INTRODUCTION TO RESEARCH IN EDUCATION

Ary Cheser Jacobs Sorensen Irvine Walker

10e

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Tenth Edition

Introduction to Research in EDUCATION

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To Donald Ary, our friend and colleague.

contents

preface

This tenth edition of *Introduction to Research in Education* continues our commitment to providing a comprehensive, reader-friendly introduction to the concepts, principles, and methodologies used in educational research. As in previous editions, our goal is to provide students with the knowledge and skills needed to be intelligent consumers of research as well as to plan and conduct quality research studies on their own. This book is written primarily for beginning graduate students in education, but it is also appropriate for students in other social sciences.

Text Organization

The organization of this book was updated for this edition into four parts:

1. **Part 1:** The first four chapters focus on an introduction to the nature of research in education, the research problem, the review of relevant literature, and planning for ethical research.
2. **Part 2:** Chapters 5 through 14 focus on quantitative research and deal with the measurement tools used in gathering quantitative data, issues of reliability and validity in quantitative research, quantitative research designs, the statistical procedures used in the analysis of quantitative data, and interpreting and reporting quantitative research.
3. **Part 3:** Chapters 15 through 19 focus on qualitative research and examine how it differs from quantitative research; types of qualitative approaches; data gathering in qualitative studies; issues of rigor and particular ethical challenges in qualitative inquiry; and analyzing, reporting, and critiquing qualitative research.
4. **Part 4:** The final two chapters, Chapters 20 and 21, introduce action research and mixed methods research, both of which combine both qualitative and quantitative elements.

Changes in This Edition

For the tenth edition, we have retained features previously designed to enhance students' understanding.

- "Think About It" boxes conclude major discussions in chapters and prompt students to apply and think critically about material covered in a previous section. These exercises can be used as concept checks for students.
- The "Research in the Public Eye" box in each chapter presents examples of research that appeared in popular publications. Students are asked questions that require them to critique various methodologies employed, interpret findings, and evaluate the conclusions reached.
- End-of-chapter exercises expose students to intriguing research problems and help develop critical thinking.

In addition to these features, chapters and references have been updated, and the information on qualitative research has been expanded. Significant reorganization also occurred, including combining Chapters 1 and 2 in the previous edition into streamlined coverage of the nature of research in education. Chapters 3 and 5 in the previous edition are now combined into one chapter, Chapter 2, on the research problem. Information on qualitative data-collection tools, previously in Chapter 15, is now in a standalone chapter, Chapter 17. Similarly, information on rigor in qualitative research, previously in Chapter 17, now is in its own chapter, Chapter 18. Appendices A and B, cover guidelines for writing quantitative and qualitative research proposals, respectively.

Accompanying Teaching and Learning Resources

This tenth edition of *Introduction to Research in Education* is accompanied by an extensive package of instructor and student resources.

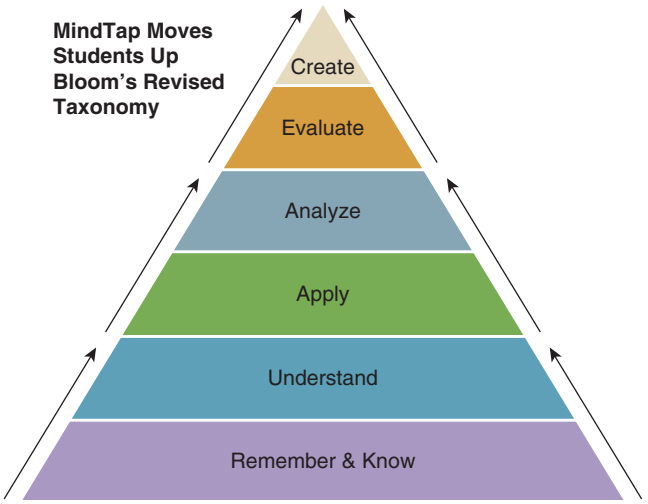
MindTap™: The Personal Learning Experience

MindTap for Ary/Jacobs/Sorensen Irvine/Walker, *Introduction to Research in Education*, 10e represents a new approach to teaching and learning. A highly personalized, fully customizable learning platform with an integrated eportfolio, MindTap helps students to elevate thinking by guiding them to:

- Know, remember, and understand concepts critical to becoming a great teacher;
- Apply concepts, create curriculum and tools, and demonstrate performance and competency in key areas in the course, including national and state education standards;
- Prepare artifacts for the portfolio and eventual state licensure, to launch a successful teaching career; and
- Develop the habits to become a reflective practitioner.

As students move through each chapter's Learning Path, they engage in a scaffolded learning experience, designed to move them up Bloom's Taxonomy, from lower- to higher-order thinking skills. The Learning Path enables preservice students to develop these skills and gain confidence by:

- Checking their comprehension and understanding through Did You Get It? assessments, with varied question types that are autograded for instant feedback;
- Developing their critical thinking skills by having them read a journal article and then write an essay in response to a question about the article;
- Applying concepts through mini-case scenarios—students analyze typical research situations, and then create a reasoned response to the issue(s) presented in the scenario; and
- Reflecting on and justifying the choices they made within the teaching scenario problem.



Anderson, L. W., & Krathwohl, D. (Eds.). (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives*. New York: Longman.

MindTap helps instructors facilitate better outcomes by evaluating how future teachers plan and teach lessons in ways that make content clear and help diverse students learn, assessing the effectiveness of their teaching practice, and adjusting teaching as needed. MindTap enables instructors to facilitate better outcomes by making grades visible in real time through the Student Progress App so students and instructors always have access to current standings in the class.

MindTap for *Introduction to Research in Education*, 10e helps instructors easily set their course since it integrates into the existing Learning Management System and saves instructors time by allowing them to fully customize any aspect of the learning path. Instructors can change the order of the student learning activities, hide activities they don't want for the course, and—most importantly—create custom assessments and add any content they do want (e.g., YouTube videos, Google docs). Learn more at www.cengage.com/mindtap.

Instructor's Manual

An online Instructor's Manual accompanies this book. It contains information to assist you in designing the

course, including sample syllabi, discussion questions, teaching and learning activities, learning objectives, chapter outlines, and key terms.

Test Bank

For assessment support, the Test Bank includes multiple-choice and short-answer questions for each chapter.

PowerPoint Lecture Slides

These vibrant Microsoft PowerPoint lecture slides for each chapter assist you with your lecture by providing concept coverage using images, figures, and tables directly from the textbook.

Cognero

Cengage Learning Testing Powered by Cognero is a flexible online system that allows you to author, edit, and manage test-bank content from multiple Cengage Learning solutions; create multiple test versions in an instant; and deliver tests from your LMS, your classroom, or wherever you want.

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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.

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.

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.

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.

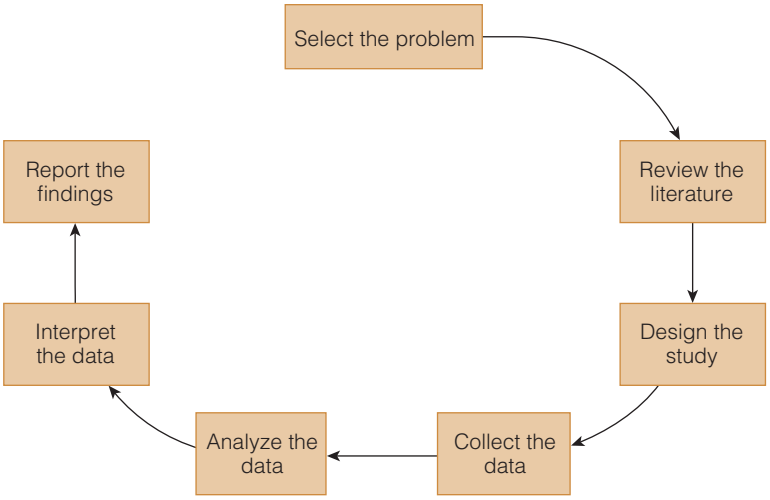

Figure 1.1 Stages in the Research Process

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,

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.

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

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

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.

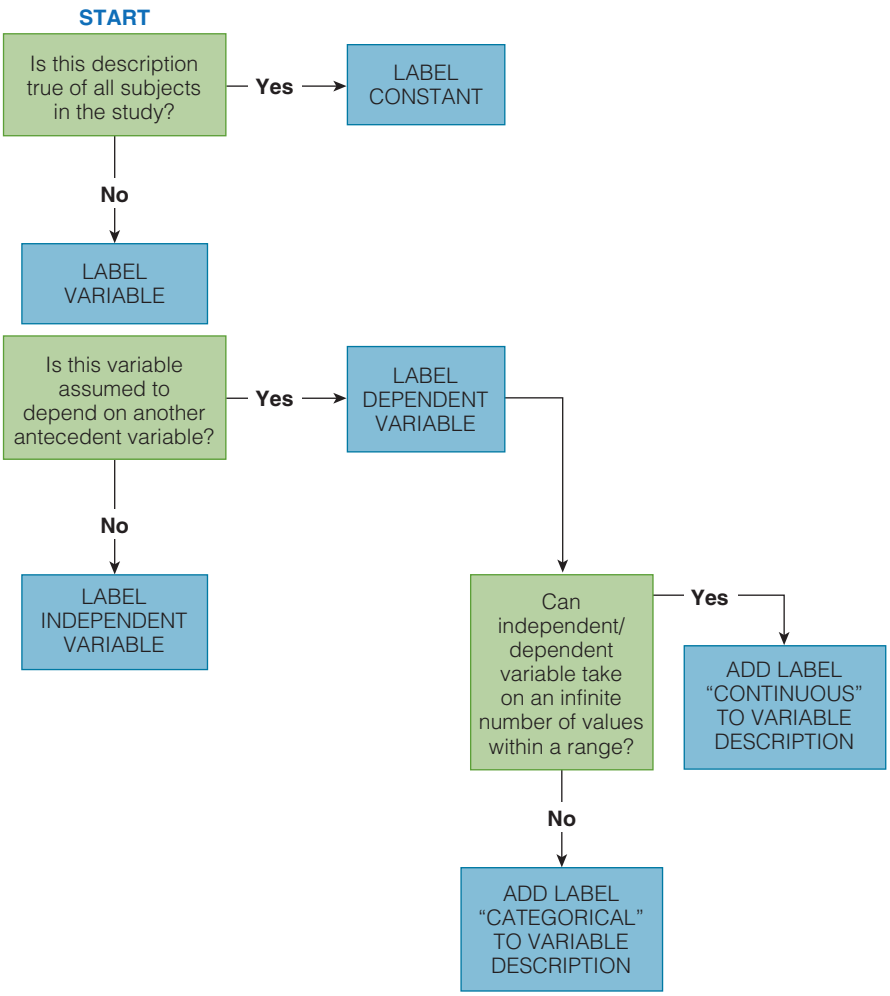

Figure 1.2 Flow Chart for Classifying Variables and Constants