

Chapter 1

The Nature and Tools of Research

In virtually every subject area, our collective knowledge about the world is incomplete: Certain questions remain unanswered, and certain problems remain unsolved. Systematic research provides many powerful tools—not only physical tools but also mental and social tools—that can help us discover possible answers and identify possible solutions.

Learning Outcomes

- 1.1 Distinguish between (a) common uses of the term *research* that reflect misconceptions about what research involves and (b) the true nature of research in academic settings.
- 1.2 Describe the cyclical, iterative nature of research, including the steps that a genuine research project involves.
- 1.3 Distinguish among positivism, postpositivism, constructivism, and pragmatism/realism as philosophical underpinnings of a research project.
- 1.4 Identify examples of how six general research tools can play significant roles in a research project: (a) the library and its resources, (b) computer technology, (c) measurement, (d) statistics, (e) language, and (f) the human mind.
- 1.5 Describe steps you might take to explore research in your field.

In everyday speech, the word *research* is often used loosely to refer to a variety of activities. In some situations the word connotes simply finding a piece of information or taking notes and then writing a so-called “research paper.” In other situations it refers to the act of informing oneself about what one does not know, perhaps by rummaging through available sources to locate a few tidbits of information. Such uses of the term can create considerable confusion for university students, who must learn to use it in a narrower, more precise sense.

Yet when used in its true sense—as a systematic process that leads to new knowledge and understandings—the word *research* can suggest a mystical activity that is somehow removed from everyday life. Many people imagine researchers to be aloof individuals who seclude themselves in laboratories, scholarly libraries, or the ivory towers of large universities. In fact, research is often a practical enterprise that—given appropriate tools—*any* rational, conscientious individual can conduct. In this chapter we lay out the nature of true research and describe the general tools that make it possible.

WHAT RESEARCH IS NOT

Following are three statements that describe what research is not. Accompanying each statement is an example that illustrates a common misconception about research.

1. *Research is not merely gathering information.* A sixth grader comes home from school and tells her parents, “The teacher sent us to the library today to do research, and I learned a lot

about black holes.” For this student, research means going to the library to find a few facts. This might be *information discovery*, or it might be learning *reference skills*. But it certainly is not, as the teacher labeled it, research.

2. *Research is not merely rummaging around for hard-to-locate information.* The house across the street is for sale. You consider buying it and call your realtor to find out how much someone else might pay you for your current home. “I’ll have to do some research to determine the fair market value of your property,” the realtor tells you. What the realtor calls doing “some research” means, of course, reviewing information about recent sales of properties comparable to yours; this information will help the realtor zero in on a reasonable asking price for your own home. Such an activity involves little more than searching through various files or websites to discover what the realtor previously did not know. Rummaging—whether through records in one’s own office, at a library, or on the Internet—is not research. It is more accurately called an *exercise in self-enlightenment*.

3. *Research is not merely transporting facts from one location to another.* A college student reads several articles about the mysterious Dark Lady in William Shakespeare’s sonnets and then writes a “research paper” describing various scholars’ suggestions of who the lady might have been. Although the student does, indeed, go through certain activities associated with formal research—such as collecting information, organizing it in a certain way for presentation to others, supporting statements with documentation, and referencing statements properly—these activities do not add up to true research. The student has missed the essence of research: the *interpretation* of data. Nowhere in the paper does the student say, in effect, “These facts I have gathered seem to indicate such-and-such about the Dark Lady.” Nowhere does the student interpret and draw conclusions from the facts. This student is approaching genuine research; however, the mere compilation of facts, presented with reference citations and arranged in a logical sequence—no matter how polished and appealing the format—misses genuine research by a hair. Such activity might more realistically be called *fact transcription, fact documentation, fact organization, or fact summarization*.

Going a little further, this student would have traveled from one world to another: from the world of mere transportation of facts to the world of interpretation of facts. The difference between the two worlds is the distinction between transference of information and genuine research—a distinction that is critical for novice researchers to understand.

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WHAT RESEARCH IS

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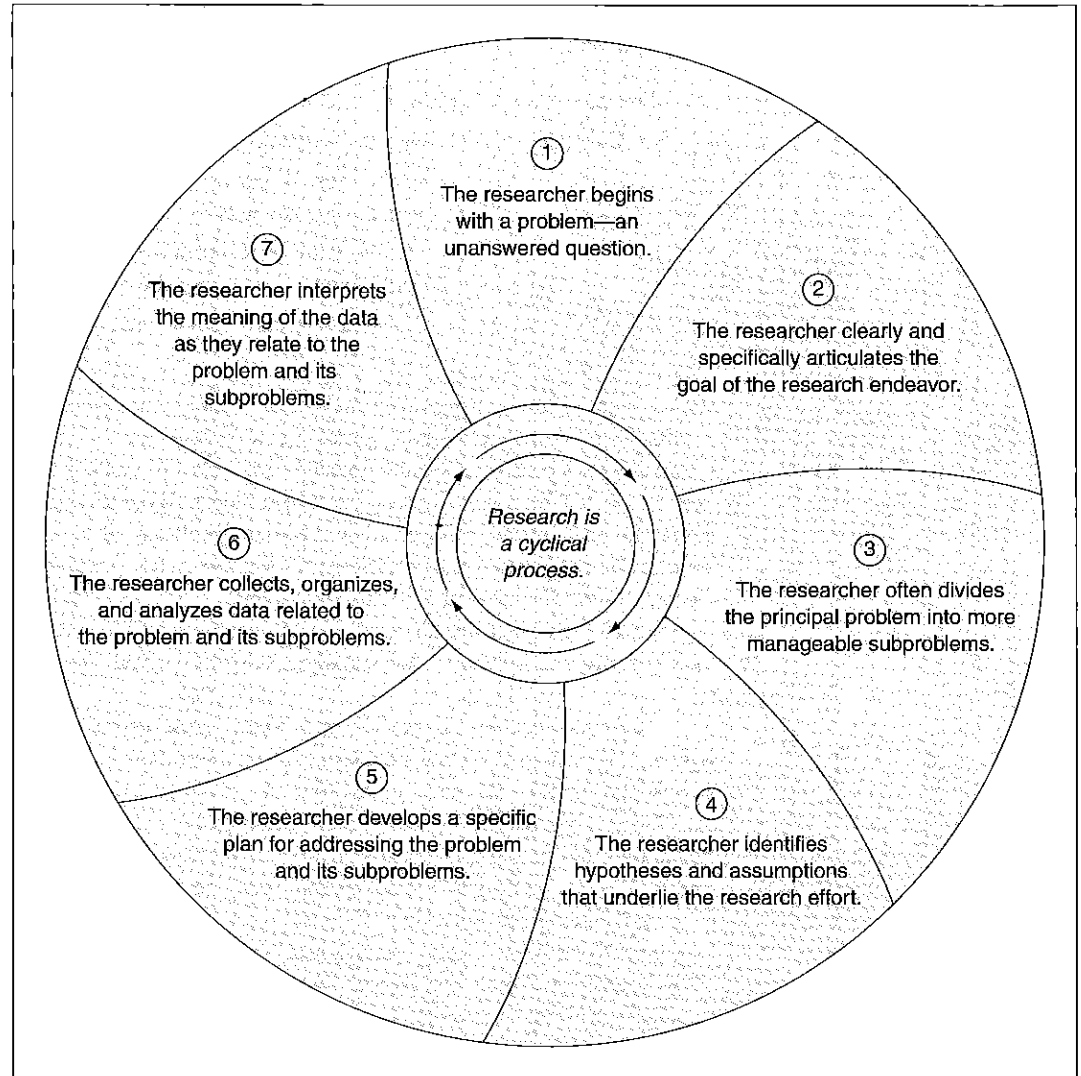
Research is a systematic process of collecting, analyzing, and interpreting information—*data*—in order to increase our understanding of a phenomenon about which we are interested or concerned.¹ People often use a systematic approach when they collect and interpret information to solve the small problems of daily living. Here, however, we focus on *formal research*, research in which we intentionally set out to enhance our understanding of a phenomenon and expect to communicate what we discover to the larger scientific community.

Although research projects vary in complexity and duration, in general research involves seven distinct steps, shown in Figure 1.1. We now look at each of these steps more closely.

1. *The researcher begins with a problem—an unanswered question.* Everywhere we look, we see things that cause us to wonder, to speculate, to ask questions. And by asking questions, we strike a spark that ignites a chain reaction leading to the research process.

¹Some people in academia use the term *research* more broadly to include deriving new equations or abstract principles from existing equations or principles through a sequence of mathematically logical and valid steps. Such an activity can be quite intellectually challenging, of course, and is often at the heart of doctoral dissertations and scholarly journal articles in mathematics, physics, and related disciplines. In this book, however, we use the term *research* more narrowly to refer to *empirical research*—research that involves the collection and analysis of new data.

FIGURE 1.1 ■
The Research Cycle



An inquisitive mind is the beginning impetus for research; as one popular tabloid puts it, “Inquiring minds want to know!”

Look around you. Consider unresolved situations that evoke these questions: What is such-and-such a situation like? Why does such-and-such a phenomenon occur? What does it all mean? With questions like these, research begins.

2. *The researcher clearly and specifically articulates the goal of the research endeavor.*

A clear, unambiguous statement of the problem one will address is critical. This statement is an exercise in intellectual honesty: The ultimate goal of the research must be set forth in a grammatically complete sentence that specifically and precisely answers the question, “What problem do you intend to solve?” When you describe your objective in clear, concrete terms, you have a good idea of what you need to accomplish and can direct your efforts accordingly.

3. *The researcher often divides the principal problem into more manageable subproblems.*

From a design standpoint, it is often helpful to break a main research problem into several subproblems that, when solved, can resolve the main problem.

Breaking down principal problems into small, easily solvable subproblems is a strategy we use in everyday living. For example, suppose you want to drive from your hometown to a town many miles or kilometers away. Your principal goal is to get from one location to the

other as expeditiously as possible. You soon realize, however, that the problem involves several subproblems:

- Main problem: How do I get from Town A to Town B?
- Subproblems:
1. What route appears to be the most direct one?
 2. Is the most direct one also the quickest one? If not, what route might take the least amount of time?
 3. Which is more important to me: minimizing my travel time or minimizing my energy consumption?
 4. At what critical junctions in my chosen route must I turn right or left?

What seems like a single question can be divided into several smaller questions that must be addressed before the principal question can be resolved.

So it is with most research problems. By closely inspecting the principal problem, the researcher often uncovers important subproblems. By addressing each of the subproblems, the researcher can more easily address the main problem. If a researcher doesn't take the time or trouble to isolate the lesser problems within the major problem, the overall research project can become cumbersome and difficult to manage.

Identifying and clearly articulating the problem and its subproblems are the essential starting points for formal research. Accordingly, we discuss these processes in depth in Chapter 2.

4. The researcher identifies hypotheses and assumptions that underlie the research effort. Having stated the problem and its attendant subproblems, the researcher sometimes forms one or more hypotheses about what he or she may discover. A hypothesis is a logical supposition, a reasonable guess, an educated conjecture. It provides a tentative explanation for a phenomenon under investigation. It may direct your thinking to possible sources of information that will aid in resolving one or more subproblems and, as a result, may also help you resolve the principal research problem.

Hypotheses are certainly not unique to research. In your everyday life, if something happens, you immediately try to account for its cause by making some reasonable conjectures. For example, imagine that you come home after dark, open your front door, and reach inside for the switch that turns on a nearby table lamp. Your fingers find the switch. You flip it. No light. At this point, you identify several hypotheses regarding the lamp's failure:

Hypothesis 1: A recent storm has disrupted your access to electrical power.

Hypothesis 2: The bulb has burned out.

Hypothesis 3: The lamp isn't securely plugged into the wall outlet.

Hypothesis 4: The wire from the lamp to the wall outlet is defective.

Hypothesis 5: You forgot to pay your electric bill.

Each of these hypotheses hints at a strategy for acquiring information that may resolve the nonfunctioning-lamp problem. For instance, to test Hypothesis 1, you might look outside to see whether your neighbors have lights, and to test Hypothesis 2, you might replace the current light bulb with a new one.

Hypotheses in a research project are as tentative as those for a nonfunctioning table lamp. For example, a biologist might speculate that certain human-made chemical compounds increase the frequency of birth defects in frogs. A psychologist might speculate that certain personality traits lead people to show predominantly liberal or conservative voting patterns. A marketing researcher might speculate that humor in a television commercial will capture viewers' attention and thereby will increase the odds that viewers buy the advertised product. Notice the word *speculate* in all of these examples. Good researchers always begin a project with open minds about what they may—or may *not*—discover in their data.

Hypotheses—predictions—are an essential ingredient in certain kinds of research, especially experimental research (see Chapter 7). To a lesser degree, they might guide other forms

of research as well, but they are intentionally *not* identified in the early stages of some kinds of qualitative research (e.g., see the discussion of grounded theory studies in Chapter 9).

Whereas a hypothesis involves a prediction that may or may not be supported by the data, an assumption is a condition that is taken for granted, without which the research project would be pointless. Careful researchers—certainly those conducting research in an academic environment—set forth a statement of their assumptions as the bedrock upon which their study rests. For example, imagine that your problem is to investigate whether students learn the unique grammatical structures of a language more quickly by studying only one foreign language at a time or by studying two foreign languages concurrently. What assumptions would underlie such a problem? At a minimum, you must assume that

- The teachers used in the study are competent to teach the language or languages in question and have mastered the grammatical structures of the language(s) they are teaching.
- The students taking part in the research are capable of mastering the unique grammatical structures of any language(s) they are studying.
- The languages selected for the study have sufficiently different grammatical structures that students might reasonably learn to distinguish between them.

Aside from such basic ideas as these, however, careful researchers state their assumptions, so that other people inspecting the research project can evaluate it in accordance with *their own* assumptions. For the beginning researcher, it is better to be overly explicit than to take too much for granted.

5. *The researcher develops a specific plan for addressing the problem and its subproblems.*

Research is not a blind excursion into the unknown, with the hope that the data necessary to address the research problem will magically emerge. It is, instead, a carefully planned itinerary of the route you intend to take in order to reach your final destination—your research goal. Consider the title of this text: *Practical Research: Planning and Design*. The last three words—*Planning and Design*—are especially important ones. Researchers plan their overall research design and specific research methods in a purposeful way so that they can acquire data relevant to their research problem and subproblems. Depending on the research question, different designs and methods are more or less appropriate.

In the formative stages of a research project, much can be decided: Are any existing data directly relevant to the research problem? If so, where are they, and are you likely to have access to them? If the needed data *don't* currently exist, how might you generate them? And later, after you have acquired the data you need, what will you do with them?² Such questions merely hint at the fact that planning and design cannot be postponed. Each of the questions just listed—and many more—must have an answer early in the research process. In Chapter 4, we discuss several general issues related to research planning. Then, beginning in Chapter 6, we describe strategies related to various research methodologies.

6. *The researcher collects, organizes, and analyzes data related to the problem and its subproblems.* After a researcher has isolated the problem, divided it into appropriate subproblems, identified hypotheses and assumptions, and chosen a suitable design and methodology, the next step is to collect whatever data might be relevant to the problem and to organize and analyze them in meaningful ways.

The data collected in research studies take one of two general forms. Quantitative research involves looking at amounts, or *quantities*, of one or more variables of interest. A quantitative researcher typically tries to measure variables in some numerical way, perhaps by using

²As should be apparent in the questions posed in this paragraph, we are using the word *data* as a plural noun; for instance, we ask “Where *are* the data?” rather than “Where *is* the data?” Contrary to popular usage of the term as a singular noun, *data* (which has its origins in Latin) refers to two or more pieces of information. A single piece of information is known as a *datum*, or sometimes as a *data point*.

commonly accepted measures of the physical world (e.g., rulers, thermometers, oscilloscopes) or carefully designed measures of psychological characteristics or behaviors (e.g., tests, questionnaires, rating scales).

In contrast, qualitative research involves looking at characteristics, or *qualities*, that cannot be entirely reduced to numerical values. A qualitative researcher typically aims to examine the many nuances and complexities of a particular phenomenon. You are most likely to see qualitative research in studies of complex human situations (e.g., people's in-depth perspectives about a particular issue, the behaviors and values of a particular cultural group) or complex human creations (e.g., television commercials, works of art). Qualitative research is not limited to research problems involving human beings, however. For instance, some biologists study, in a distinctly qualitative manner, the complex social behaviors of other animal species; Dian Fossey's work with gorillas and Jane Goodall's studies of chimpanzees are two well-known examples (e.g., see Fossey, 1983; Goodall, 1986).

The two kinds of data—quantitative and qualitative—often require distinctly different research methods and data analysis strategies. Accordingly, three of the book's subsequent chapters focus predominantly on quantitative techniques (see Chapters 6, 7, and 8) and three others focus largely on qualitative techniques (see Chapters 9, 10, and 11). Nevertheless, we urge you *not* to think of the quantitative–qualitative distinction as a mutually exclusive, *it-has-to-be-one-thing-or-the-other* dichotomy. Many researchers collect both quantitative and qualitative data in a single research project—an approach sometimes known as mixed-methods research (see Chapter 12). Good researchers tend to be *eclectic* researchers who draw from diverse methodologies and data sources in order to best address their research problems and questions (e.g., see Gorard, 2010; Onwuegbuzie & Leech, 2005).

7. The researcher interprets the meaning of the data as they relate to the problem and its subproblems. Quantitative and qualitative data are, in and of themselves, *only* data—nothing more. The significance of the data depends on how the researcher extracts *meaning* from them. In research, uninterpreted data are worthless: They can never help us answer the questions we have posed.

Yet researchers must recognize and come to terms with the subjective and dynamic nature of interpretation. Consider, for example, the many books written on the assassination of U.S. President John F. Kennedy. Different historians have studied the same events: One may interpret them one way, and another may arrive at a very different conclusion. Which one is right? Perhaps they both are; perhaps neither is. Both may have merely posed new problems for other historians to try to resolve. Different minds often find different meanings in the same set of facts.

Once we believed that clocks measured time and that yardsticks measured space. In one sense, they still do. We further assumed that time and space were two different entities. Then along came Einstein's theory of relativity, and time and space became locked into one concept: the time–space continuum. What's the difference between the old perspective and the new one? It's the way we think about, or interpret, the same information. The realities of time and space have not changed; the way we interpret them has.

Data demand interpretation. But no rule, formula, or algorithm can lead the researcher unerringly to a correct interpretation. Interpretation is inevitably a somewhat subjective process that depends on the researcher's hypotheses, assumptions, and logical reasoning processes.

Now think about how we began this chapter. We suggested that certain activities cannot accurately be called research. At this point you can understand why. None of those activities demands that the researcher draw any conclusions or make any interpretations of the data.

We must emphasize two important points related to the seven-step process just described. First, *the process is iterative*: A researcher sometimes needs to move back and forth between two or more steps along the way. For example, while developing a specific plan for a project (Step 5), a researcher might realize that a genuine resolution of the research problem requires addressing a subproblem not previously identified (Step 3). And while interpreting the collected data (Step 7), a researcher may decide that additional data are needed to fully resolve the problem (Step 6).

Second, *the process is cyclical*. The final step in the process depicted in Figure 1.1—interpretation of the data—is not *really* the final step at all. Only rarely is a research project a one-shot effort that completely resolves a problem. For instance, even with the best of data, hypotheses in a research project are rarely proved or disproved—and thus research questions are rarely answered—beyond a shadow of a doubt. Instead, hypotheses are either *supported* or *not supported* by the data. If the data are consistent with a particular hypothesis, the researcher can make a case that the hypothesis probably has some merit and should be taken seriously. In contrast, if the data run contrary to a hypothesis, the researcher *rejects* the hypothesis and turns to other hypotheses as being more likely explanations of the phenomenon in question. In either case, one or more additional, follow-up studies are called for.

Ultimately, then, most research studies don't bring total closure to a research problem. There is no obvious end point—no point at which a researcher can say "*Voilà!* I've completely answered the question about which I'm concerned." Instead, research typically involves a cycle—or more accurately, a *helix* (spiral)—in which one study spawns additional, follow-up studies. In exploring a topic, one comes across additional problems that need resolving, and so the process must begin anew. Research begets more research.

To view research in this way is to invest it with a dynamic quality that is its true nature—a far cry from the conventional view, which sees research as a one-time undertaking that is static, self-contained, an end in itself. Here we see another difference between true research and the nonexamples of research presented earlier in the chapter. Every researcher soon learns that genuine research is likely to yield as many problems as it resolves. Such is the nature of the acquisition of knowledge.

