their misbehavior.

The overall conclusion was that implicit biases "do not begin with black men and police. They begin with young black boys and their preschool teachers—if not earlier."

- How would you classify this research according to methodology, purpose, and so on?
- Why did the researchers not inform the teachers of the real purpose of the investigation?
- In order to verify the findings of this research, try to locate another study investigating the same question.

1. A combination of qualitative and quantitative research. Researchers recorded data like how long teachers gazed at students of different races, and document ratings that teachers gave. On the other hand, they also interview teachers about the disciplinary approach they want to give.
2. The purpose of this research is to investigate if teachers are unconsciously biased toward black students. Researchers didn't inform participants of this purpose to make sure the data they got is accurate.

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Summary

Systematic research is the most reliable source of new knowledge for educators. Research follows a series of steps to collect and analyze data that answer a specific question. When this procedure is applied to an education question, we call the process educational research. The design of a research study refers to the methods used in conducting the research. A variety of methods are available to educational researchers; these are typically classified as quantitative, qualitative, or mixed methods.

Quantitative research uses objective measurement in a controlled setting to gather numeric data that are used to answer questions or test predetermined hypotheses. Qualitative research uses different forms of inquiry that focus on understanding social phenomena from the perspective of the human participants in natural settings. Mixed methods research combines both quantitative and qualitative research in the same investigation and is regarded by many as giving more reliable results than either of these alone provides.

There are many different types of quantitative research classified as experimental or nonexperimental and also many different types of qualitative research. One chooses the method that will provide the data needed to answer the research question.

Key Concepts

action research
applied research
basic research
case study
constitutive definition
construct
content analysis
correlational research
deductive reasoning
dependent variable
dichotomous variable
documentary analysis
ethnography
ex post facto research
experimental research
grounded theory
historical research
hypothesis
hypothesis testing
independent variable
inductive reasoning
mixed methods research
narrative inquiry
operational definition
phenomenological studies
qualitative research
quantitative research
scientific approach
scientific method
theory
universal determinism
variable

Exercises

1. Classify each of the following studies according to the research method that might be used:
   a. Relationship Between Measures of Self-Efficacy in Math and Achievement in Mathematics
   b. Incidence of Sexual Assaults on a University Campus
   c. An Analysis of Social Studies Textbooks Used in Russian Middle Schools to Determine How America Is Portrayed
   d. Cognitive Development in Gifted Children: Toward an Understanding of Emerging Differences in Intelligence
   e. The Relationship Between Number of Semesters of Math Taken in High School and Students' First Semester GPA in College
2. Which educational research methodology (qualitative or quantitative) is used most commonly in your field of study? Locate and read a journal article reporting a research study in your field.
3. Identify the source of knowledge in the following:
   a. After *extensive* observations of reactions, Lavoisier concluded that combustion is a process in which a burning substance combines with oxygen.
   b. Knowing that radioactive substances constantly give off particles of energy without apparently reducing their mass, Einstein developed a formula for converting matter into energy.
4. In what ways are mixed methods research and action research similar? How are they different?
5. Which quantitative research method would most effectively answer each of the following questions?
   a. Do children who eat breakfast get better grades in school?
   b. Does a unit on proper nutrition change children's breakfast-eating habits?
   c. How many children in school report that they do not have breakfast at home?
   d. Does the provision of a free breakfast at school make a difference in student achievement?

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6. Which characteristic attitudes expected of scientists are violated in the following statements?
   a. We can add five points to the mean score for the experimental group; it will make the results more impressive.
   b. This study proved conclusively that the new method of teaching math is superior to other methods.
   c. The purpose of the study was to prove that the use of drugs by high school students is detrimental to academic achievement.
7. In the following example (Associated Press, 2016), circle the types of research that describe the example:
   a. Qualitative b. Quantitative
   c. Experimental d. Nonexperimental

   A well-known drug company in this country reported in 2016 that extensive research on a drug to slow the progression of symptoms in Alzheimer's disease had failed. They found that the drug did not work better than a placebo treatment in a study of more than 2,100 people with mild Alzheimer's.
8. Consider the following characteristics of a research study. Indicate whether each one is most likely in (1) quantitative research or (2) qualitative research. Researcher
   a. is objective and detached from participants.
   b. develops hypotheses after data have been collected.
   c. uses large representative samples of individuals.
   d. uses narrative description.
9. The statement: "Science achievement will be measured as the score made on the science subtest of the Iowa Test of Educational Development" is an example of a(n)
   a. constitutively defined construct.
   b. operationally defined construct.
   c. hypothesis.
   d. independent variable.

Answers

1. a. Quantitative—correlational
   b. Quantitative—survey
   c. Qualitative—document analysis
   d. Mixed methods
   e. Quantitative—correlational
2. Answers will vary.
3. a. Induction
   b. Deduction
4. They use some of the same methods but differ in purpose. Action research focuses on local problems and is conducted by practitioners.
5. a. Quantitative—perhaps ex post facto
   b. Quantitative—experimental
   c. Quantitative—survey
   d. Quantitative—experimental
6. a. Researchers do not change or fabricate data.
   b. Researchers report the findings; they may find support for their hypothesis, but they don't speak of proving anything.
   c. Same as b. above
7. b. and c.
8. a. Quan. b. Qual. c. Quan. d. Qual.
9. b.

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