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## THE NATURE OF RESEARCH AND SCIENCE

There are two major approaches to research in the behavioral and social sciences—qualitative and quantitative. **Qualitative research** focuses on in-depth understanding of social and human behavior and the reasons behind such behavior. The qualitative method depends on the reported experiences of individuals through ethnographic analyses, fieldwork, and case studies. **Quantitative research** is scientific investigation that includes both experiments and other systematic methods that emphasize control and quantified measures of performance (Proctor & Capaldi, 2006). Measurement and statistics are central to quantitative research because they are the connections between **empirical** observation and mathematical expressions of relations. Qualitative researchers are interested in understanding, exploring new ideas, and discovering patterns of behavior. Quantitative researchers are concerned with the development and testing of **hypotheses** and the generation of models and theories that explain behavior. The two approaches are complementary, but this book is primarily about quantitative research.

### WAYS OF KNOWING

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The philosopher Charles Peirce has proposed four basic ways of knowing—(1) the method of tenacity, (2) the method of authority, (3) the method of intuition, and (4) the method of science (Buchler, 1955). Let's take a look at each.

The **method of tenacity** refers to the fact that people hold to certain beliefs because they have always known these beliefs to be true. Habit is strong. Once people believe in something, they look for evidence to confirm that belief and ignore disconfirming instances. They repeat beliefs over and over and in the process convince themselves of the correctness of their perspective. Even in the face of clear facts to the contrary, they hold tenaciously to their beliefs and build new knowledge from **assumptions** that are often false.

The **method of authority** is anchored in the statements of experts and is the second way of knowing. If an idea has public support, it must be true. Individuals turn to those in authority positions for truth; they turn to the church, their leaders, their superiors, and experts. Peirce suggests that the method of authority is superior to the method of tenacity because human progress can be made, albeit slowly, by using this method. Authority seems to be a necessary condition for social life. Groups bestow legitimate power to those in authority positions; that is, the group legitimizes the belief that those in authority have not only the right, but also the obligation to guide others. The method of authority is not necessarily unsound, but it is clearly not always sound (Kerlinger, 1986).

The **method of intuition** is built on assumptions that are obvious; such propositions are accepted as self-evident. They may agree with reason, but not necessarily with experience. The idea seems to be that individuals can discover the truth by using reason and logic because there is a natural inclination toward truth. But, as Fred Kerlinger (1986) points out, “Whose reason?” Suppose two sincere people use reason, but come to opposite conclusions. Who is right? Is it a matter of taste? Is something that is evident to many people correct? Not always. We now know the world is round, not flat, even though the flat world was self-evident to people for centuries. The test of the method of intuition is that the issue in question is “self-evident” and just “stands to reason.” Unfortunately, many self-evident propositions are simply not true.

The method of science, or **reflective inquiry**, is the fourth way of knowing or fixing belief. To Peirce and to scientists in general, it is the most **reliable** way of knowing. Peirce argues that the method of science provides a means to fix beliefs in such a way that the “ultimate conclusion of every man must be the same. . . . There are real things, whose characters are entirely independent of opinions about them” (Buchler, 1955, p. 18; see also Boghossian, 2006). The **scientific approach** has two unique characteristics absent in the other methods of knowing. **Science** is self-critical and self-correcting. These safeguards are so conceived to control and verify the procedures and experiments and produce dependable outcomes. Even if a hypothesis is supported, the researcher is skeptical and seeks rival hypotheses in an attempt to find counter examples and refine the findings.

When using the scientific approach, no explanation is final, because a better one may be devised at any time; science is open. Nothing is irrevocably proved; in fact, those with a scientific temper stay clear of the term *proved* when talking about findings in educational or psychological research; instead, they are content with the statement “At this time, the weight of the evidence supports this conclusion.” The norms of science are oriented toward openness, transparency, and public inspection.

Peirce argues that safeguards and built-in checks of the scientific approach are outside the scientist's personal attitudes, values, perceptions, and emotions; that is, the procedures of science are outside the scientists themselves. We agree with Kerlinger (1986) that such an impersonal, disinterested, and external perspective is best captured in one word—**objectivity**. The ideal of objectivity coupled with rigorous and controlled empirical tests leads to dependable knowledge and promotes confidence in the outcomes.

## OBJECTIVITY

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Before proceeding, we return to the notion of objectivity because it is so important to science and a scientific approach. Although it may not be possible to attain complete objectivity, it is the aim of the scientist; it is the ideal to which researchers and scientists are committed. Objectivity is *impartial judgment that rests outside an individual's personal preferences, biases, and wishes* (Peirce as cited in Buchler, 1955). Admittedly, attaining this is no easy task, yet it is the goal to which scientists adhere—to find a method of fixing beliefs that is independent of our desires and wills, that is outside or apart from ourselves, as Peirce would say. Scientists try to design their experiments such that they are apart from themselves, their influence, their predilections, and their biases. They objectify their ideas, that is, make them **objects** that have a separate existence from the researcher and can be tested in an independent fashion.

Although it is true that all knowledge is affected and at times distorted by the prejudices and predispositions of observers, the goal is to find a method of knowing that stands the test of independence from the researcher—in other words, one that is objective. Kerlinger (1979) defines objectivity as *agreement among knowledgeable judges of what is observed and what is done* and asserts that the main condition of objectivity “is ideally, that *any* observers with minimum competence will agree on their observations” (p. 9). In education and educational administration, we use objective measures of our **concepts**. They are called objective because with clear instructions, individuals score the measures and get the same results (within small margins of error).

A second and wider notion of objectivity in educational research is the attempt by researchers to make their designs and procedures so clear and exact that others can replicate their studies to get the same or similar findings (Kerlinger, 1979). When educational researchers carry out their studies, they aim for objectivity by making their procedures, measures, and controls clear, explicit, and replicable. Replication is an indispensable feature of a scientific approach that is objective. Make no mistake, it is easier to be objective in the physical sciences than in the social sciences because

the physical is more amenable to objectification than the social. Furthermore, in education **variables**, such as leadership, creativity, school effectiveness, school climate, empowerment, and trust are more complex, more problematical, and harder to isolate from other variables. The bottom line is that objectivity in the social sciences is more difficult; hence, educational research is less objective than in the physical sciences. Although objectivity is more difficult to achieve in education, it is certainly not impossible, and it is the goal. Moreover, the principle, the approach, and the general methods of objectivity are the same whether the objects of study are physical, individual, or social.

Finally, *objectivity* as it is used here is *not a characteristic* of individual researchers; rather, it is a description of a procedure (Kerlinger, 1979). Although some people may be more objective than others, *objectivity* as it is used here and in science refers to the approach and method of science and not to the individual scientists themselves. In sum, objectivity is a goal of all science; it is a disinterested, impartial, and external perspective and a set of procedures that enables observers with minimum competence to agree on their observations. Objective procedures are clear, accurate, consistent, replicable, and reliable.

## THE NATURE OF SCIENCE

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The purpose of all science is to understand the world in which we live and work. Scientists describe what they see, discover regularities, and formulate theories (Babbie, 1990). **Organizational science**, for example, attempts to describe and explain regularities in the behavior of individuals and groups within organizations. Organizational scientists seek basic principles that provide a general understanding of the structure and dynamics of organizational life, a relatively recent goal in educational administration (Roberts, Hulin, & Rousseau, 1978).

Some researchers view science as a static, interconnected set of principles that explains the universe in which we live, but most would agree that science is not inert. **Science** is a *dynamic process of experimentation and observation that produces an interconnected set of principles, which in turn generates further experimentation, and observation, and refinement* (Conant, 1951). In this view, the basic aim of science is to find general explanations, called “theories.” Scientific theories are created by thoughtful individuals trying to understand and explain how things work. Good theories are explanations that are heuristic; they predict novel observations (Wright, 2013). No **theory** (explanation), however, is ever taken as final because a better one may be devised at any time as new data become available.

## The Empirical Nature of Science

At the heart of our working definition of science is experimentation and observation. These are critical tools of science, and they are linked to an empirical approach.

*Empirical* refers to evidence based on observations, especially evidence obtained by systematic and controlled **scientific research** (Kerlinger, 1979). In other words, the empirical evidence in science is based on experimentation and careful observations, which are methodical, measured, and controlled. Science is an empirical approach to knowledge; scientific knowledge is based on systematic and controlled studies of hypothetical explanations.

Carefully obtained empirical evidence provides a check on unbridled assertions about the world, assertions that may or may not be true (Kerlinger, 1986). The frequent comment “That is an empirical question” refers to the need for an empirical test of the assertion. Where is the empirical evidence that supports the conclusion? Researchers and scientists are much more confident when their conclusions are based on empirical evidence rather than tradition, intuition, authority, or religious or political beliefs. In brief, at the heart of science is empirical evidence.

## Scientific Tools

Researchers use statistics as a tool to test their observations and findings. **Inferential statistics** provide a mathematical way to see if the results are likely a function of chance. Did these results of this experiment occur by chance, or is some systematic influence producing the outcomes? That is the question that inferential statistics answer. Scientists use statistics and probability to reject the chance model and support their theoretical explanation.

**Deduction** is a logical method of deriving specific predictions and hypotheses from a general set of assumptions, that is, moving from general premises to specific predictions and conclusions. Consider the assumption that *a threat to one's status leads individuals to respond in ways that enable them to gain control over the threat*. Apply this premise to teachers. Not surprisingly, teachers want to minimize student threat to their status as teacher and maintain control over students. Teachers typically dress in more formal attire than their students; they usually insist on the use of formal address by students (e.g., Mr. Smith); they correct students for not behaving; they give verbal reprimands to students for not following their directives; and they send unruly students to the principal's office for discipline. The premise and supporting evidence suggest the following hypothesis: *The more threatened a teacher's status by students, the more likely the teacher responds with an autocratic approach to control* (Hoy, 2001). Deduction does not go beyond its basic premise; it simply conserves the premise.

**Induction** is another logical method used by scientists and researchers. Here, the researcher moves from a series of observations in a variety of situations to a **generalization** that captures the basic tendencies in the observations. In other words, a generalization is developed from a set of specific instances. Of course, induction does not prove anything, but it leads to generalizations that can be tested.

Both deduction and induction are useful scientific tools. Yet, there is a third logical process that is not as widely known, but that also has scientific utility. **Abduction** is the process of studying a number of phenomena, observing their pattern, and formulating a causal hypothesis (Peirce, 1940). Proctor and Capaldi (2006) explain that abduction is neither induction nor deduction. It is not induction because there may only be a few examples and the generalization is not about their shared **properties**, but rather about their cause. Deduction is not involved because the generalization is not derived from the phenomena it applies to, but is rather an explanation of them.

The point here is that scientists use many methods to develop and test their explanations. Statistics, deduction, induction, and abduction are useful tools, yet none of them alone is sufficient. These methods must be harnessed to a scientific approach that is grounded in empirical evidence developed from careful, systematic, and controlled research. One final observation—science has two faces: (1) the creative formulation of ideas and explanation (developing hypotheses), and (2) the rigorous, systematic testing of ideas and explanations (testing hypotheses).

## **THE SCIENTIFIC APPROACH**

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The scientific approach is a process of reflective inquiry, which is described in general form in John Dewey's (1933) classic analysis *How We Think*. The approach has four basic steps:

1. The identification and definition of a problem (Problem)
2. The formulation of a hypothesis to solve the problem (Hypothesis)
3. The logical analysis of the implications of the hypothesis (Reasoning)
4. Testing to corroborate or reject the hypothesis (Testing)

Whether the objective is problem solving, decision making, or scientific research, the reflective process is the same. Of course, its application is more or less rigorous, depending on the situation. For example, in real-life decision making the reflection

is often truncated because of the constraints of time and resources, whereas in **experimental research** we see a rigorous application of the approach. Let's turn to each step in the reflective process to get a better sense of the scientific approach (see "Elements of a Proposal," Appendix A).

## **Problem**

A problem, obstacle, or new idea triggers the reflective process of inquiry (see "Elements of a Proposal," Appendix A). This stage of the approach is often filled with struggle and angst; the individual grapples with a difficulty, which may be vague and sketchy at best, as an attempt is made to understand the issues and complexities at hand. Just what is the problem? How can one express it? What are its dimensions? How complex is it? How does one conceptualize the difficulties? The challenge is to wrap your mind around the problem as you begin to analyze and specify it. This may be the most important step in the process because framing the problem has a great deal to do with the paths to a solution. A scientist usually needs a reasonable formulation of a problem before proceeding. To a researcher, a **research problem** is a question, which is carefully stated and guides the research. Of course, reframing or refining the initial problem is likely as more information and data become available. Remember, science is a dynamic process, not a static one; ideas beget other ideas; more data create new questions.

## **Hypothesis**

After conceptualizing the problem, the scientist proposes provisional answers to the question. In the process of generating answers, scientists draw on their knowledge, experience, observations, and imagination to formulate tentative responses to the issues. A possible solution to the puzzle is their hypothesis—a conjectural statement that indicates the relation between key ideas in their formulation of an answer. Often the hypothesis takes the form of "If  $x$ , then  $y$ ; that is, if such and such occurs, then the consequences will be so and so." The development of hypotheses is a creative journey based on experience, observations, reflection, or some implicit or explicit theory (plausible explanation). The formulation of hypotheses is the creative side of the scientific approach. The inventive researcher proposes novel explanations and insightful hypotheses.

## **Reasoning**

At this stage of the process, the scientist deduces the consequences of the hypotheses. What are the outcomes and implications if this hypothesis is true? At an informal level, the process demonstrates how ongoing experience leads to re-approximations of

answers through inquiry. The process of deduction often leads to a reformulation of the problem and hypotheses because things don't work out for one reason or another. For example, the scientist may have overlooked an important element or miscalculated or simply finds it impossible to test the relation. At this stage, the reasoning is deductive, trying to anticipate the consequences of a given generalization (hypothesis). Dewey focused on the deductive aspect of the reasoning, but once the deduction leads to other difficulties, individuals may draw on other reasoning tools—induction and abduction. For example, looking for regularities in data and formulating possible causes of those patterns may provide insight and allow for reframing of the problem, and the generation of new hypotheses. Likewise, the reasoning may lead to the development of rival hypotheses (see “A Few Writing Tips,” Appendix B).

Logical reasoning may also change the question. For instance, in the analysis we may realize that the initial formulation was only a specific instance of a much broader problem. Does programmed instruction improve student achievement in mathematics? This formulation of the problem is probably too narrow because it neglects the *why* question. Why would programmed instruction be effective? We can generalize the problem to the broader and more inclusive form: Does immediate reinforcement lead to more effective learning? Note that the latter question subsumes the former and begins to deal with the causal question. The point is that reasoning can reaffirm the utility of a hypothesis, or it can refine the hypothesis and deal with a more important problem, one that promotes a deeper understanding of the issue. The reasoning process is usually anchored in one's experience or flows from some theoretical explanation.

## Testing

The next phase of the process involves making observations, testing, and experimenting; this is the systematic, controlled side of science. Once the problem has been clearly stated, the hypotheses formulated, and the consequences of the hypotheses carefully examined, then the next step is to test the hypotheses. This testing phase involves making observations and devising an experiment or a plan for testing. The plan is an empirical test of the relation expressed in the hypothesis. An important aspect of the testing process is control: We want to control the influence of as many other variables as we can that may affect our relation (hypothesis) so that after the test we have confidence that the relation in question is a viable one. Control in the testing enhances confidence in the outcomes. On the basis of the empirical evidence, the hypothesis is either supported or rejected. The evidence is considered in light of the original problem, and the question is answered, changed, or refined based on the evidence.

Dewey emphasized that the scientific process is not fixed. Depending on the problem and data, the researcher may jump around a bit and use the steps in an order different



from the one we just outlined. After the hypothesis is constructed, for instance, the researcher may go back to the problem and revise or reframe it, or as the data are gathered, new ideas and issues may arise, calling for change. The reflective process is neither a neat, simple straight line nor a locked-step procedure; the scientist or researcher often moves spontaneously in a number of directions, jumping forward, skipping steps, then retreating, and then beginning again. Kerlinger (1986) captures the chief feature of the scientific process when he concludes that research may be orderly or disorderly. It does not matter, but what does matter is the controlled rationality of the scientific approach as a progression of reflective inquiry, the interdependence of the parts of the method, and the principal importance of the problem and its statement.

## **THEORY: A SCIENTIFIC CONCEPT**

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*Theory* is one of those words that makes many people uncomfortable, largely because of their misconceptions of the term. Much of the skepticism about theory is based on the assumption that education in general, and educational administration in particular, is art, not science, a skepticism that has plagued all social sciences. Theory in the natural sciences, on the other hand, has attained respectability not only because it necessarily involves precise description, but also because it describes ideal phenomena that “work” in practical applications.

Most people think that scientists deal with facts, whereas philosophers delve into theory. Indeed, to many individuals, including educators and educational administrators, *facts* and *theories* are antonyms; that is, facts are real and their meanings self-evident, whereas theories are speculations or dreams. Theory in education, however, has the same role as theory in physics, chemistry, biology, or psychology—that is, providing general explanations and guiding research.

### **Theory Defined**

As the ultimate aim of science, *theory* has acquired a variety of definitions. Some early agreement, for example, emerged in the field of educational administration that the definition of theory produced by Herbert Feigl (1951) was an adequate starting point. Feigl defined *theory* as a set of assumptions from which a larger set of empirical laws can be derived by purely logico-mathematical procedures. Although there was much initial support for this definition, Donald Willower (1975) cautioned that Feigl’s definition was so rigorous as to exclude most theory in education and educational administration. A more general and useful definition for the social sciences was provided by Kerlinger (1986): “A theory is a set of interrelated **constructs** (concepts), definitions, and propositions that present a systematic view of phenomena by specifying relations among variables, with the

purpose of explaining and predicting phenomena” (p. 9). Willower’s (1975) definition is more parsimonious: He defined theory simply as a body of interrelated, consistent generalizations that explain phenomena.

In the study of education, the following definition of theory is useful: Theory *is a set of interrelated concepts, definitions, assumptions, and generalizations that systematically describes and explains regularities in behavior in educational organizations*. Moreover, hypotheses are derived from the theory to predict additional relations among the concepts. When the hypotheses receive overwhelming empirical support, the accepted hypotheses become principles (Hoy & Miskel, 2013). This definition suggests three things:

1. First, theory is logically composed of concepts, definitions, assumptions, and generalizations.
2. Second, the major function of theory is to describe and explain—in fact, theory is a general explanation, which often leads to basic principles.
3. Third, theory is heuristic because it stimulates and guides the further development of knowledge.

Theories are by nature general and abstract; they are not strictly true or false, but rather they are either useful or not useful. They are useful to the extent that they generate explanations that help us understand more easily. Albert Einstein, one of the greatest theorists of all times, and Leopold Infeld (Einstein & Infeld, 1966) capture the essence of theorizing in the following:

In our endeavor to understand reality we are somewhat like a man trying to understand the mechanism of a closed watch. He sees the face and the moving hands, even hears its ticking, but he has no way of opening the case. If he is ingenious he may form some picture of a mechanism, which could be responsible for all the things he observes, but he may never be quite sure his picture is the only one which could explain his observations. He will never be able to compare his picture with the real mechanism, and he cannot even imagine the possibility of the meaning of such a comparison. (p. 31)

In sum, theory is a special language that explains and helps us understand some phenomenon, for example, learning, motivation, or administration (Tosi, 2009). Just as with any language, theory has its vocabulary (concepts) and grammar (generalizations). Concepts are abstract words that are given specific definitions, which enable us to agree on the meaning of the terms. Words alone, however, are

not sufficient to explain something. We need to know not only the meaning of the words, but also why and how they relate to each other. In other words, we need to combine our concepts into coherent generalizations that indicate the relation between two or more concepts. For example, “division of labor produces specialization,” and “specialization creates expertise.” Note that these two theoretical generalizations each indicate the relation between two concepts, and together they yield an explanation of how expertise can be developed in organizations. In brief, theories provide explanations; they provide a coherent and connected story about why acts, events, and behavior occur (Higgins, 2004; McKinley, 2010).

## Meaning of Reality

Reality exists, but our knowledge of it always remains elusive and uncertain. It should not be surprising that different individuals often draw different conclusions from the same perceptual experiences because they hold different theories that affect their interpretation of events (Carey & Smith, 1993). Our knowledge consists of our theories, but the form of the theory is less important than the degree to which it generates useful understanding; theory is judged by its utility.

The use of theory in organizational analysis seems indispensable to reflective practice. The beginning student of education may ask, “Do these theories and models really exist?” Our position is the same as Mintzberg’s (1989). The models, theories, and configurations used to describe organizations in this book are mere words and pictures on pages, not reality itself. Actual organizations are much more complex than any of these representations: In fact, our conceptual frameworks are simplifications of organizations that underscore some features and neglect others. Hence, they distort reality. The problem is that in many areas we cannot get by without theoretical guidance (implicit, if not explicit, theories), much as a traveler cannot effectively navigate unknown territory without a map.

Our choice is not usually between reality and theory, but rather between alternative theories. Mintzberg (1989) captures the dilemma nicely:

No one carries reality around in his or her head, no head is that big. Instead we carry around impressions of reality, which amount to implicit theories. Sometimes these are supplemented with explicit frameworks for identifying the concepts and interrelating them—in other words, with formal theories, built on systematic investigation known as research, or at least on systematic consideration of experience. In fact, some phenomena cannot be comprehended without such formal aid—how is one to develop an implicit theory of nuclear fission, for example? (p. 259)

In sum, we all use theories to guide our actions. Some are implicit, and others are explicit; in fact, many of our personal implicit theories are formal ones that have been internalized. To paraphrase John Maynard Keynes (1936), educators who believe themselves to be exempt from any theoretical influences are usually slaves of some defunct theory. Good theories and models exist; they exist where all useful knowledge must survive—in our minds.

## COMPONENTS OF THEORY

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The nature of theory can be better understood by looking at the meanings of each of the components of theory and how they are related to one another.

### Concepts and Constructs

The terms *concept* and *construct* are often used interchangeably. Sociologists are more apt to use *concept*, whereas psychologists typically favor the word *construct*. Both refer to *a term that has been given an abstract, generalized meaning*. A few examples of concepts in sociology are status, social system, stratification, social structure, and culture. Some constructs from psychology are motivation, ego, hostility, personality, and intelligence. In administration, our concepts or constructs include centralization, formalization, leadership, morale, and informal organization. Social scientists invent concepts to help them study and systematically analyze phenomena. In other words, they invent a language to describe behavior. There are at least two important advantages of defining theoretical concepts—first, theorists, researchers, and practitioners can agree on their meaning, and second, their abstractness enhances the development of generalizations.

Although concepts are by definition abstract, there are different levels of abstraction. Examples of terms arranged along a concrete to abstract continuum are *Jefferson Elementary School*, *school*, *service organization*, *organization*, *social system*, and *system*. Each succeeding term is more general and abstract. Generally speaking, terms that are specific to a particular time or place are concrete and less useful in developing theories. The most useful concepts, generalizations, and theories in the social sciences are in the “middle range”; that is, they are somewhat limited in scope rather than all-embracing. For example, organizational theories are not attempts to summarize all we know about organizations; rather, they explain some of the consistencies found in organizations; in our case, schools are of particular interest.

A concept or construct can be defined in at least two ways. First, it may be defined in terms of other words or concepts. For instance, we might define *permissiveness*

as the degree to which a teacher employs a relaxed mode of pupil control; that is, *permissiveness* is defined in terms of *relaxedness*, another term that we believe brings more clarity to the concept. Although this kind of definition often provides one with a better understanding of the term, it is inadequate from a scientific point of view. The researcher must be able to define the concept in measurable terms. *A set of operations or behaviors that has been used to measure a concept is its operational definition.* For example, an operational definition of permissiveness might be the number of hall passes a teacher issues per day. This definition is limited, clear, and concise. Permissiveness is the specific set of operations measured. The intelligence quotient (IQ) is the standard operational definition of intelligence, and leadership can be measured and operationalized using Bass's Multi-factor Leadership Questionnaire (1998). Operationalism mandates that the procedures involved in the relation between the observer and the measures for observing be explicitly stated so that they can be duplicated by any other equally trained researcher (Dubin, 1969). Remember that objectivity is a pivotal part of science and research.

## Assumptions and Generalizations

An assumption is a statement that is taken for granted or accepted as true. Assumptions accepted without proof are often, but not necessarily, self-evident. For example, consider the following assumptions:

1. There is no one best way to teach.
2. All ways of teaching are not equally effective.

The first assumption challenges the conventional idea that there are universal principles for effective teaching regardless of time or place. The second assumption challenges the notion that the complexity of teaching makes it futile to seek guiding principles. Now consider a third assumption:

3. The best way to teach depends on the nature of the teaching task.

The third assumption posits that effective teaching is conditional; it depends on the nature of the teaching task. All these assumptions have been accepted as reasonable by various groups of people; in fact, there is evidence that all three assumptions might lead to an explanation of effective teaching.

A generalization is a statement or proposition that indicates the relation of two or more concepts or constructs. In other words, a generalization links concepts in a meaningful fashion. Many kinds of generalizations are found in theoretical formulations:

- *Assumptions* are generalizations if they specify the relationship among two or more concepts.
- *Hypotheses* are generalizations with limited empirical support.
- *Principles* are generalizations with substantial empirical support.
- *Laws* are generalizations with an overwhelming degree of empirical support (more than principles); there are few laws in the social sciences, but consider the law of supply and demand in economics.

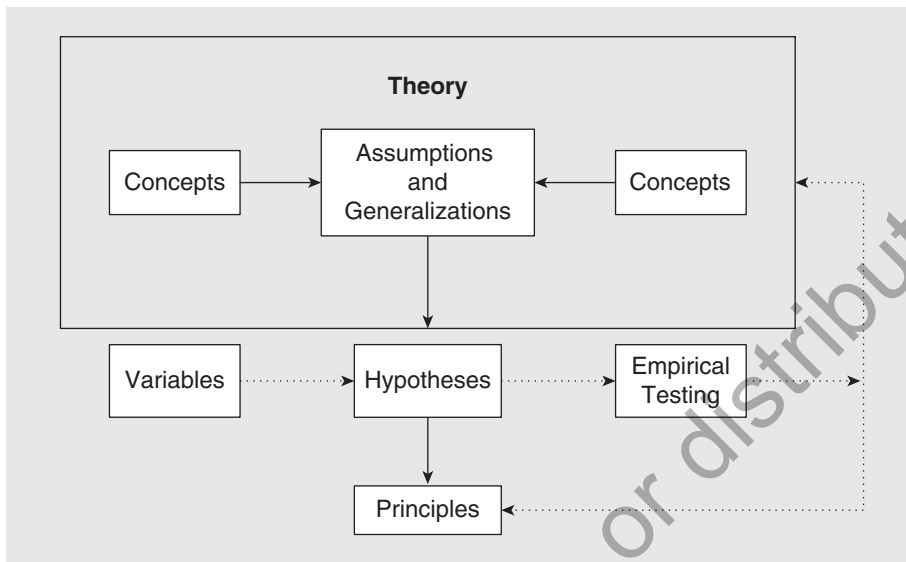
The basic form of knowledge in all disciplines is similar; it consists of concepts or constructs, generalizations, and theories, each dependent on the one preceding it. Figure 1.1 summarizes the basic components of theory that are necessary for the development of knowledge. The figure shows that concepts are eventually linked together into generalizations that in turn form a logically consistent set of propositions providing a general explanation of a phenomenon (a theory). The theory is then empirically checked by the development and testing of hypotheses deduced from the theory. The results of the research then provide the data for accepting, rejecting, reformulating, or refining and clarifying the basic generalizations of the theory. Over time, with continued empirical support and evidence, the generalizations develop into principles that explain the phenomenon. In the case of organizational theory, principles are developed to explain the structure and dynamics of organizations and the role of the individual in organizations. Theory is both the beginning and the end of scientific research. It serves as the basis for generating hypotheses to test propositions that explain observable empirical phenomena, but in the end it also provides the general explanations and knowledge of a field.

## **THE NATURE OF SCIENTIFIC RESEARCH**

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Research is inextricably related to theory; therefore, many of the misconceptions and ambiguities surrounding theory are reflected in the interpretation of the meaning and purpose of research. Some individuals use the term *research* loosely—for example, going to the library to review some literature and draw some conclusion. We use the term in a more rigorous scientific fashion, one that is consistent with a scientific approach. Research is systematic, empirical investigation to test theory and gain a general understanding of some phenomenon. Kerlinger (1986) provides us with a more formal definition: “Scientific research is systematic, controlled, empirical, and critical investigation of hypothetical propositions about the presumed relations among natural phenomena” (p. 10).

**Figure 1.1 Theory: Its Components and Testing**



Source: [www.waynekhoy.com/pdfs/Theory-Research.pdf](http://www.waynekhoy.com/pdfs/Theory-Research.pdf). © Hoy, 2007

This definition suggests that scientific research is guided by hypotheses, which are empirically checked against observations about reality in a systematic and controlled way. The observations are systematic and controlled to prevent spurious conclusions. Many school variables (e.g., leadership, school climate, teaching style) are positively correlated with student achievement, but once the socioeconomic level of the school is considered, the positive relationship disappears; thus, variables like socioeconomic level must be controlled in such studies of school achievement. Furthermore, evidence to test hypotheses is based on objective and empirical data subjected to disciplined inquiry. Finally, the results of such tests are then open to public scrutiny and critical analyses by other scientists and researchers.

Good research in education is theoretical, empirical, controlled, and replicable. Haphazard observations followed by the conclusion that the facts speak for themselves do not qualify as scientific research; in fact, such unrefined empiricism can distort reality and does not lead to the systematic development of knowledge (Hoy & Miskel, 2008). Well-conceived surveys and ethnographic studies for the express purpose of developing hypotheses are at times useful starting points in terms of hypothesis and theory generation; ultimately, however, knowledge in any discipline is expanded by research that is guided by hypotheses that are derived from theory. In brief, findings from research are not as important as the general patterns and explanations that they provide.

## TYPES OF QUANTITATIVE RESEARCH

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There are different types of research; for example, we have already distinguished between quantitative and qualitative research. We turn to some of the common distinctions of quantitative research that are found in the literature.

### Experimental and Nonexperimental (or Ex Post Facto) Research

One useful distinction for our purposes is to differentiate between experimental and nonexperimental (or ex post facto) research. Many people think that all quantitative research is experimental. Not true! In fact, most research in education, and in the behavioral and social sciences for that matter, is **nonexperimental research**. Experimental research is the ideal because there is more control over the factors that might confound the findings. But, experimental research is difficult to conduct in educational settings because parents don't want their children involved in experiments; furthermore, this research requires more control over things than most educators have at their disposal. Experimental research is more easily conducted in a laboratory rather than in a social setting.

To conduct an experiment, the researcher has to be able to manipulate one specific aspect of the situation called the **independent variable** (more about variables in Chapter 2). Ideally, a number of conditions must be met to have a good experiment:

- Subjects should be selected at random.
- Then the subjects should be assigned to groups at random.
- Next, the experimental and control groups should be selected at random.
- Finally, the researcher must manipulate the independent variable, that is, apply an intervention or treatment to the experimental groups and withhold treatment from the control group.

In sum, experimental research is systematic empirical inquiry where the researcher introduces changes, notes effects, and has full control over the design of the study.

In nonexperimental or **ex post facto research**, the situation cannot be manipulated because the change in the independent variable has already occurred. For example,



a study of school climate typically involves measuring the property in existing schools and not manipulating the climate to produce the wanted type. Nonexperimental research is *systematic empirical inquiry in which the researcher does not have direct control of the independent variable because the variable has already occurred* (Kerlinger, 1986). The basic difference between experimental and nonexperimental research can be summed up in one word—*control*.

## Theoretical and Practical Research

Some individuals like to distinguish between what they call practical and theoretical research. This distinction is not useful and is artificial because, in the end, sound theoretical research is practical research. More than a half century ago, the father of modern social psychology, Kurt Lewin (1952), captured the idea in this way, “There is nothing more practical than a good theory” (p. 152). Principles and generalizations that explain how things work are about as practical as it gets!

## Descriptive Research

Descriptive research is another phrase that is used to characterize inquiry in the social sciences. It is a term that I typically avoid because it has several connotations, one of which is not really research. Research always should involve examining relations between at least two variables. Yet, many “researchers” simply use statistics to describe the characteristics of various groups of individuals. For example, they ask what the proportions are of males and females in a given group of teachers, the average age and experience of the group, the number who have BA, MA, and PhD degrees, the percentage of teachers who drop out of teaching after one year, the average level of experience before teachers become principals, and on and on. The answers to such queries may be quite useful, but such compilations are not examples of descriptive research because they do not relate variables—a more appropriate term for the process is *social bookkeeping*, not *research*.

**Descriptive research** is the process of simply describing relations without speculating about the cause. The two variables go together; they are correlated. For example, weight and height are correlated, but gaining weight does not cause you to grow taller. Likewise, growing taller does not necessarily lead to growing heavier. Correlational studies give us interesting information about relations, but until we can begin to make causal inferences, their utility is limited. Careful description is important, but it is only the beginning of the study of causal relations.

## SUMMARY

This chapter provides an overview of the nature of research and science. The following propositions are key:

- This text is an analysis of quantitative research; our concern is with reflective inquiry, a scientific approach to understanding.
- Our perspective emphasizes objectivity, empirical data, and theory—a system of concepts, assumptions, and propositions that provide an explanation of the issue at hand.
- Science is a dynamic process of experimentation and observation that produces an interconnected set of principles that in turn generates further experimentation, observation, and refinement.
- Throughout this book, we focus on the critique and generation of hypotheses as well as their systematic, controlled, empirical, and critical investigation.
- Our philosophic stance is eclectic: realistic, pragmatic, and postpositive.
- Finally, our quest is for general patterns and reliable explanations that are supported by rigorous empirical research.

## CHECK YOUR UNDERSTANDING

1. Discuss the similarities and differences between “common sense” and “reflective inquiry.” In which do you have more confidence and why?
2. Describe an objective measure of organizational structure. What makes the measure objective? To what extent is subjectivity involved in your measure?
3. Discuss the differences among deduction, induction, and abduction.
4. Select a concept or construct in education (e.g., classroom climate, teaching style, school climate). Define your concept in two ways: theoretically (in words) and operationally (as a set of operations).
5. Identify a generalization from the research in education in which you have confidence. What are the concepts in this generalization? Can you define each concept? Can you think of a circumstance when the generalization might not hold?
6. Give a specific example of a hypothesis. How many concepts does the hypothesis contain and what are they? Can the concepts be measured?
7. Discuss the relationship of theory and explanation. What form does scientific explanation take?

## KEY TERMS

- Abduction (p. 6)
- Assumption (p. 1)
- Concept (p. 3)
- Construct (p. 9)
- Deduction (p. 5)
- Descriptive research (p. 17)
- Empirical (p. 1)
- Experimental research (p. 7)
- Ex post facto research (p. 16)
- Generalization (p. 6)
- Hypothesis (p. 1)
- Independent variable (p. 16)
- Induction (p. 6)
- Inferential statistics (p. 5)
- Method of authority (p. 1)
- Method of intuition (p. 1)
- Method of science (p. 1)
- Method of tenacity (p. 1)
- Nonexperimental research (p. 16)
- Objectivity (p. 3)
- Objects (p. 3)
- Operational definition (p. 13)
- Organizational science (p. 4)
- Properties (p. 6)
- Qualitative research (p. 1)
- Quantitative research (p. 1)
- Reflective inquiry (p. 2)
- Reliable (p. 2)
- Research problem (p. 7)
- Science (p. 2)
- Scientific approach (p. 2)
- Scientific research (p. 5)
- Theory (p. 4)
- Variable (p. 4)