INTRODUCTION TO RESEARCH IN EDUCATION

Ary Cheser Jacobs Sorensen Irvine Walker

10e

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Tenth Edition

Introduction to Research in EDUCATION

Donald Ary
Emeritus, Northern Illinois University

Lucy Cheser Jacobs
Indiana University

Christine K. Sorensen Irvine
University of Hawaii at Mānoa

David A. Walker
Northern Illinois University

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Tenth Edition
Donald Ary, Lucy Cheser Jacobs, Christine K. Sorensen Irvine, David A. Walker

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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.

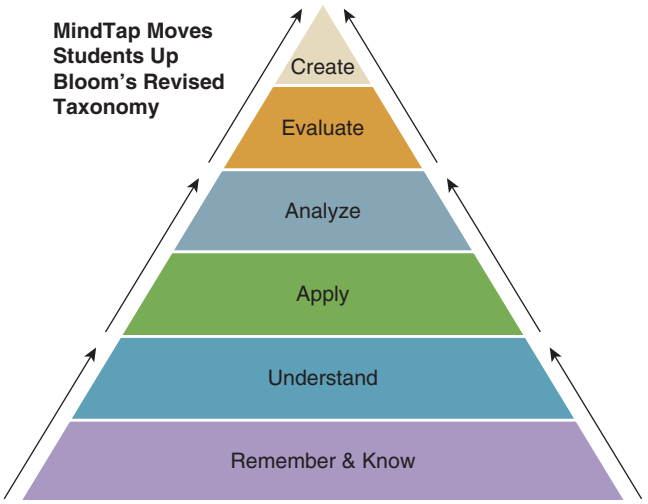
MindTap™: The Personal Learning Experience

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.

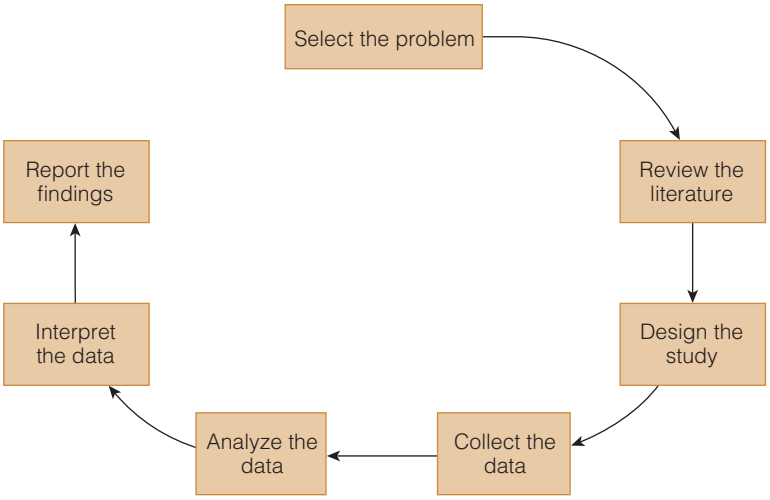

Figure 1.1 Stages in the Research Process

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.

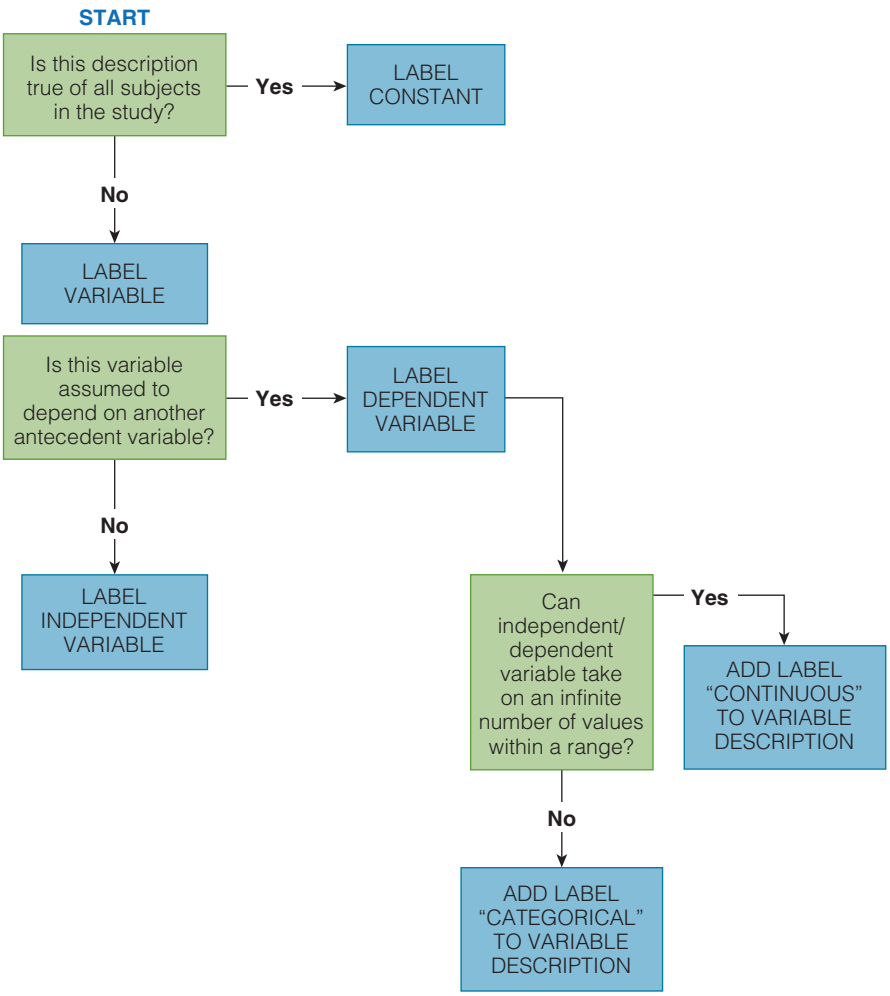

Figure 1.2 Flow Chart for Classifying Variables and Constants

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.

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

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

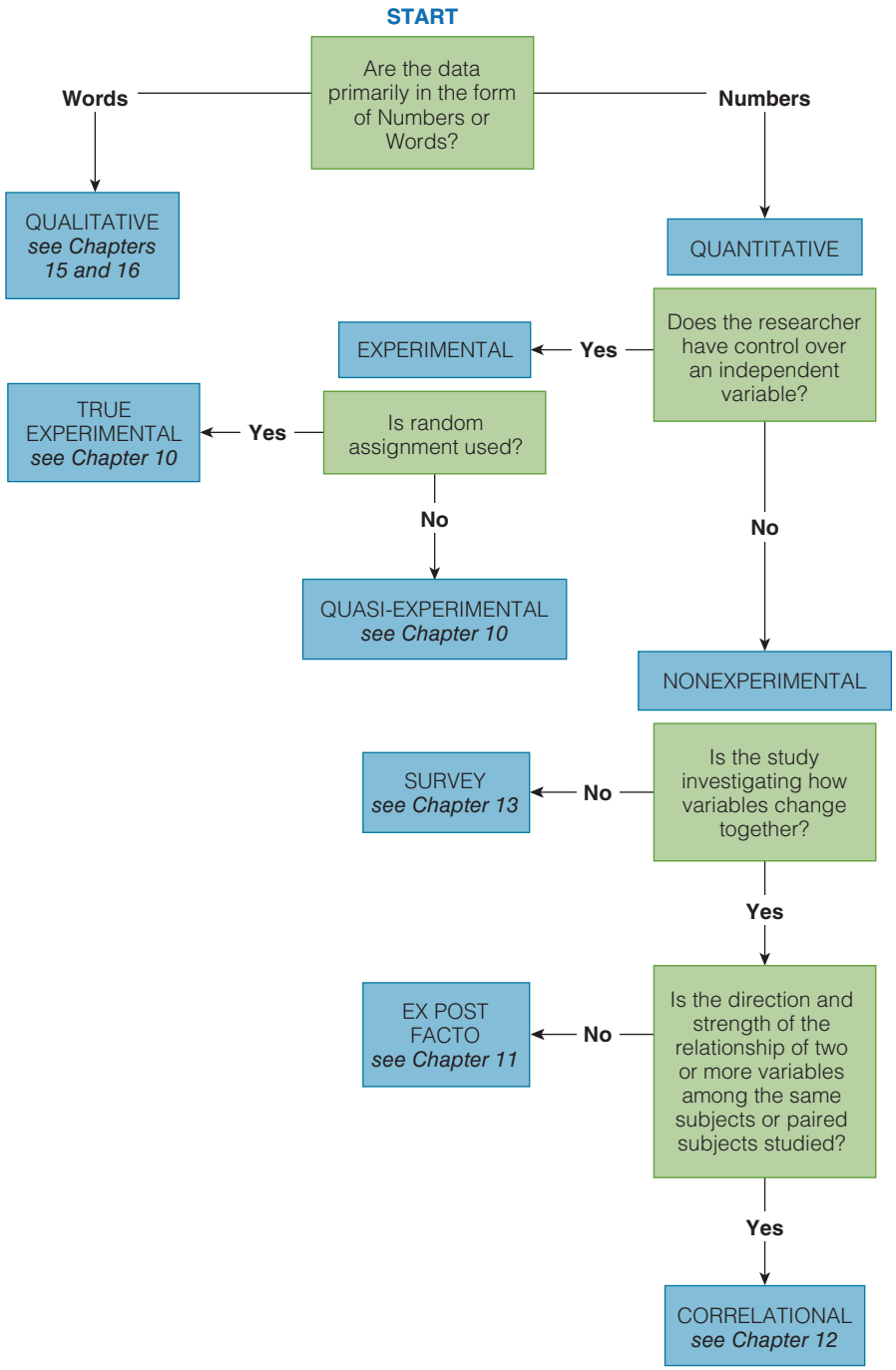

Figure 1.3 Major Types of Quantitative Educational Research

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.

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.

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,

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.

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?

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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chapter 2

The Research Problem

LEARNING OBJECTIVES

After studying this chapter, you will be able to:

- **2-1** Define a research problem and identify sources of problems for educational research, describe the characteristics of a qualitative research problem, and distinguish between quantitative and qualitative research problems.
- **2-2** State the criteria for evaluating a research problem, and use the criteria to evaluate a problem.
- **2-3** Define terms such as *population* and the different types of variables as used in a quantitative study, and write a research question using operational definition of variables.
- **2-4** Define hypothesis and understand its purpose in quantitative research, define null hypothesis and its operational definition and be able to give examples and explain its use in hypothesis testing, identify a testable hypothesis from given examples, and write a research hypothesis and a null hypothesis for a quantitative research study.
- **2-5** List the elements to be included in a research plan, and write a directional and nondirectional research hypothesis.

Photo above by Marlene Somsak

A research problem is not a nuisance; it is a step toward new knowledge.

As pointed out in Chapter 1, educational research begins with a problem. Thus, the first step in a research study is to select a problem for investigation. The problem refers to the general area of interest or concern that starts the investigation. It may be an issue, a controversy, or a question that puzzles the researcher, such as multicultural education, elementary school children with reading or math difficulties, working with parents of low-achieving or disadvantaged children, or teaching strategies to use with at-risk high school students. There is no way to do research until a problem is recognized, thought through, and articulated in a useful way. Skill in

doing research is, to a large extent, a matter of making wise choices about what to investigate. The problem is usually presented as a statement in the introduction to the written report of a study.

Beginning researchers are often surprised to find that selecting and formulating a problem can take up a large part of the total time invested in a research project. Actually, isolating a good research problem is always a concern, even to experienced researchers. When professors or advanced graduate students submit a research paper to a journal for publication, to a professional meeting, or to a grant-funding agency, it is the quality of the research problem that often makes the difference between acceptance or rejection.

The choice of a problem must be very personal or else the researcher may find it difficult to muster the motivation to carry the research through to its end. The problem should hold deep interest or be one about which the researcher is really curious. For example, an elementary school teacher may be interested in finding an effective teaching strategy to use with students diagnosed with attention deficit/hyperactivity disorder (ADHD). A high school biology teacher may want to know if using computer simulations would improve students' problem-solving skills.

2-1 Sources of Problems

The first question most students ask is: "How do I find a research problem"? There are several sources that one can use.

2-1a Experience

Among the most fruitful sources for beginning researchers are their own experiences as educational practitioners. Most graduate students in education have been in the classroom or are currently working full- or part-time in schools. Teachers have intuitions or hunches about new relationships or why certain things in school happen the way they do. They can ask questions about the effectiveness of certain classroom practices and perhaps initiate an action research study to investigate. We suggest that you make a list of ideas, noting things that you question. By studying these notes, you may soon identify a worthwhile research problem.

Students who have not had teaching experience can get ideas for research problems from discussions and their reading in education courses. An excellent source of ideas is to talk to one of your professors. Most professors have research projects under way and perhaps could suggest an aspect of the problem that you might investigate.

2-1b Related Literature

Another valuable source of research problems is the published literature in your area of interest. The literature can help to formulate and refine research problems. You will find many examples of interesting research problems and a rationale others have given for research on the problems. You can see what other researchers have found out about the problem and what they suggest as the next steps in an investigation. You can learn what theories others have used that are relevant to the problem and what the key variables are to understanding the problem. You can also see what methodologies have been used and the strengths and limitations of the methods. You might look at general journals like *American Educational Research Journal,* the *Elementary School Journal, Education Week, Journal of Educational Psychology,* or subject-focused journals like *The Reading Teacher, Journal for Research in Mathematics Education,* and *Remedial and Special Education.*

You might choose to replicate a study that interests you. Replication is an acceptable activity in research because it provides more evidence of the validity of the findings in the original study.

As studies are repeated at different times and in different places and as the findings are supported by each study, our confidence in the validity of the findings increases. You wouldn't necessarily repeat the study exactly. You could use a different age group, different setting, different measuring instruments, or a different population. For example, researchers have conducted numerous replications of Piaget's famous studies on the development of moral judgment in children (Piaget, 1999). These studies used Piaget's basic approach but investigated the development of moral judgment in children of the same chronological age but differing in intelligence, in children differing in the nature of parental discipline in the home, and in both girls and boys. In general, the large body of research stemming from Piaget's investigations has supported his original conclusions. Thus, a single research study, if it deals with a significant problem and its findings are exciting, can inspire many other studies. In the concluding section of a report, researchers often mention new questions that have arisen and suggest additional studies that should be done.

2-1c Theory

You can read discussions of interesting theories in educational, psychological, and sociological research journals. A theory is a set of interrelated statements, principles, and propositions that specify the relationship among variables. There are many educational theories dealing with learning, motivation, and personality development. You could choose an interesting theory that you believe would have implications for educational practice. Make a prediction of what would be expected to happen in a particular setting, if the theory has validity. Your problem involves designing a study that will confirm or fail to confirm the theory.

For example, assume you are interested in how adolescents form their academic self-concepts. Sociology has a social comparison theory that suggests that students form their academic self-concepts by comparing their self-perceived academic accomplishments to some standard or frame of reference. The frame of reference for most adolescents is the perceived academic abilities of their classmates. From this, one could deduce the following hypothesis: "Gifted students placed in selective homogeneous classes will have lower academic concepts over time than equally gifted students placed in heterogeneous classes." A theory-based research problem is beneficial because the results of the study can be tied to a body of existing knowledge.

2-1d Noneducation Sources

One can get inspiration for educational research from noneducation sources. For example, the women's movement led researchers to study gender stereotyping in educational materials, the influence of schools on the learning of gender roles, gender differences in achievement, and so on. The civil rights movement led to many studies about the education of minority students. Researchers are now investigating the effect of mindfulness (meditation and yoga-type exercises) instruction in elementary schools to help students deal with bullying, stress, and anxiety at school as well as other mental health challenges in our society. Research shows that mindfulness not only lowers student stress and anxiety, but also improves academic performance, kindness, and empathy among students.

2-1e Qualitative Research Problems

Qualitative studies begin with a general research problem. Just as is true for quantitative researchers, beginning qualitative researchers can look to their personal experiences and interests, to theory, to the professional literature, or to current social issues and real-world concerns to find a potential problem. Assume a researcher has read about an elementary

Table 2.1 Differences between Quantitative and Qualitative Research Problems

Quantitative	Qualitative
• Specific	• General
• Deductive	• Inductive
• Narrow	• Broad
• Close-ended	• Open-ended
• Static	• Emergent
• Outcome-oriented	• Process-oriented
• Confirms	• Describes
• Contains variables	• Contains ideas and concepts

From *Research in Education* by J. H. McMillan and S. Schumacher, 2010, Boston: Pearson.

school in an inner city that has been completely turned around. Academic achievement has improved; there are few, if any, discipline problems; parental involvement has increased; and standardized test scores have gone up. A potential problem for research could be to learn what the faculty and administrators at the school did and how they did it to bring about such positive changes. A case study of the school would be an excellent data-collection method.

Formulation of a qualitative research problem begins with the identification of a general topic or issue one wants to know more about. Some examples of topics for investigation might be teacher burnout, retention of at-risk students, adjustment of transgender students in high school, and the preparation of elementary level students for state achievement tests. The general topic of interest is sometimes referred to by qualitative researchers as the **central question**. The central question is an open-ended statement of purpose that identifies the main phenomenon that will be investigated. This initial broad focus provides the framework but allows for changes as the study proceeds. As the researcher gathers data and discovers new meanings, the central problem narrows to more specific topics and new questions may arise.

central question The initial, broad statement of the general purpose of a qualitative research study. It becomes more specific as the study proceeds.

Whereas the quantitative researcher always states the problem before collecting data, the qualitative researcher may not present the final statement of the problem until he or she has collected at least some data about the site, the people, and the situation. At this point, the researcher narrows the options and can state the problem more specifically. Table 2.1 summarizes the main differences between quantitative and qualitative research problems.

We discuss qualitative research in greater detail in Chapters 15 through 19.

2-2 Evaluating Research Problems

After you tentatively select a problem that interests you, you need to ask if it is important and one that warrants an expenditure of time and effort to investigate. The following are criteria to use in evaluating a research problem:

1. *The problem should have significance*. That is, it should be one whose solution will make a contribution to educational theory or practice. The findings may fill a gap in current knowledge or help resolve inconsistencies in previous research. You should be able to answer the question, "So what?" with respect to your proposed study. Would the solution make any difference to educational practice? Would other educators be interested in the findings? Does it test a theory? Does the proposed study introduce new methodology that would be useful in other investigations?
2. *The problem should be one that will lead to new problems and so to further research*. A good study, although arriving at a solution to one problem, usually generates a number of other problems for investigation. Avoid trivial problems that have little or no relationship to theory or previous research. We suggest that a beginning

researcher consider selecting a problem that could possibly be expanded or followed up later in a master's thesis or even a doctoral dissertation.

3. *The problem must be researchable*. A researchable problem is one that can be investigated empirically; that is, it's possible to gather data that answer the question. Philosophic questions that ask what should be done are not researchable and should be avoided. Questions such as "Should we offer more vocational training in high schools?" or "Should schools give more attention to character education?" cannot be answered by gathering and analyzing data.

   It is possible to restate philosophic questions to make them researchable. The previous question could be restated as "What is the effect of a character education program on the incidence of cheating in high school?" One could gather data on this question, which could then be used by educators to help make decisions about the value of a character education program.

4. *The problem should be one that is ethically appropriate*. That is, the problem should be one that you can investigate without violating ethical principles.
   a. *Consent*. You need to obtain consent from the intended participants in the study. If minors are to be involved, parental consent is required.
   b. *Protection from harm*. The research must not cause physical or psychological harm such as stress, discomfort, and embarrassment that could have lasting adverse effects.
   c. *Privacy*. The researcher should keep invasion of privacy to a minimum. If a survey is used, for example, avoid sensitive issues or at least do not attach names to the responses. Participants have the right to expect that their anonymity will be preserved.

5. *The problem should be suitable for the researcher*. It should be interesting and a problem whose solution is personally important because of what it can contribute to one's own knowledge or to improve one's performance as an educational practitioner. Researchers must make sure that they have the necessary skills to carry the study through to completion. They may have to develop and validate a new measuring instrument or do complex statistical analyses. Consider whether you will have access to participants and the data needed to answer the research question. A common problem that many beginning researchers face is selecting a problem that is far too broad in scope. It is very important that the problem be the one that can be investigated in the allotted time and with the resources available.

Figure 2.1 illustrates the selection and evaluation of a quantitative research problem.

THINK ABOUT IT 2.1

Using the criteria for judging the significance of a research problem, evaluate the following research problems:

1. Should schools include environmental education in the high school curriculum?
2. Is there a relationship between verbal aptitude scores and reading scores for elementary students?
3. What is the best way to teach fractions to fourth graders?
4. What is the attitude of Indiana middle school principals toward the mandated state testing program? (An interview study)
5. What is the relationship between the number of math courses taken in high school and freshman GPA at the state university?

Answers

1. Not suitable as a research problem; research does not answer questions of "should."
2. The problem is trivial because it has been investigated sufficiently in past research.
3. Research does not answer the question of "the best"; furthermore, a single study would not investigate all the different methods of teaching fractions.
4. Too broad; one could not interview all the middle school principals in Indiana in a single study.
5. Acceptable

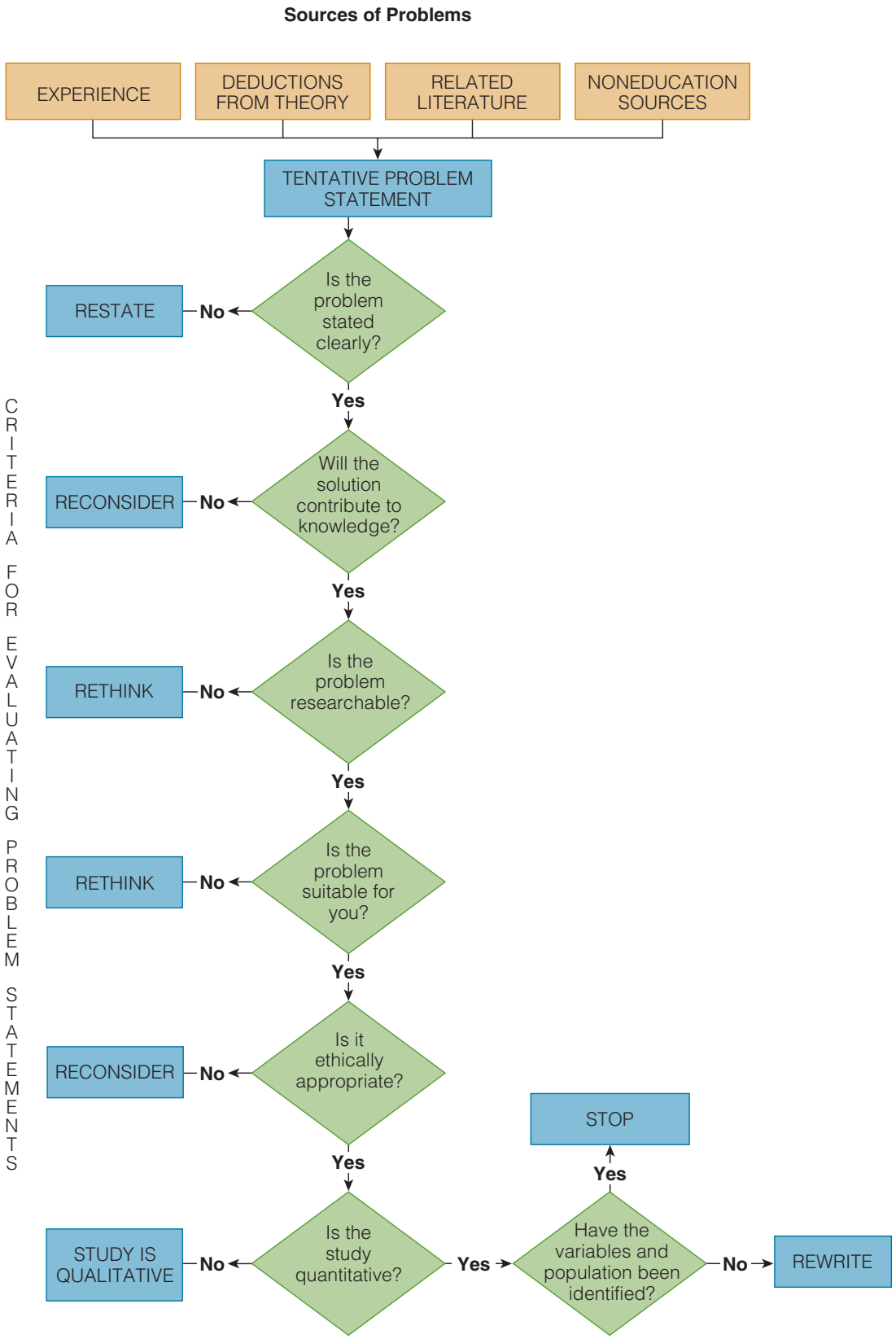

Figure 2.1 Developing a Research Problem

2-3 The Research Question

problem statement A statement of the question that will be investigated in a research study.

After one has selected and evaluated the quantitative problem, the next task is to state a more specific question. The question is inherent in the problem that you've selected, but it is expressed more precisely than the **problem statement**. The research question clarifies the problem because the question usually specifies the variables and the population of interest. The question form is straightforward and psychologically orients the researcher to the task at hand, namely to find the answer to the question. "What is the relationship between use of computer simulations and achievement in middle school science?" is an example of a quantitative research question. The question can be clarified by operationally defining the variables involved in the study. The question then becomes, "What is the effect of a computer assisted biology course on students' performance on the Test of Biological Concepts in an eighth-grade biology class?"

population The larger group to which a researcher wishes to generalize; it includes *all* members of a defined class of people, events, or objects.

A good strategy for transforming your problem into a research question is to think in terms of population and variables. Consider the problem: "Does individual tutoring by upper-level students have a positive effect on the reading achievement of younger below-average readers?" It is usually easiest to identify the population. In this example, the **population** (those people about whom you wish to learn something) is below-average readers. "Below-average readers" is too broad a category; the researcher would decide to confine the study to a particular age. Thus, the researcher selects below-average second-grade readers.

Next, we will consider the variables in the problem. Recall from Chapter 1 that the independent variable is the variable that is manipulated to determine its influence on another variable called the dependent variable. In this case, the variable, "tutoring by upper-level students" is the independent variable; some students will receive the tutoring and some will not. The word *tutoring* is too general; all students who will receive tutoring must have exactly the same kind and amount of tutoring. The researcher decides on "word flash drill" as the type of tutoring and to specify 15 minutes per day as the amount of time. The dependent variable (the consequence of the independent variable) is reading achievement.

What will be the measure of reading achievement? An objective measure of reading achievement may be the reading scores from the California Achievement Test (CAT). The revised question now reads: "Among below-average second-grade readers, is there a difference in CAT reading scores between those who have received 15 minutes per day of individual word flash drill by upper-level students and those who have received no word drill?" You can see that the research question has added greater specificity to the original problem.

Some scholars recommend using a diagram similar to that used in diagramming a sentence. Draw a vertical line and write *Population* on the left and *Variables* on the right. Draw a horizontal line and list the elements in the study below the line. The diagram for the preceding example is shown next.

Population	Variables
Below-average second-grade readers	• Word flash drill for 15 minutes daily by upper-grade students versus no word flash drill (independent) • Reading scores on CAT (dependent)

2-4 The Hypothesis in Research

research hypothesis A statement of the relationships one expects to find as a result of the research.

After stating the research question and examining the literature, the quantitative researcher is ready to state a **research hypothesis** based on the question. Recall that the quantitative question examines the relationship between two (or more) variables. Based on the review of the literature and experience, the researcher states a hypothesis, which is a tentative statement presenting the researcher's expectations about the

relationship between the variables within the question. The hypothesis is stated before data collection. One understands that the ensuing investigation may lead to support or lack of support for the hypothesis. Note that we use the word *support,* not *prove*. Research may find support for a hypothesis, but it does not prove a hypothesis.

2-4a Purpose of the Hypothesis

The main purposes of the hypothesis in quantitative research are:

1. *The hypothesis integrates information that enables the researcher to make a tentative statement about how the variables in the study are related.* Based on experience and related research, the researcher states the hypothesis that provides the most satisfactory prediction of the outcome.
2. *Because the hypothesis is derived from related literature, the hypothesis provides a way to connect the literature to the current study.* The hypothesis stimulates the research endeavor that results in the accumulation of new knowledge.
3. *The hypothesis provides direction to the research.* The hypothesis posits a specific relationship between variables and thus determines the nature of the data needed to test the proposition. It tells the researcher what to do.
4. *The hypothesis provides a framework for reporting the findings and conclusions of the study.* When writing the research report, it is convenient to take each hypothesis separately and state the conclusions that are relevant to it. It makes for a more meaningful presentation. It should be noted that a beginning researcher will probably have only one hypothesis, although more complex investigations may have several.

2-4b Characteristics of a Usable Hypothesis

Characteristics of a usable hypothesis include:

testable hypothesis
A hypothesis that is verifiable; deductions can be drawn in such a way that empirical observations either support or do not support the hypothesis.

1. *A hypothesis must be testable.* Testability is the most important characteristic of a "good" hypothesis. A **testable hypothesis** is verifiable; that is, it is possible to determine through data collection and analysis whether the predicted consequences of a relationship or a difference actually occur. To be testable, a hypothesis must relate variables that can be measured. This means that unless you can give an operational definition for each variable, you cannot test the hypothesis. Consider the hypothesis: "There is a positive relationship between children's self-esteem and their reading achievement in first grade." To measure the variables, they must be defined operationally. Self-esteem could be defined as the scores obtained on the Self-Image Profile for Children (Butler, 2001) and reading achievement defined as scores on the California Reading Test, or as first-grade teachers' ratings of reading achievement.
2. *A hypothesis should be stated as simply and concisely as possible.* A concisely stated hypothesis makes clear what the researcher needs to do to test it. If one is exploring more than one relationship, he or she would need to state more than one hypothesis. A general rule is to state only one relationship in any one hypothesis. For example, if you were investigating the effect of a new teaching method on student achievement and student satisfaction, you would need to state two hypotheses—one for effect on achievement and another for effect on satisfaction.
3. *A hypothesis should be consistent with the existing body of knowledge.* The hypothesis, "My car will not start because the fluid in the battery has turned to gold" is so contrary to what is known about the nature of matter that you wouldn't pursue it. The hypothesis, "My car will not start because the fluid in the battery has evaporated to a low level" is consistent with previous knowledge and would be worth pursuing. This characteristic highlights the necessity for a thorough review of the literature so that hypotheses are formulated on the basis of theory and/or previously reported research in the area.

THINK ABOUT IT 2.2

A teacher observed that more than twice as many boys as girls were enrolled in the remedial reading class. To explain this observation, the teacher came up with a number of hypotheses. Select the hypotheses that are testable.

a. Even before birth, girls' brains are "wired" to succeed in reading-type activities.
b. During elementary school boys are physically maturing more rapidly than girls and therefore have less energy remaining to do things such as reading.
c. Boys are less inclined to do quiet things like sitting and reading.
d. The Devil distracts boys when they try to read.

Answer

Only one hypothesis (c) is testable. Hypotheses (a) and (d) are not testable because of an inability to measure the variables. (b) is not testable, because it is not consistent with the body of knowledge. In elementary school, girls mature more rapidly than boys. Boys catch up during adolescence.

2-4c Types of Hypotheses

directional hypothesis A hypothesis that specifies the direction of the expected findings—that is, whether a "greater than" or "less than" result is expected.

nondirectional hypothesis A hypothesis that states that a relationship between variables will be observed but does not specify the direction of the expected findings.

The hypothesis described in the previous section is called the research hypothesis (symbolized as H). It states the relationship the researcher expects to find, or the expected difference between the groups in the study. Research hypotheses may be stated in a directional or nondirectional form. A **directional hypothesis** states the direction of the predicted relationship or difference between the groups. The hypothesis, "Children who show high achievement motivation will have higher anxiety scores on the Children's Manifest Anxiety Scale than will children with low achievement motivation" is a directional hypothesis. A **nondirectional hypothesis** states that there is a relationship or a difference between the groups but does not specify the direction of that difference. "Achievement motivation and anxiety level are related" is a nondirectional hypothesis.

A directional hypothesis is stated when you have some basis for predicting the direction of the relationship or whether a "greater than" or "less than" result is expected. It is the literature review that generally provides the basis for stating the hypothesis as directional or nondirectional.

2-4d The Null Hypothesis

null hypothesis A hypothesis that states there is no effect, no difference, or no relationship between variables; it is a negation of the research hypothesis—hence one that the researcher hopes to reject.

Another widely used type of hypothesis is the **null hypothesis** (symbolized as H_0). The null hypothesis states that there is no relationship between the variables or no statistically significant differences between the groups in the study. It is a negation (not the reverse) of what the researcher expects or predicts (research hypothesis). In the preceding example, the null hypothesis would be stated: "There is no relationship between children's achievement motivation and their anxiety level in the population."

Remember that researchers gather data from a sample. If they find a relationship between variables in a sample, can they infer that the relationship would be found in the population from which the sample was drawn? That is the question they must answer, and it is the null hypothesis that helps with this decision. It lets researchers assess whether the apparent observed relationships in a sample are genuine or are they likely just a function of chance alone.

In fact, the null hypothesis of no relationship between the variables is either true in the population, or it is not true. We use a statistical test to determine the probability that the null is true. If the tests indicate that the observed relationship had only a slight probability ($< 1\%$) of occurring by chance, the null hypothesis becomes an unlikely explanation, and the researcher rejects it.

The rejection of the null provides support for the research hypothesis. If researchers reject the null hypothesis, they conclude that there is a relationship between the variables in the population, just as the research hypothesis predicted.

Testing a Null Hypothesis

It is the null hypothesis that is directly tested by statistical procedures. Let us summarize the steps followed in testing a hypothesis.

1. State the research hypothesis, which is the relationship or the difference that should be observed if the research hypothesis is true.
2. State the null hypothesis.
3. Select a research method that will enable the hypothesized relationship to be observed if it exists.
4. Using appropriate measuring instruments, gather the empirical data and calculate the descriptive statistics for these data. (See Chapter 7.)
5. Calculate inferential statistics to determine the probability that your obtained results could have occurred by chance when the null hypothesis is true. (See Chapter 8.)
6. If the probability of the observed findings being due to chance is very small (only 1 in 100 chances), you would have sufficient evidence to reject the null hypothesis.

2-5 The Quantitative Research Plan

research plan A preliminary proposal for research indicating the steps to be followed.

After identifying a worthwhile problem and stating a research hypothesis, one is ready to develop a tentative **research plan**. The research plan is a preliminary proposal indicating the steps to be followed in the study. Developing this tentative plan is essential because it forces a researcher to set down his/her ideas in a concrete form. Many initial ideas seem promising until one must spell them out in black and white; then the difficulties or inadequacies become obvious.

Another advantage of a written plan is that one can give it to others for their comments and criticism. In a research methods class, for example, the professor would need to see students' research plans; the director of a dissertation would want to see a written plan rather early in the process. It is much easier for another person to detect flaws in a proposal that is written out than in one communicated orally. Another point to remember is that the more complete and detailed the initial proposal, the more useful it will be to the researcher and the more time may be saved later.

A research plan should include the following elements: the problem, the research question, the hypothesis, the research methodology, and the proposed data analysis.

1. *Problem.* One begins with a clear statement of the research problem. A quantitative problem generally asks about the relationship between specified variables. Or the problem might be presented in the form of the purpose of the study. One should include the rationale for the study and a brief description of the background of the problem in theory and/or related research.
2. *Question and hypothesis.* A concise statement of the research question should follow the problem. Inherent in the problem is a question for which the study will provide an answer. The question should be followed by a concise statement of the research hypothesis, which states the researcher's expectations or prediction about what the results of the study will show about the relationship between the variables of the study.
3. *Methodology.* This section explains how the study will be conducted. It includes the proposed research design, the population of concern, the sampling procedure,

measuring instruments, and any other information relevant to the conduct of the study.

4. *Data analysis.* In this section, one indicates how he/she will analyze the data to answer the research question or test the hypothesis. Beginning researchers may find this section difficult to write, because they may not yet be familiar with statistics. You might look at some journals with reports of research relevant to your problem in order to see what type of analysis other researchers used, or you might need to consult your professor.

2-5a Example of a Research Plan

Let's assume you're a sixth-grade teacher, and the principal and a committee from the department have decided that some social studies classes will use iPads. You have concerns about how effective they will be compared to your traditional teaching method. You want to plan a study in order to investigate this concern.

Problem: You might state the problem in terms of the purpose of the study. "The purpose of the study is to determine if students who use iPads in social studies will achieve at a higher level than comparable students who are taught in the traditional way." You will need to explain why you chose the problem and why you think it's a significant problem; in other words, give a rationale for the study.

Question: Based on the problem, state the specific question you want the research to answer. Remember to use operational definitions of the variables. The question is: "Will sixth-grade social studies students who use iPads receive higher grades on objective achievement tests that accompany the textbook than comparable students who receive traditional instruction from the teacher?"

Research Hypothesis: "Sixth-grade students in social studies classes who use iPads will receive higher grades on the objective achievement tests than sixth-grade students who had traditional classroom instruction in social studies."

Null Hypothesis: The population mean test score of students using iPads will not differ from the mean population scores of students having traditional instruction.

Methodology: The proposed study would use a quasi-experimental design. Recall that a "true" experiment would require that you randomly assign students to the two sections. The principal would probably not agree to let you draw students randomly from the total population of sixth-grade social studies students to set up two new sections. Instead, you would take two classes as they are already organized and randomly (use a coin toss) make one the experimental group using iPads and the other the control group having the traditional instruction.

Data Analysis: Indicate what data you will gather and how you will analyze the data. The study will continue through one semester. Thus, there will be scores from a number of unit tests given during the semester. You would have scores for each student on each of the tests. Calculate an average (mean) for the experimental group and an average for the traditional group. These two means would be compared to see if the groups differed and the direction of the difference. If the experimental group mean is higher, can you assume that you have support for the research hypothesis? You would need an inferential statistical test that would tell you the probability that the null hypothesis is not true. If the null hypothesis is false, we reject it and conclude that there is a high probability that the means of the two groups differ significantly. If you find that the difference in achievement could have occurred simply by chance, you would not reject the null hypothesis.

pilot study A trial run employed with a percentage of the subjects derived from the population to assess the appropriateness and practicability of the procedures and data-collecting instruments.

After the tentative research plan is approved, it may be helpful to try out the proposed procedures on a few participants. This trial run, or **pilot study**, will help the researcher to decide whether the study is feasible and worth continuing. At this point, you can ask a colleague to check your procedures for any obvious flaws. The pilot study

RESEARCH IN THE PUBLIC EYE

The October 3, 2016, issue of *Time* reports on research that has investigated the effect of mindfulness classes in elementary schools across the country (Oaklander, 2016). The purpose of the research was to determine if mindfulness can be taught in the elementary school and if it is effective in changing children's behavior. Researchers found that a mindfulness program can improve students' focus, ability to pay attention, academic performance, and even their empathy. Children learn how to communicate their feelings, how to be kind and get along with classmates, and how to modulate reactions. Results show that mindfulness exercises are also helping children who have anxiety, ADHD symptoms, and other behavior problems.

Encouraged by the results, a growing group of researchers are pushing for mindfulness to be taught in all public schools. A movement is now also under way to train teachers to teach mindfulness classes. Research that focused on hundreds of elementary school teachers in a sample of public schools in New York City reported that half of the teachers received mindfulness training, whereas the other half did not. Those who were trained in mindfulness became better at handling their own stress and also were more sensitive to their students' needs and became better at fostering a productive environment for learning.

- What was the main research question in this study?
- What was the research hypothesis?

provides the opportunity to assess the appropriateness of data-collection methods and other procedures and to make changes if necessary. It also permits a preliminary testing of the hypothesis, which may give some indication of its tenability and suggest whether further refinement is needed.

Unanticipated problems that appear can be solved at this stage, saving time and effort later. A pilot study is well worth the time required and is especially recommended for the beginning researcher.

Summary

The first task facing both quantitative and qualitative researchers is choosing a researchable problem for investigation. To find a problem, they can look to their personal experiences, to educational or psychological theories, to the current literature in their area of interest, or to noneducation sources. Quantitative and qualitative researchers use many of the same criteria to evaluate the significance of the proposed problem: Will the study contribute to the body of knowledge? Does it have potential for leading to further research? How appropriate is the problem with respect to the researcher's interests, knowledge, and experience in the area? Does the researcher have access to necessary data? Is the study ethically acceptable? Can the study be completed in the time available?

A quantitative research problem is most generally concerned with the relationship between two (or more) variables: the independent variable, which is the variable that is manipulated or changed, and the dependent variable, which is the consequence of the manipulation of the independent variable. In addition to the variables, the quantitative problem also identifies the population of interest. A qualitative problem called the **focus of inquiry** initially has a broader focus, but questions become more narrow as the study proceeds.

focus of inquiry In qualitative research, the initial topic (problem) that a researcher pursues. It may be presented in the form of a question or a statement.

After selecting and evaluating the problem, the researcher states a more specific research question that clarifies the problem by specifying the variables and population

involved. In a quantitative study, the independent and dependent variables are operationally defined. The next step is to state a hypothesis, which is the researcher's prediction about the outcome of the study. Hypotheses are important because they provide direction to the research and tell the researcher what to do to test the proposition. Because the hypothesis is often derived from the related literature, it connects the study to a body of knowledge. It also provides a framework for reporting the findings and conclusions of a study and facilitates the writing of a research report.

An acceptable hypothesis must meet certain criteria. The most important criterion is that it must be testable, which means that it is possible to gather data that will either support or fail to support the hypothesis. It should be stated clearly and concisely and should agree with the preponderance of existing data.

The two major types of hypotheses are the research and the null hypotheses. The research hypothesis is a statement of the researcher's prediction or expectation about the outcome. The null hypothesis, a negation of the research hypothesis, states that there is no relationship between the variables or no effect of the independent variable, or no differences between the groups. The null is important in the statistical analysis of the data and is explained more fully in later chapters.

Hypotheses can be directional or nondirectional. A directional hypothesis states the direction of the predicted relationship or difference between groups. A nondirectional hypothesis states that there is a relationship or a difference between the groups but does not specify the direction of the difference.

It is crucial to remember that a research hypothesis cannot be proved or disproved, only supported or not supported. Even if it is not supported, a hypothesis may serve a useful purpose because it can lead a researcher to reevaluate rationale and procedures and consider other approaches to the problem.

Key Concepts

central question
directional hypothesis
focus of inquiry
nondirectional hypothesis
null hypothesis
pilot study
population
problem statement
research hypothesis
research plan
testable hypothesis

Exercises

1. The following are topics for research. Restate each so that it becomes an acceptable statement of a research question.
   a. Preparation of home-schooled children for high school
   b. Predicting achievement in a graduate education program
   c. Self-concept of children with learning disabilities
   d. Attitudes of parents toward a later start time for classes at the local high school
2. Evaluate the following research questions:
   a. Should the school day be lengthened in order to improve student achievement?
   b. Should students be retained in the early grades because of poor performance?
   c. Has the mandated state testing program in the elementary schools been good for U.S. education?
   d. Is there a relationship between SAT scores and performance in the freshman year of college?
3. Write a directional hypothesis for the following research question: Is there a relationship between the type of reward (tangible and intangible) and the amount of learning taking place in a program for low-achieving students?
4. Select a broad area you might be interested in researching, and identify a research problem in that area. What was the source of the problem?
5. Evaluate the following statements as research hypotheses:
   a. Do SAT prep courses improve students' scores on the SAT?
   b. Students who participate in the high school volunteerism program become better adult citizens.
   c. International high school students are better in math than American high school students.

6. Label the following hypotheses as research hypotheses or null hypotheses:
   a. Students will receive lower scores on achievement tests that measure the higher levels of Bloom's taxonomy than on tests measuring the lower levels of Bloom's taxonomy.
   b. There is no difference in the performance of students taught math by Method A and those taught by Method B.
   c. Students taught by laissez-faire teachers will show higher problem-solving skills in political science than will students taught by highly structured teachers.
7. The following is an abstract of research by Skaalvik, E. M. and Skaalvik, S. taken from C. Roberts (Ed.), *New Developments in Educational Research*, Nova Science Publishers, 2007.

   This research investigated if math self-perception (self-concept and self-efficacy) predicted subsequent math achievement over and above the prediction that could be made by prior achievement in math. The participants in Study 1 were 246 middle school students, whereas the participants in Study 2 were 484 high school students. Achievement was indicated by final grades in math in two successive school years, whereas self-concept, self-efficacy, and self-esteem were measured at the beginning of the second school year with appropriate measures.

   Data analysis showed that students' self-perceptions strongly predicted subsequent achievement in math over and above the prediction that could be made from prior achievement. Both studies indicated that self-concept and self-efficacy are important mediators of academic achievement.

   Identify the following:
   a. The research methodology
   b. The independent variable
   c. The dependent variable
8. Write a directional and nondirectional research hypothesis and a null hypothesis based on the research question: What is the relationship between achievement motivation and anxiety level in children?
9. Classify the following studies as most likely being qualitative or quantitative:
   a. Life of an Adolescent Boy with Type I Diabetes
   b. The Effect of Ability Grouping on Academic Outcomes of Gifted Students
   c. Racial Stereotypes in Middle School Literature Textbooks
   d. What Is the Relationship Between Adolescents' Self-Esteem and Their Self-Perception as a Student?
10. State the independent variable and the dependent variable in the following studies:
    a. The influence of an antismoking program on the attitudes of middle school students toward smoking
    b. The effect of participation in school sports on the social skills of adolescents with intellectual disabilities
    c. The effect of an early intervention program on the academic achievement of children from disadvantaged families

Answers

1. a. How do children who have been home-schooled during the elementary grades perform academically in high school compared with children who have attended regular school?
   b. What is the relationship between GRE scores and achievement in the first year of a graduate education program?
   c. How do children with learning disabilities perceive themselves as students in the classroom?
   d. How do parents of high school students feel about having a later start time for classes?
2. a. Research cannot answer questions of "should."
   b. Research won't tell us whether students should be retained. One could investigate how students who have been retained perform in later years compared to comparable students who were not retained.
   c. Research does not deal with value judgments.
   d. Trivial question; it has been investigated in numerous studies.
3. Low-achieving students perform at a higher level when tangible rather than intangible rewards are used.
4. Answers will vary.
5. a. Hypotheses are not written as questions.
   b. It would be difficult to operationally define "better adult citizens" and measure it.
   c. Vague! How does one define and measure "better in math"?
6. a. Research
   b. Null
   c. Research

7. a. Correlational
   b. Math self-perceptions
   c. Math achievement
8. Directional: There is a positive relationship between achievement motivation and anxiety level in children.

   Nondirectional: Achievement motivation and anxiety level in children are related.

   Null: There is no relationship between children's achievement motivation and their anxiety level.
9. a. Qualitative
   b. Quantitative
   c. Qualitative
   d. Quantitative
10. a. I.V. antismoking program; D.V. attitudes of students toward smoking
    b. I.V. participation in school sports; D.V. social skills of students with intellectual disabilities
    c. I.V. early intervention program; D.V. academic achievement of disadvantaged children

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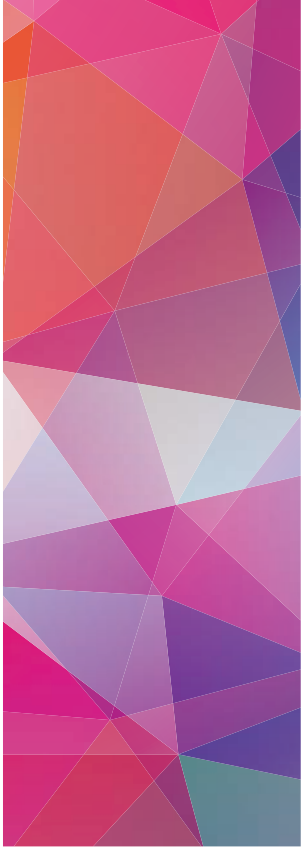
chapter 3



Reviewing the Literature

LEARNING OBJECTIVES

After studying this chapter, you will be able to:

- **3-1** Describe the role of related literature in quantitative research, and identify the main functions of a literature review in quantitative research.
- **3-2** Describe the role of related literature in qualitative and mixed methods research.
- **3-3** Describe and use resources to efficiently locate related literature.
- **3-4** Understand the key reasons for the importance of mastering online database searching.
- **3-5** Understand the criteria for judging the merit of information on the Internet.
- **3-6** Detail a systematic progression of steps in organizing the literature, and explain the purpose of each step.

If I have seen further it is by standing on the shoulders of giants.

Sir Isaac Newton (1642–1727)

The search for related literature plays a fundamental but different role in qualitative and quantitative research. It must be completed early in quantitative research but not in qualitative research.

Photo above by Marlene Somsak

3-1 The Role of Related Literature in Quantitative Research

related literature Literature (studies, theories) connected to the topic under investigation.

Quantitative researchers are urged not to rush headlong into conducting their study. The search for **related literature** should be completed before the study commences to provide a context and background that supports the conduct of the study. This literature review stage serves several important functions:

1. *Knowledge of related research enables investigators to define the frontiers of their field.* To use an analogy, an explorer might say, "We know that beyond this river there are plains for 2,000 miles west, and beyond those plains a range of mountains, but we do not know what lies beyond the mountains. I propose to cross the plains, go over the mountains, and proceed from there in a westerly direction." Likewise, the researcher in a sense says, "The work of A, B, and C has discovered this much about my question; the investigations of D have added this much to our knowledge. I propose to go beyond D's work in the following manner."
2. *A thorough review of related theory and research enables researchers to place their questions in perspective*. You should determine whether your endeavors are likely to add to knowledge in a meaningful way. Knowledge in any given area consists of the accumulated outcomes of numerous studies that generations of researchers have conducted and of the theories designed to integrate this knowledge and explain the observed phenomena. You should review the literature to find links between your study and the accumulated knowledge in your field of interest. Studies with no link to the existing knowledge seldom make significant contributions to the field. Such studies tend to produce isolated bits of information that are of limited usefulness.
3. *Reviewing related literature helps researchers limit their research question and clarify and define the concepts of the study.* A research question may be too broad to be carried out or too vague to be put into concrete operation; for example, "What do parenting practices have to do with mental health?" A careful review of the literature can help researchers revise their initial questions so that the final questions can be investigated. The literature review also helps to clarify the constructs involved in the study and translate these constructs into operational definitions. Many educational and behavioral constructs—such as stress, creativity, frustration, aggression, achievement, motivation, and adjustment—need to be clarified and operationally defined. These, as well as many other educational and behavioral constructs, do not lend themselves to research until they can be quantified. In reviewing literature, you become familiar with previous efforts to clarify and operationally define these constructs. Successful reviews often result in the formation of hypotheses regarding the relationships among variables in a study. The hypotheses can provide direction and focus for the study.
4. *Through studying related research, investigators learn which methodologies have proven useful and which seem less promising*. The investigator develops increasing sophistication after digging through the layers of research that the related literature represents. As you delve into your topic, you soon see that the quality of research varies greatly. Eventually, you should notice that not all studies in any one field are necessarily equal. You will soon be critiquing studies and noticing ways of improving them. For example, early studies in any one particular field may seem crude and ineffective because research methodology and design are constantly refined with each new study. Even so, many research projects fail because they use inappropriate procedures, instruments, research designs, or statistical analyses. Becoming proficient at evaluating research to determine its worth helps the investigator discover the most useful research path.