2

The Research Process

Chapter Outline

CHAPTER OBJECTIVES

After reading Chapter 2, you should be able to do the following:

- Describe where to find research ideas and how to identify them from articles, literature reviews, other previous studies, and combinations of these plus personal experiences.
- Describe how to build justifications for conducting studies.
- Describe the process of distilling a research idea into a research question.
- Describe and distinguish between descriptive, difference, and relationship research questions.
- Write operational definitions for key elements of a research question and study.
- Write null and directional hypotheses to fit a research question.
- Draft a design or plan for a research investigation including how to maximize data reliability, identify the participants, and suggest instrumentation to gather data.
- Describe details of data collection procedures from beginning to end, including planning for unusual events.
- Draft outlines of sections for data analysis and interpretations of results to be completed later as these topics are discussed in the text.

FINDING A TOPIC TO INVESTIGATE

Research can be conducted for a wide variety of reasons. Studies can be undertaken to (1) try out new methods or techniques, (2) to indulge the investigator's curiosity, (3) to establish the existence of behavioral phenomena, and (4) to explore the conditions under which certain events occur. These reasons cover a lot of territory. However, the point to be emphasized for beginning students is that **research ideas** come from many sources.

The Process of Discovering an Idea

Ideas for research come from everywhere. There is an abundance of them. The challenge for a beginning researcher is knowing where to find them and narrowing the focus, which lead to pinpointing a research topic. Someone who is working on an idea assumes ownership of that idea or problem, although ownership is not exclusive—history is replete with examples of multiple researchers working on the same or similar topics. You can build on someone else's research as long as you give that particular person appropriate credit in your publication. As a matter of fact, this reference citing not only does not devalue your current work, it also makes good sense from a research perspective. Moreover, it is a very public means of tracing your logic as you think through different ideas and the nuances of your reasoning as you link one idea to the next and then to the research question.

Reading Published Articles

The world of practicing investigators and their research ideas should also be examined briefly. Many research ideas studied by professors do not come solely from topics existing in their minds. In many cases, the experienced researcher obtains ideas for investigation by reading articles written by other people. As these articles are read, a new research idea may emerge by identifying a gap in the information presented. Such an information gap might involve a variety of topics. For example, it may be that the study being reported in the article did not focus on children of a particular age group (say, 10 to 12 years of age). If a teacher has a class

of children that are 10 to 12 years old, he or she may be very interested in data on that group. Since children of that age were not included in the article, this represents an information gap. If a researcher reading this article thinks the study could be improved (or made more applicable to his or her classroom) by studying such children, this may be the target for his or her next study. Actually, such information gaps are sometimes mentioned in the discussion sections of research articles in statements about implications for future research. Implications for future research are an integral part of many published articles and are nearly standard in theses and dissertations.

In most cases, implications for future research are easily identified in an article, since the author typically uses such phrases as "future research should . . ." or "additional study is needed to . . ." or "further investigation might . . ." In the case of the example above, you might find a phrase in the article such as this: "Future researchers might find it useful to include participants from 10 to 12 years of age because [of the social skills they are developing at this age, or because of their emerging academic skills, or whatever other reason that makes this an important group to study]." If these gaps and speculations are of interest to you, they will most probably become *your idea* on which to work. What about the source? Are such ideas "original"? According to the literal interpretation often used by students, they may not appear to be *original,* but, in fact, a spin-off (or tangent) from someone else's idea is considered in the field to be a *valid contribution* to the field of study, as long as specific content or ideas are not copied verbatim or used without citing sources.

Reading Literature Reviews

Students should identify broad areas of interest and then read articles in those areas as a means of identifying and narrowing their research ideas. One of the most efficient approaches is to read the literature reviews on general areas like reading comprehension, character education, or school organization. **Literature reviews** are very helpful because the author has done a lot of work searching, reading, and assembling articles on a topic area. Some journals primarily or even exclusively publish literature reviews, which are very rich and scientific sources of information on a topic (see, for example, the following journals: *Psychological Bulletin, Review of Educational Research*). Other journals occasionally publish reviews but also publish a mixture of articles that report single investigations as well as literature reviews. In all cases, such articles can generate many research ideas to be used for theses or dissertations in the same way that was described earlier. No matter what the topic, there are always specific ideas that emerge in literature reviews suggesting future research.

Literature reviews are important for students to learn about for other reasons besides identifying research ideas. As you prepare to begin your project, you will also have to review literature in order to justify and build your case for conducting your study. Beyond the research ideas that can be drawn from literature reviews, it is also instructive to examine how authors assemble such written documents. You will likely have to write a literature review as one of the early chapters in your thesis or dissertation—don't panic, the idea of a *chapter* sounds quite daunting, but you will be able to work through it one topic at a time.

As you read published literature reviews, you will see that the authors use a structure for the article that is important as you begin your first chapter. The very beginning of the article introduces a reader to the topic in a general way. In the first paragraph or first few paragraphs, an author will indicate what the topic is (e.g., the effect of instructional time on academic achievement), indicate in a general way why it is important, and likely state explicitly that "the purpose of the present article is to review the literature on academic achievement and to draw implications for classroom management." Often the author will present this first introductory statement very briefly—within one to three paragraphs. Completing an introductory, general orientation for the reader is important because readers are best served when

they know in general terms what topics are going to be examined, why the author thinks a topic is important, and what implications or interpretations the author is going to present at the end. This allows a reader to make some determinations about whether he or she is interested in continuing to read and invest time on the topic as presented by the author.

The purpose of the literature review is to examine research and findings from research over a broader scope of topics than is possible in any single empirical study. A literature review on instructional time allocation may cover studies that have investigated the *amount* of instructional time devoted to particular curricular areas such as math, reading, and social studies. The review may also cover investigations of how teachers *manage* classroom time allocation in any single day, a week, or even a longer period of time. Depending on an author's conceptualization and the availability of published investigations, the writer will use headings to separate subtopics within the broader overall topic. Those headings represent subtopics, or miniature reviews on various pieces of the literature (e.g., what are the variations in instructional time allocations in most classrooms today, or what are the apparent effects of time spent on academic achievement). There will also be a heading near the end of the literature review that may be called "Implications for Classroom Management" or something similar, which is where the author draws his or her conclusions from the research reviewed. As was mentioned earlier, authors of literature reviews will also make statements like "future research may find it fruitful to . . ." and these are nice places to find research ideas.

As noted before, when you approach your thesis or dissertation, you will begin by writing a chapter that reviews the literature on your topic. In this chapter, you will outline for your readers (your supervisory committee) what your topic is and why it is important, and you will finish your chapter by very specifically stating your research question. Your literature review will inform your audience and lead logically to a justification for conducting your study.

Justifications for conducting your study often fall into one or more of several categories. Your study may be justified because "this particular research question has not been investigated before," and it is important for the educational well-being of students. Another justification might be "although it has been investigated, previous studies had flaws in their research methods" and it is important for the educational well-being of students. A third type of justification might be "although the topic has been investigated, it has not been studied with these particular children" and it is important for the educational well-being of those students. Notice the recurring tag line about being *important for the education of students.* This reasoning is important in educational research and is one you should use in some form.

Like the literature review structure described above, your general topic will have subtopics. For example, suppose you are interested in academic assessment of children learning English as a second language. Some of your logical subtopics might include headings such as the following: (1) assessment instrument development, (2) academic assessment in various content areas, (3) assessment or testing of second-language learners, (4) test bias (both instrument bias and procedural bias), and perhaps others depending on the nature of your study. It is likely that you will conduct electronic searches on these topics in the library and develop headings within your literature review that are based on them. Your headings are likely to evolve and shift over time as you become better acquainted with the published articles on various topic areas.

Replicating Previous Studies

Many faculty view student theses as learning experiences and therefore are delighted to have students replicate or duplicate previous studies. Replications provide added evidence to the growing data accumulation on any topic, which students should understand is also important. Thus, faculty advisors will often suggest

research ideas to students that are replications of earlier studies. Even if students are handed a research topic in this way, it is still important for them to conceptualize the scientific and practical logic leading to the topic and not just conduct a study in a mindless manner because their adviser told them to do so. All researchers create a logic trail that builds a case for undertaking their study, as we noted before. Part of that logic trail will include reviewing existing literature on *your* topic.

Finally, student research ideas can also emerge in effective and creative ways as students work with their faculty mentors on research underway. This type of collaborative effort can be enormously productive for both the student and faculty member.

Student Research Ideas and Educational Objectives

Good guidance for beginning student researchers is often difficult to find. In some cases, students are given a document that outlines format, reference forms, and other information, often covering the technical aspects of manuscript production for their thesis or dissertation. Manuscript production is a type of information that is easy to describe in a student handbook. It is not uncommon for these documents to provide guidance concerning font size and what type of paper is to be used in the thesis or dissertation. However, this is not the most important information that most students need as they begin their research careers. It is more important to examine the educational objectives involved in a thesis and to help students develop their research ideas and research plan. There is some difference of opinion among faculty whether student thesis research is viewed as a learning experience or as an examination of competency. The current authors strongly believe that it is a learning experience.

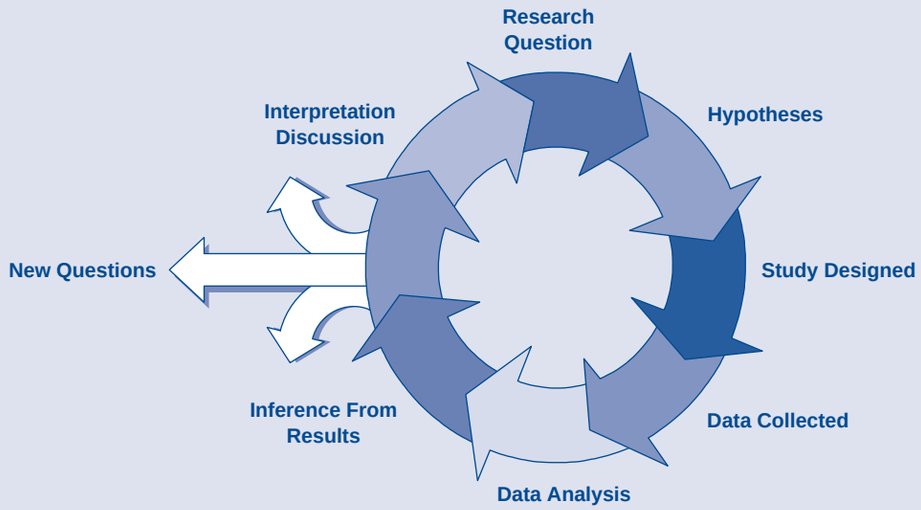
Objectives for a Thesis

Students may also encounter a belief by some faculty that a student's thesis or dissertation should be related to a theory. Practically speaking, and also considering reasonable educational objectives, sometimes it makes sense to relate a student's research to a theory and sometimes it does not. In many cases, students are studying topics that are related to practice rather than theory. For example, they may simply be interested in which of two teaching methods works more effectively. On the surface, students may conduct such a study as a pilot investigation, just to whet their skills with the research process. After the pilot study, they may get a little more involved with the theory underlying each teaching method. Although the second study might also compare different teaching methods, the research may be following two theories of instruction. It makes some sense to relate a study to theory if the student is interested in becoming a teacher or researcher who will be expected to publish theoretically related scholarship. However, many students are not planning for an academic or scientific career at that point in their lives. At best, they are going to be consumers of research. For them, a requirement that they develop a theory-driven research project contributing to scientific literature probably makes little sense and is a meaningless academic hurdle. They can learn about investigations just fine by studying an applied question like which of two instructional methods is most effective for teaching spelling (Johnson, 2005). This is more consistent with a reasonable educational objective of learning basic elements of research.

STEPS IN THE SCIENTIFIC METHOD

We will examine variations in the research process as appropriate. However, it is important to begin our examination of the research process with the closed-loop notion shown in Figure 2.1 since it demonstrates the steps involved, from investigating an idea to developing the research question. The research question may then

FIGURE 2.1 **Closed-Loop Conceptualization of the Research Process**



lead to some hypotheses or "guesses" about the topic under study, which in turn may lead to a design or plan for the investigation. Data are then collected and analyzed to answer the question, which hopefully closes the loop. Along the way, additional questions often emerge as topics for future research.

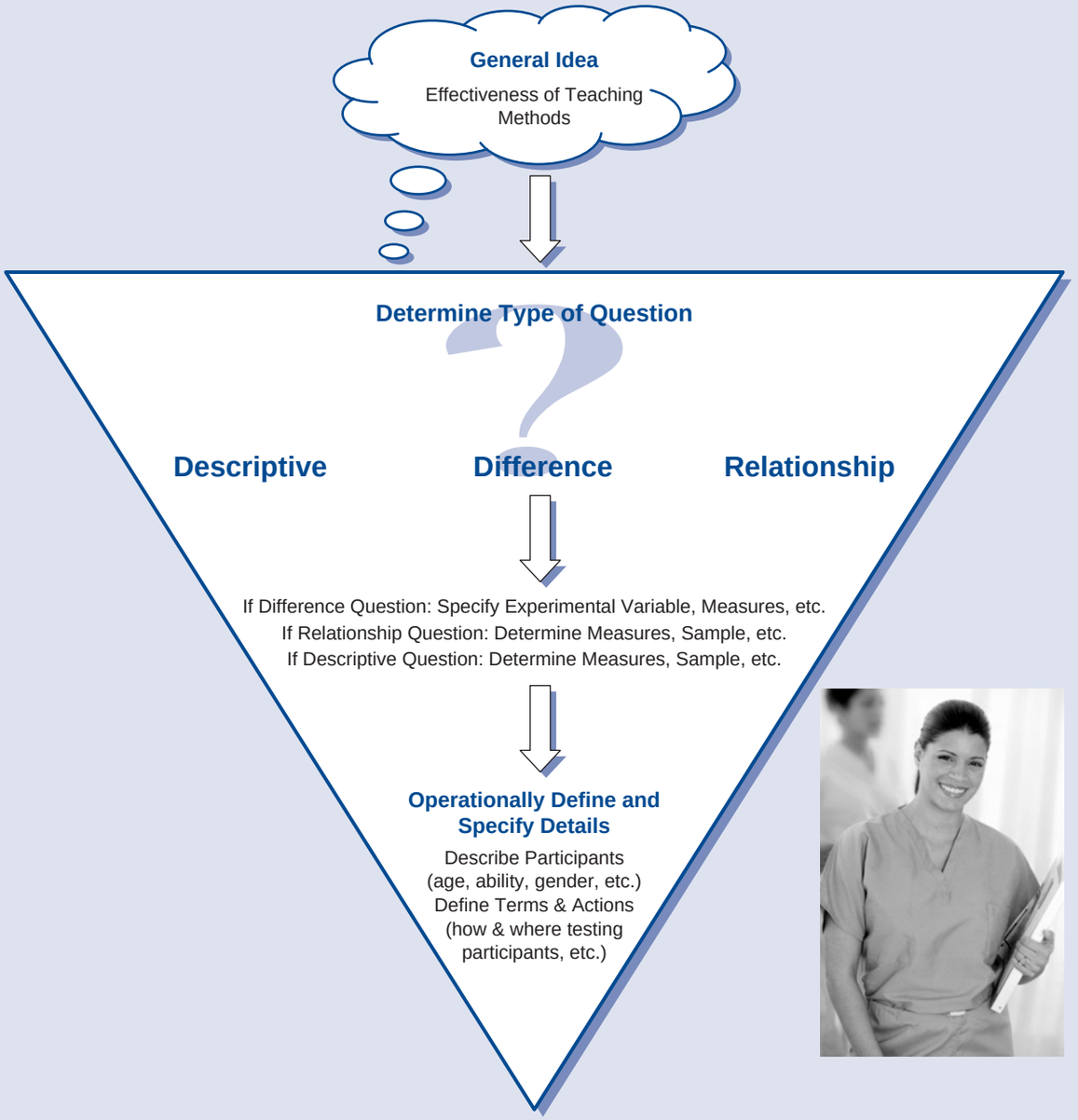
Distilling the Idea or Problem

Ideas for research always go through some evolution. In most cases, they will become more specific and more focused the longer they are discussed. You will likely define more terms and describe your **participants** in more detail. These changes will occur as you read more about the topic and as you discuss it with colleagues. This change process will continue until you have enough of the operational details specified to guide the actual process of conducting a study. Usually, this set of operational definitions can be turned into a research proposal for your thesis supervisory committee.

Once the research idea or topic area is identified, the next process involves distilling the problem. *Problem distillation* refers to the process of refining the problem or idea and making it sufficiently specific so that it can be investigated. Transforming a broad idea into a more specific, researchable question is critical before beginning a study and usually involves seemingly endless definition and description.

Problem identification and problem distillation are a continuous process of defining the details and procedures for a study. For an experienced researcher, these steps are often indistinguishable. They are differentiated here somewhat artificially for instructional convenience to guide beginning investigators through a process with which they are not very familiar. Figure 2.2 outlines the processes of distilling a general idea into a researchable question. As suggested by the funnel-shaped outline, distillation processes involve becoming increasingly specific in the definition of terms and activities, such as how you "test" participants, and when and where you test them, as well as describing the participants, their backgrounds, important characteristics, and abilities.

FIGURE 2.2 **Diagram of Distilling the Research Idea**



As a research problem is identified, it is often in the form of a fairly general question. For example, in reading an article you may encounter something that makes you wonder, "What are effective teaching methods?" The investigation that you have been reading studied the effects of students' response time, but something seems troublesome about that. At this point, you may recall from your own experience that response time seems to have different effects depending on how meaningful the material is. This represents a stage of initial problem identification that tends to focus and guide additional reading and search of existing studies. You are beginning to distill the problem into more specific form.

Types of Questions

Early in the process, it is very important to determine the type of research question to be studied. Three types of research question are typically studied in education: *descriptive, difference,* and *relationship.* Is the question being asked a descriptive question, a difference question, or a relationship question? It is critical that you know what type of research question is being studied from the beginning. As you become more experienced, it is also possible to shape a question or push a topic into a particular type of question. This means that a topic area or a particular idea may be studied using a descriptive, difference, or relationship question, depending on how you plan the study. Determining the type of research question being asked seems like a simple task, but it is one that repeatedly baffles beginning research students. However, it is a crucial step. If the researcher does not know what type of question is being asked, there is a very poor likelihood that the study can be planned successfully. We should also note that it is possible for more than one question to be included in a single study, but it is extremely important to be explicit about how many questions and what types that you want answered before moving forward with a plan. Distilling the problem area or idea into research questions is always challenging and particularly important in action research because these studies are typically conducted in field settings where there are lots of distracting influences. Determining the type of question and how many specific research questions, if there is more than one, is a crucial step in action research. The Research in Action box sketches this process for two studies.

Descriptive questions. **Descriptive questions** ask, "What is . . . ?" or "What does . . . ?": What does this culture look like, or what does this group look like? Descriptive studies are basically static and there is no manipulation of a treatment, such as a teaching method. Descriptive studies are frequently undertaken in surveys and qualitative investigations.

Difference questions. **Difference questions** make comparisons and ask the question, "Is there a difference?" Comparisons may be made either between groups (e.g., between two groups of children receiving different math instruction) or between measurements within a single group (i.e., pre- and posttests on the same group). In many cases, these comparisons are made between the average scores of the groups if the data are quantitative. Such a question may be phrased, "Is there a difference in the average scores between these groups (or treatments)?" Difference questions are frequently used in experimental research, although nonexperimental studies may also compare groups or cultures.

Problem distillation for a difference question involves identifying the experimental variable as indicated in Figure 2.2. The experimental variable refers to the factor that an investigator manipulates to see what the effect is. (This is also called the *independent variable* by some researchers.) For example, if you were interested in which of two reading instruction methods was more effective, you might design a study in which two groups were taught, one using Method 1 (CORI in our Research in Action box) and one using Method 2 (DAP). After the two groups had been instructed with their respective methods for a specified time, you would then test both groups to find out which had the better score. All other important characteristics between the groups are supposed to be equal (like age, academic ability, etc.). If all of these other characteristics are equivalent, you are likely to draw a conclusion that the method used to teach the group that performs better is more effective. In this example, the experimental variable is the *teaching method* (which is what you were investigating). Figure 2.3 is a diagram of the study. This study is for a difference question, comparing two teaching methods for reading (i.e., CORI vs. DAP). You would probably be testing the two groups using some reading test as the measure. You would likely conclude that the teaching method for the group that performs better is more effective, assuming other important matters between the two groups are equal. Figure 2.4 illustrates another study from the Research in Action box, this one examining self-esteem differences between Latino and Caucasian students with learning disabilities.

RESEARCH IN ACTION

KEY POINTS IN THE CHAPTER REFLECTED IN THIS BOX:

- The research ideas will be distilled into research questions.
- Determine what types of research questions are being asked.

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OBJECTIVES TO LEARN FROM THIS BOX:

- Determine what types of research questions are being asked.
- Visualize the question with a diagram.
- Begin to refine the research questions and think about the design and implementation of the study.

Background: Below you will find two action research scenarios, one related to student engagement in reading and the second involving student self-esteem. For each scenario, the portion presented will relate to selected key points discussed in the chapter. In this case, we are focusing on how the research ideas will be distilled into research questions and determining what types of research questions are being asked. Follow the development of these research questions. You may also wish to develop your own research questions and work through the progression to a study you could undertake.

SCENARIO 1

Emily is interested in the effects of engagement on how young students learn to read. To her, it seems that students who are engaged in academic subjects are more excited about them and learn more quickly. One of the subjects she is teaching her young students is beginning reading.

Initially, Emily views her research question as a difference question that compares students who are engaged with those who are not engaged. From her review of literature, she decides that using conceptual knowledge is a good mechanism to engage the students. This conceptual knowledge includes ideas the students are interested in and concepts or questions they have about the world around them. For Emily, this is what she calls *concept-oriented reading instruction* (CORI). She is initially viewing this as a difference question that compares students taught using a CORI method to students taught using *drill and practice* (DAP). Thus, she has a difference question. A diagram for Emily's action research study is shown in Figure 2.3.

Think about this: How does the action research idea regarding reading engagement become more focused and specific as it evolves into the research question stage? What type of research question or questions is Emily developing? What does the study diagram look like?

SOURCE: This action research scenario is roughly based on Swan, E. A. (2003). *Concept-oriented reading instruction: Engaging classrooms, lifelong learners.* New York: Guilford Press.

SCENARIO 2

Daniel wants to see if his students with learning disabilities have different self-esteem depending on whether they are of Latino or Caucasian descent. He believes that his students have rather low self-esteem, and it seems to him that his Latino students' self-esteem is somehow different from that of his students who are Caucasian.

Daniel has waded through a lot of literature. His reading has indicated that matters are not at all clear regarding what self-esteem *is,* and furthermore, there are different types of self-esteem that have been studied. Daniel sees his study as a general difference question between Latino students and Caucasian students. He initially outlines three difference questions with three types of self-esteem. They are as follows:

1. Do Latino students with disabilities have a different global self-esteem from European American students with disabilities?
2. Do Latino students with disabilities have a different private self-esteem from European American students with disabilities?
3. Do Latino students with disabilities have a different public self-esteem from European American students with disabilities?

A diagram for Daniel's study is found in Figure 2.4. This diagram illustrates a difference question. Daniel has three of these as outlined above.

Think about this: How does the action research idea regarding self-esteem in Latino and Caucasian students become more focused and specific as it evolves into the research question stage? What type of research question or questions is Daniel developing? What does the study diagram look like?

SOURCE: This action research scenario is roughly based on Rubin, D. (2000). *Race and self-esteem: A study of Latino and European-American students with learning disabilities.* Unpublished master's thesis, University of Utah, Salt Lake City.

FIGURE 2.3 Diagram of an Action Research Study Comparing Two Teaching Methods

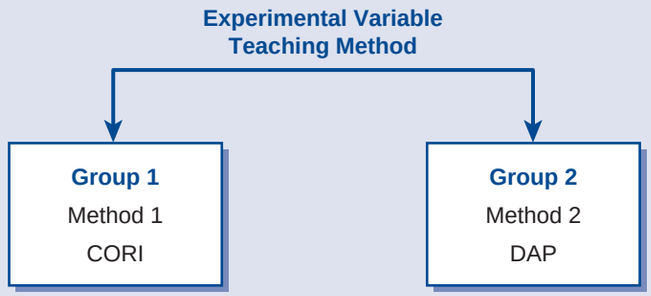
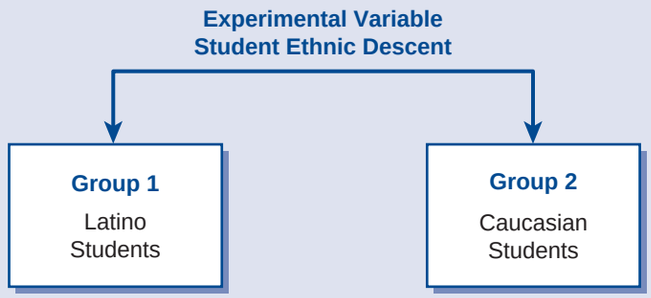


FIGURE 2.4 Diagram of an Action Research Study Comparing Latino and Caucasian Students



Relationship questions. **Relationship questions** explore the degree to which two or more phenomena relate or vary together. For example, a researcher might be curious about the relationship between intelligence and math scores. Structured as a relationship question, the statement would be, "As intelligence varies, what *tends* to happen to math scores?" More specifically, if intelligence increases, do math scores *tend* to increase or decrease, or is there no systematic tendency? The researcher records both intelligence and math scores on a sample of participants to determine the relationship between them. With two scores on each participant (an intelligence score and a math score), the investigator then computes a correlation coefficient, which is a statistical analysis that provides an estimate of the degree to which the variables relate. It is important to emphasize that you are determining to what degree intelligence and math scores relate—what *tends* to happen to math scores when intelligence increases. You are *not* comparing intelligence and math scores.

The Operational Definition

Another important task involved in problem distillation relates to operational definition. In this part of distillation, a researcher needs to carefully consider and identify the following factors important to the study:

- Steps to be taken
- Measurements to be recorded
- All other characteristics, settings, or features

This essential phase of problem distillation must precede implementation of the study. The level of detail needed is often surprising to beginning research students, but the more specific the itemization that can be articulated at this stage, the better the planning will be. This will reduce the likelihood that unanticipated events will surface that can cause data collection errors. The operational definition will always be done in writing so you can refer back to it and so you can share it with your colleagues for their review and suggestions.

Suppose for the moment that a researcher is going to study the effects of material meaningfulness on learning. Distillation of the problem will require operational definition of all terms, procedures, and measures involved in the study. An example of this definition process is found in the term "learning," which is what we are going to measure. While we want to study learning, learning cannot be measured directly since it is something that occurs cognitively and beyond our direct observation. Consequently, the investigator must *infer* that a certain amount of learning has occurred based on how well participants perform. If the students do well on a test, it might be concluded that considerable learning has occurred, whereas if they do poorly, you might infer that they didn't learn much. We are going to infer about how much learning has occurred by *measuring* test scores. This is our criterion measure and is also called a *dependent variable* since the level or score is presumably dependent on our teaching. Several measures may be recorded that reflect different aspects of learning. For example, you might measure the rate of acquisition. If you do, it is crucial to specify *how* this is to be measured. The point to be made here is that learning must be rigorously defined in terms of what is observable so that it can be measured.

Problem distillation for nonexperimental research is also important. Once again, the same principles apply as discussed before. The topic under study must be clearly in mind before the planning can begin. For example, if you were interested in learning about study behaviors of college sophomores, a survey might be an appropriate method for conducting the research. In such a situation, *study behaviors* would be the "problem," and you would then have to specify the precise behaviors to be investigated. If you don't define what study behaviors are (e.g., cramming, reading material over time), it will be difficult to identify them. Without this type of definition, a

survey can be like a fishing expedition: you may end up on the lake simply pulling in everything you can get and keeping anything that bites.

Serious definition efforts will be required for the survey on study behaviors, and the definitions must include operational terms that can be translated into a description of procedure. Each aspect of the idea must be operationally defined in the same manner to fully distill the problem. The distillation process (as discussed above) involves several essential activities:

1. Determine what type of question is being studied.
2. If you have a difference question, you need to specify what the experimental variable is, and then determine what you are going to measure, who your participants are, and so on.
3. If you have a relationship question or a descriptive question you will not have an experimental variable so the next step is determining measures, sample, and so on.
4. For all types of questions, you will need a complete operational definition of all necessary terms. All of these processes of defining and describing will literally provide an operational script to follow so you can do the study. This operational script needs to spell out all of the details of what you do, because any steps you leave out become points where you can weaken the study by making an error.

There are some qualitative approaches to research that allow definitions to emerge as the research goes forward. This makes the definition process obviously less structured than the approach we have described above. While such approaches may work well for experienced qualitative investigators, we do not recommend them for beginning researchers. There is simply too much room for error, which could be dangerous, especially if you are conducting a study required for graduation (like a thesis or dissertation). Such an approach will put you at risk for not knowing *when* you're finished, because you cannot check off the steps in the process.

Formulating a Specific Research Question

You are producing a written proposal as you proceed through the narrative outlined above. As you move from a broad idea through the type of question and operational definitions, you have outlined a short thesis proposal. Each department has slightly different formats but generally this process ends with some type of written proposal document that outlines your study for your adviser and supervisory committee. There are two other points that need to be considered in this document: (1) building the case for conducting your study, and (2) including hypotheses and what they look like.

Building Your Case

As indicated earlier, you need to build a case for conducting your study in your thesis proposal. This is also something that practicing researchers do as they outline the logic trail that builds the justification for undertaking a study. This process of building the case for a study occurs as the research idea is described. In a proposal document, the writer states the research idea and begins distillation or narrowing of the topic. As this is done, literature is reviewed that relates to the topic, covering studies that have relevance to the area being investigated. The purpose of this literature review is to outline what research has been published that has a bearing on different aspects of the study being proposed. For example, some studies may have been published that investigated younger children than you plan to in your study,

Simulation

Simulation 2.1

Topic: Problem distillation

Background statement: One of the most crucial operations in the early planning stages of research is problem distillation. This is the process of refinement that changes a general, frequently vague idea into a specific, researchable question.

Tasks to be performed:

1. Read the following stimulus material, which represent research ideas stated in somewhat general terms.
2. For each statement, restate the idea in a distilled form that makes it more specific and a researchable question. Your restatement may be rather lengthy. In the statement, specify what is necessary to indicate the experimental variable (keeping in mind the principle of generality). Make the statement as specific as possible in terms of operational definitions.

Stimulus material: The idea to be distilled reads as follows: "Assess the effects of variation in teaching experience on material evaluation."

Write your response, then turn to page 54 for Simulation Feedback 2.1.

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use different instructional materials, or elicit written as opposed to verbal responses from the participants. These all become relevant to your literature review and are woven into the justification for conducting your study.

There are a number of typical reasons why a study should be done. Although these are stated in general terms, they can be translated into building a case for conducting your own investigation. In the process of reviewing related literature, you will find one or more of the following reasons may support undertaking your study:

After reviewing the literature, it becomes clear that the study has not been done (and it is important to education).

After reviewing the literature, it appears the study has been done, but it was conducted badly and has methodological flaws (and it is important to education).

The study has been done, but not with *these* children, or in *this* setting, with *these* materials . . . (and is important to education).

The current study will resolve or work around the problem and therefore have important value.

In this list of reasons, we included the phrase "and it is important" to state that it is not enough to just point out that the study has not been done. There are a lot of studies that have not been done but they may not be important, either theoretically or for practical purposes. As you build the case for conducting your study, it is necessary to spell out the details of *why* your particular investigation is important. The rationale might be centered on a piece of theory that still needs developing. It may

also be that the study has practical value, and the results will help us instruct children more effectively. The practical approach here is what many call *action research,* in that the study is important to conduct because results are likely to change or improve our educational practice. Using reasons such as these, you strengthen the justification for undertaking your study by specifying why it is important.

Hypotheses

Proposals for theses or dissertations often include hypotheses, particularly if the study uses experimental methods. Hypotheses are useful in this context as they help the beginning researcher to be very clear about his or her research questions. When they are written down in your proposal, your hypotheses will make it clear where your thinking is still a bit fuzzy and needs clarification. You will probably need to read completed dissertations to see examples since hypotheses are seldom published in professional journals.

An experimental **hypothesis** represents the ultimate specific, descriptive statement in problem distillation. Such hypotheses are statements made in *very* specific terms, and each one is typically a statistically testable prediction. Hypotheses like these might appear in your proposal:

1. Participants will not differ in mean correct responses as a function of high versus low meaningful material.
2. Participants will not differ in correct responses as a function of 5-second versus 20-second response time.

These hypotheses were adapted from a study that compared student academic performance on two types of material (high meaningfulness vs. low meaningfulness) and under two response-time conditions (5 seconds to respond vs. 20 seconds to respond). As suggested by these examples, a hypothesis is written for each comparison or experimental variable (in this case, there are two experimental variables: material meaningfulness and response time). With the research problem distilled to this level of specific detail, planning the study is simple because the larger composite idea has been broken into its most fundamental components: two experimental comparisons. These hypotheses were used in an experiment that collected *quantitative* data.

Null and directional hypotheses. One factor that may cause confusion involves the use of null and **directional hypotheses.** *The null hypothesis predicts no difference between comparison groups.* The hypotheses above on material meaningfulness and response time are both null hypotheses. **Directional hypotheses,** on the other hand, *do predict a difference and indicate the expected direction of that difference* (i.e., which group will perform at the higher level). If we were to change the first hypothesis above to a directional form, it might say, "Students receiving the high meaningful material will have significantly more correct responses than those receiving the low meaningful material."

This example of a directional hypothesis makes sense because we would expect participants receiving highly meaningful material would do better than those taught with material of low meaningfulness. However, beginning researchers are probably better served if they use **null hypotheses** for several reasons. One reason is that seasoned researchers have usually tried directional hypotheses during their careers and may have obtained results that didn't always support the direction. This makes it more difficult to explain why the results turned out as they did and not as you expected. It is more challenging to change your thinking if your directional guess is wrong than it is to use a null hypothesis to begin with. For a beginning researcher, the null hypothesis is valuable for clarifying the question, even if it serves

little other purpose. Under most conditions, a researcher is well-served with a null hypothesis, and nothing is gained by predicting the direction of differences. For statistical testing and problem distillation purposes, the null hypothesis works very well and is probably used more frequently by practicing researchers than the directional hypothesis.

Design and Implementation of the Study Plan

The most important decisions affecting the soundness of an experiment are made *before initial data collection.* The pre-study planning that determined how the data was to be gathered directly influences the strength of any piece of data. The more clearly the problem is articulated (distilled or defined), the easier the data-related planning will be accomplished. A basic concept that influences data quality is that of *control.* Control has an enormous impact on what can be said about the meaning of data. In an experiment, for example, it is desirable to be able to say that the data reflect the experimental variable. The researcher will be able to do this *only if there is confidence that the data do reflect the experimental variable, which is the topic of interest,* and *not some other influence that should have been eliminated.* This is generally known as controlled observation in experimental design. You can only infer that a change in your experimental variable influenced change in the criterion measure if all other possibilities can be discounted as causes of the change. This principle is a central aspect of experimental research design and an important consideration in the quality or accuracy of the data.

A second consideration involved in data planning relates to the *generalizability* of results. To what degree do the results generalize or have meaning beyond the specific participants and exact setting used in the research? Essentially, the topic being addressed here involves the reliability of data obtained. How reliably can one obtain the same or similar results in circumstances beyond those where the data are collected?

Reliability of Data

Data reliability is an important factor in research and basically relates to how dependable the information is that the investigator collects. Data reliability surfaces in all research methods even though different terminology is used to refer to it. Quantitative researchers may talk about the "consistency" of a participant's scores from one test to another (Fraenkel & Wallen, 2006). Qualitative researchers use terms such as "trustworthy" or "authoritative" to describe data reliability (Creswell, 2005; Denzin & Lincoln, 2005). In all methodologies, however, the reliability of data is important. Several factors influence the reliability of data.

Participants in the study. Perhaps the most obvious influence involves the participants in the study. If it is desirable that results be applicable to a given group of individuals, the participants in the investigation should look like that group in terms of age, schooling, and other characteristics. Usually this larger group is defined as the population to which generalization is desired. The researcher wants to achieve generalizability, that is, to be able to observe the same or similar performance in the general population that was evident in the sample of participants. To obtain this data reliability between participants and population, the experimenter must be able to assume that the participants are representative of the larger population.

Stability of measures. A second factor to be considered in data reliability involves the *stability of measures* being used in the research. Stability is also related to generalizability, although most discussions of generalizability focus on participant sample considerations. In the context of data reliability, a primary concern is that the measure is sufficiently stable so that a *participant having the same status* (e.g., physical, motivational, or anxiety level) and *performing at the same level as an individual*

in the broader population, will obtain the same or a similar score on the measure (e.g., providing the same or similar answers on a survey questionnaire). Thus, for the results of an investigation to be generalizable, the measures recorded must be stable enough that a given score or answer is likely to recur under the same conditions. If a measure is unstable, the data may indicate two different scores for the same participant status. Although behavioral science is plagued by measurement problems, it is usually possible to select or contrive measures that are adequately stable. Of course, this does not mean that there is no variation in the behavior. Instead the concern is that the measure is sensitive to variations in performance and not capriciously variable when performance is not changing (i.e., the variability in the measure is coincidental to performance variation).

Forms of instrumentation. The instrument used for collecting data has a lot to do with the reliability of the data. Instrumentation takes many different forms ranging from a paper-and-pencil questionnaire to a test presented on the computer that each participant completes at the keyboard. Instrumentation also includes human observation in situations where that is involved in the data collection protocol. In each case, steps can and should be taken to make the collection of data as reliable as possible. We will now discuss selected approaches.

If a survey is being used for data collection, then the questionnaire is the instrument being used for data collection. Questionnaires have a long history of use as data collection instruments, and considerable information is available regarding how to enhance data reliability (Hutchinson, 2004; Nardi, 2006). For example, it is important for survey questions to be uncomplicated, to ask for only one piece of information from the respondent, and to avoid wording that will bias respondents' answers. It is also vital that the questionnaire be as brief as possible and have a response format that is easy and convenient for the respondent to complete. In some cases, the survey will be administered in paper-and-pencil form, whereas in others the respondents will complete the questionnaire on a computer, on the Web, or some other medium (Leece et al., 2004; Mertens, 2005). Data reliability using these varied formats and presentations for questionnaires involves examining the interaction between the respondent and each question. Attempts are then made to improve the likelihood that a respondent will give the same answer to the same question when it is presented repeatedly.

Instruments may also be in the form of a test, which in many ways is like a questionnaire. A test might be in paper-and-pencil format, or it might collect data from the respondents through their interaction with a computer. Tests might ask the respondents for information they have learned such as academic content or information about traffic laws for a driver's test. In all cases, reliability of the data will be improved if the question is unambiguous, simple, and has a distinctly correct or incorrect answer. Each of these features will contribute to a respondent giving the same answer to the same question on multiple occasions, which enhances data reliability.

Another instrument example involves the use of human observers where the observers become the instrument for data collection. Reliability of data collection in circumstances where observers are collecting data can be enhanced in a number of ways. For example, the behaviors that an observer is watching for (and then recording on a laptop or data sheet) need to be clearly defined so they are easily seen, easily distinguished from other behaviors, and conveniently recorded. Reliability is improved by making it easy for the observer. If it is easy for the observer to see the target behavior and to record that as a piece of data, reliability is going to be improved and the observer is more likely to record the occurrence of a behavioral event in the same way, repeatedly, when he or she sees it. In addition to making behavior definitions very clear, researchers often provide considerable observer training to improve data collection.

In some cases, mechanical instrumentation may be used to achieve improved measurement precision and data reliability. For example, a stopwatch may be useful if one is measuring time, and not highly vulnerable to error, especially when the observer has easily identifiable cues for operation of the stopwatch. However, reduced measurement reliability may result if it is not obvious when to begin and terminate instrument operation, or if operation of the stopwatch is cumbersome.

Some electronic devices are available that may be used to permanently record actual participant responses if the research procedures permit (e.g., audio or video recordings). Such approaches then allow the recorded responses to be removed to another site and analyzed later in a careful manner, without the pressure of ongoing procedures. Types of recording instruments vary and techniques are continually being improved. Audio devices may serve well to record verbal responses, and video equipment may similarly be appropriate for image records of ongoing behavior sequences. In addition, a variety of physiological instruments, such as the electroencephalogram, polygraph, and others, may be used if that type of data is desired. The advantages of such devices are clear. Data may be permanently recorded, and analysis or categorization may be accomplished later in a relaxed and thorough fashion. Such recording of responses permits the review of performance if any uncertainty exists concerning the nature of the response. This allows multiple checks to be made on the categorization of responses, which in turn improves potential data stability.

The use of permanent recording devices seems to be desirable insurance for research in situations where such procedures are possible. We have used permanent mechanical and electronic recorders as well as human observers many times, and we offer a note of caution: Recording devices are not a panacea. Their utility is only as good as the soundness of the equipment. More than one experimenter has been dismayed when the recordings were prepared for viewing or listening and there was no record because of undetected technical failure. This unfortunate situation, of course, means lost participants, lost data, lost time, and occasionally a completely aborted study. It is always prudent to double-check equipment before it is used in a study. It is also important to be aware of the possible impact on participants' behavior when a recording device is brought into the environment. Participants may respond differently when such equipment is used since it is not part of their routine. They may become nervous, or act in a manner they believe is socially appropriate or expected. The researcher must consider these issues since the recorder itself may alter the data.

Data instability. Several examples have been given of measures or procedures that may be used to improve data stability. A variety of measurement situations also may contribute to a higher risk of instability. The probability of greater measure instability is always increased when heavy reliance is placed on observer judgment regarding a participant's response. This may occur under several conditions. The greatest variation is generated when an observer is requested to record behaviors that are not well defined or easily observable. Recording data reliably becomes more difficult when fewer distinct cues are available. Likewise, when rating scales are used to assess concepts that are poorly defined or defined in vague terms (e.g., attitudes, self-concept, anxiety), an observer is presented with a more difficult task, and often greater data instability results. Such situations may be encountered in interviews or mail-out or electronic questionnaires where it is unclear what the participant's response should be or how it should be recorded.

Four basic approaches can help minimize such difficulties. First, the behavior or performance to be measured must be as clearly defined as possible. Second, the more distinct the cues are for an observer, the greater the chance that accurate response records will result. Third, multiple observers can be trained to a point where reliability will be high among a group of judges as a whole. Using this latter technique, the multiple observers serve as checks on each other, which places less reliance on a single individual's judgment. Finally, when rating scales are used (e.g., the Likert 1 to 5 scale), each point on the scale can be as tightly anchored as possible.

A tightly anchored scale might involve very specific descriptors (e.g., 1 = 0 days per week, 5 = 7 days per week). Such arrangements can greatly increase data stability simply because a respondent's interpretation of vague descriptors (like "seldom," "often") is less involved.

Planning aspects of data collection are an extremely important operational element of the research process. It is easy to see how investigations may be seriously jeopardized by errors in data collection. The data are the central representation of participants' behavior under the research conditions. Consequently, the soundness of the data must be insured to every extent possible.

Data Collection

The **data collection** phase refers to the actual execution of the investigation. This may include the process of administering a questionnaire, conducting an interview, or presenting a math test to a participant and recording responses. *This is the point at which the study is implemented.* Activities involved in implementation are most frequently described in the "procedures" section of a research article.

The most critical elements of data collection are performed before the actual beginning of participant testing—the detailed planning of each step. Planning has been stressed throughout this discussion and is being raised again to emphasize its importance. At least two types of factors warrant attention before data collection begins. First, there are many operational details that should be planned ahead of time and that are so central to research, they are almost routine. These are present in nearly all data collection procedures. The second type of factor is much less predictable—anticipating the unexpected. Planning for an unexpected event is precautionary in its attempt to avoid incidents that are sporadic but may jeopardize the soundness of data collection procedures. In planning for both types of factors, the best preparation is research experience. The most effective method of learning about such factors is to work with a seasoned researcher over a period of time on different investigations and to note carefully the details that receive attention. (This is the most effective manner in which to learn research.) In lieu of such an internship, some areas will be suggested here that may warrant preliminary planning.

Important Considerations When Collecting Data

Regarding the nearly standard concerns, probably the most effective planning device is to *mentally or even actively rehearse* the entire procedure in detail. A series of questions is usually helpful:

1. *Where are you going to observe or administer the task to participants?* This is a question that has more tentacles than are apparent at first. Attention to location is certainly important and a great deal depends on the requirements of the method being used. If a study is being conducted in a school, do you need a separate room or will you be observing more natural settings such as classrooms? If you need a separate room, will there be one available in that school, or will you have to make other arrangements? Suppose you have a room. How close is it to the source of participants? This has certain ramifications for other questions involving transporting participants to the test area.

   There are also considerations regarding the physical details of the site. What are the characteristics of the research site that would be desirable for your purposes? If you are conducting naturalistic observation, are you going to be in the room with the participants or will you be hidden—perhaps observing through a one-way mirror? If you need a separate research space, should it be a relatively distraction-free room so the participants can focus on their task? What about air circulation? Might that be important? Final decisions on many of these details will depend on visiting the site. However, they

should also receive advance attention so you can keep in mind what will or will not be appropriate. Frequently advance planning involves the assessment of general tolerance levels that are acceptable regarding the characteristics of the site (e.g., just how stimulus-free *must* it be?). Air circulation may not generally be a problem, but when the principal shows you the room (which turns out to be an unused walk-in food locker), it may suddenly present a difficulty.

2. *Where are the participants, and how do you gain access to them?* If you are observing in a classroom, how do you gain entrance—and when? If the study requires working with children in a separate space, do you contact the teacher(s) with a prearranged list, or do they merely send children as they are free? This latter situation is desired by some teachers but could present certain sampling problems unless precautions are taken (see Chapter 4). The distance from the source of the participants to the test site is usually not a big problem. One must be concerned, however, about the mental set that participants receive during the walk to the research room. If an investigator is walking down the hallway with a child, what is said in conversation on the way can influence the child's view of the study, which may impact their responses and alter your data.

3. *If you're in a separate room, what furniture is necessary in that space, and how should it be arranged?* For example, do you want a table between you and the participant for research materials?

4. *Are your data collection sheets in proper order for the participant's appearance?* This applies in both separate research spaces as well as observations in natural settings. It is not very natural or professional for you to be fussing around with your data sheets when participants enter the classroom, nor do you want your personal organization to be part of the experience when a participant comes into the research space. Both of these activities may influence the participants' behavior. For example, do the data sheets contain space for complete and convenient recording of descriptive information concerning the participant (e.g., name or code, age, gender, and data)? Are the data sheets designed for complete and convenient recording of data? Often data recording has to be performed with one hand while the other hand manipulates research materials such as cards with words or pictures on them. Can you do this efficiently and smoothly? While fumbling around with data sheets might be embarrassing, more importantly it may contribute to data errors or influence the participant's behavior.

5. *Are your other research materials in order?* In a way, this is part of item 4 above, but worth additional emphasis. Is instrumentation, such as a stopwatch or video recorder, in place and in good working order? How should this be accomplished to save time and not make the participants nervous?

6. *What are your interactions going to be with participants?* If you're conducting an experiment, what instructions are you going to give them? Give detailed consideration to the nature of interactions between you and your participants. What you say and do will influence the environment. If you're conducting an experiment or administering a test, it is a sound procedure to have instructions typed out and either memorized or read verbatim. In a slightly different context, never send a questionnaire out without a carefully constructed cover letter. The wording is crucial to the response.

7. *What is the time interval for participants to respond?* Is it 5 seconds in an experiment or 3 weeks for a mailed questionnaire? (Do not forget to allow time for the mail delivery if you are using the mail.) What do you say or do if this interval is exceeded?

8. *Say you're working one-on-one with participants. What is your response to the participant if an error is committed?* Likewise, what is to be said if a correct response

is made? Not only will your response influence any future behaviors of the participant, but you would also be surprised at how some of your verbal interchanges might become public.

9. *How do you exit or dismiss the participant when the research is completed?* This is obviously crucial when a researcher is in direct contact with the participant(s). What should you say?

These questions are merely examples. They are relevant in a high proportion of research procedures but may not include everything that should be considered in a given investigation.

An Essential Rule for Data Collection

Beyond the mental rehearsal, there is an additional step that will provide further safeguards against errors. In fact, this step is so essential that it should be a standard rule. In preparation for data collection and where possible, *the researcher should actually practice the entire procedure from start to finish.* Pretest the questionnaire on a few individuals who are similar to the participants to be used. Practice the experimental procedures or interview in a similar fashion. Practice the observation process in realistic settings, including coding the data.

This rehearsal will serve two important purposes. First, it will usually highlight procedural elements that did not receive attention previously. Such decisions and preparations can then be accomplished before the study is to begin, which minimizes the risk of losing participants because of procedural error. Second, it will give the researcher practice and self-confidence and polish the performance of data collection procedures. This is essential, and it is surprising how much researcher improvement will be evident in the first few practice trials.

Anticipating Contingencies in the Study

It is not possible to anticipate every contingency by following a checklist of standard procedures. Unexpected situations usually arise when the procedural rules are stretched by deviant participant performance or behavior. Tales of antics by participants are exchanged in research labs much in the same way that fish stories are circulated among anglers. In many cases, a researcher's judgment is tested to a considerable extent to preserve order in the investigation setting. It is also not uncommon to lose participants because of deviant behavior, responses, or performance. This possibility can be avoided to a degree by pre-investigation planning. Such planning usually involves attempts to anticipate possible behavioral extremes before the fact. In most cases, this part of the planning involves a series of "what if" questions. Some possible decision questions are suggested here.

1. What if a participant indicates openly (or subtly) that participation in the study is no longer a desirable activity? This is a possibility and presents a definite decision point for the researcher.
2. What if a participant asks to have the instructions repeated? What if a youngster being observed decides to engage the observer in a conversation? Are these permissible or will they contaminate the data?
3. What if a participant in an experiment makes an error and then *immediately* corrects it ("Oh no, the answer is . . .") in a fashion that gives the impression that the correct answer *may* have been known in the beginning? Will you count it?
4. How many consecutive incorrect responses are permissible before a participant is deleted from the study, and is deletion the appropriate action? It is important to determine this ahead of time because some participants with

learning problems may persevere far beyond what is imaginable before they are deleted from the study. Make your rule ahead of time.

5. You're working alone with a child in a separate research space. What should you do if someone knocks on the door or enters the room without knocking while the study is in session?
6. Should records be kept out of the participants' view? How should this be accomplished? In fact, should the timing (if this is a part of the procedures) and data recording be performed surreptitiously?
7. What is to be the response if a participant gets up and walks around the table to see the materials?
8. What should you do if a fire drill is staged?

It is impossible to anticipate all the contingencies that will occur during data collection. These represent only a few drawn from the authors' experiences. It is helpful to consider these as well as others you might think of. Data collection is both exhilarating and nerve-racking. It may also be repetitious and boring in certain cases. There must, however, be something addictive about data collection since researchers keep returning to it again and again. Table 2.1 presents a data collection

TABLE 2.1 Data Collection Checklist

Pre-Implementation Planning

Clear statement of research question
Clear definition of experimental variable if difference question
Clear definition of criterion measure
Clear definition of study participants

Preparation of Measures for Data Collection

Determination of measure stability and reliability
Development of instruments to collect data
Plan and practice implementing data collection (including unexpected events)

On-Site Data Collection Preparation

Determination of exactly where data are to be collected
Determination of physical characteristics of data collection site
Determination of furniture or other space considerations in data collection site
Determination of how participants will be located and how you gain access
Preparation and pretesting of data collection sheets or other data collection mechanism
Preparation and pretesting of other research materials

Practice Procedures and Instructions to Participants

Practice verbal and physical interaction steps.
Determine and practice participant response-time intervals.
Determine and practice your responses to participant errors and correct responses.
Determine responses to potential unusual responses or behavior by participants.
Determine interaction protocols for moving participants to and from site.
Rehearse potential "what if" situations (e.g., refusal to participate, fire drills, others).

Practice Complete Protocol From Start to Finish, Multiple Times

summary, although you will need to add items to this checklist that are unique to your data collection circumstances.

Data Analysis

Once the data are collected, the next step is analysis. This step will be treated in considerable detail later in the text and will only be discussed briefly here in the context of the scientific method. **Data analysis** probably carries more negative connotations than any other single part of the research process. Actually, most quantitative analyses are merely combinations of elementary arithmetic operations. In most cases, if one is reasonably prepared with the skills of addition, subtraction, multiplication, and division, the essential components are present. Actual performance of these operations may be guided by any one of several step-by-step quantitative analysis handbooks on the market. Such handbooks are based on a viewpoint that there is little value in memorizing formulas—either by a student or a practicing researcher. Consequently, the discussion of analysis procedures in later chapters will include several references to computational handbooks. Selection of the *appropriate* analysis is often more challenging than performing the computation, and vastly more important.

Qualitative data are usually recorded in the form of words rather than numbers. Often the data reflect an attempt to capture the perceptions of the participants from the inside. Most analysis of qualitative data is also undertaken with words as the researcher attempts to isolate themes, identify trends, interpret, explain, and even undertake conceptual comparisons. Some consider qualitative data to be less about behavior and more about actions—and these actions carry implications about intentions, meanings, and consequences (Dalute & Lightfoot, 2004; Denzin & Lincoln, 2005; Neuman, 2006). While some beginning students may find comfort in the absence of mathematics, they should understand from the outset that qualitative analysis is not any easier and it is a very time-consuming and intense process.

Interpretation From Results

The data or results are not an end but merely a means by which educational, behavioral, and social descriptions may be made. Such a statement may appear somewhat obvious, but beginning researchers often have the mistaken impression that once the data are analyzed, the study is completed. Quite the contrary. One of the most exciting processes has just begun—that of data interpretation and inference. *Inference* is the interpretive process a researcher uses to construct a descriptive statement from the data; it is the explanation and interpretation of the results. Principally based on logical conclusions from the data (related back to the research question that prompted the study), the outcome of the inference may be found primarily in discussion sections of research articles.

Why It Happened and What It Means

When making an inference, it is not appropriate to use a "shotgun" search for explanations. During this part of the research process, data are examined in a way that attempts to close the information loop. At the beginning of the study, there was a research question. This question was distilled, details were defined, some hypotheses were generated, and an investigation was designed and executed to gather data relevant to that question. The process of interpretation and inference translates the results back into behavioral descriptions of what happened in order to propose an answer to the original research question. Figure 2.1 illustrated the closed-loop conceptualization of the research process and the role of inference in that model. The researcher builds a logic trail from the results to *infer* (1) why the results occurred as they did, (2) what the results might mean for any theory or literature that was

involved in conceptualizing the study, (3) what the results might mean for practice or practical applications, and (4) what the next study or studies might be that are based on these findings.

One important point needs to be considered regarding the inferences drawn from data. For some beginners, there is a tendency to consider the results as "proving" that a particular interpretation is the case. For example, a beginning researcher might infer that his or her "results prove that long practice sessions are more effective for learning vocabulary than shorter, spaced practice sessions" (in fact evidence, suggests that this is not the case). There is probably no single term that makes an experienced researcher shudder as much as "prove." Quantitative science has its foundation based on chance or probability theory, and qualitative research emphasizes the uniqueness of interactions and events. A consequence of this is that results *tend* to confirm or support a descriptive statement, or, alternatively, the results *tend* to be in disagreement with or negate a statement.

In quantitative research, results of statistical analyses are stated in terms of probability. The statistical statement of $P < .05$, often seen in published research articles, means that "the results obtained may be expected to occur due to chance alone only 5 times out of 100." The reverse or flip side of this same statement addresses the presumed effects of the treatment. The results obtained may be expected because of influences other than chance (inferring the potency of your treatment) 95 times out of 100. Inferences in discussion sections of research articles are usually written in such terms as, "These results would seem to suggest . . ." rather than saying that the results "prove" certain statements. Quantitative researchers write this way because they are working from probability bases, not because they are that unsure of their work. Qualitative researchers are very clear about the fact that they are working with interpretations, explanations, and inferences from the observations they make. They, too, are working with some level of probability of correctness or some level of confidence. However, since qualitative investigators are not working with numbers, they do not assume to know what that probability is. They rely on the concept of trustworthiness to protect the research's rigor (see, for example, Cassell & Symon, 2004; Neuman, 2006).

Meaningful Interpretation

In the process of designing an investigation and interpreting the results, researchers (particularly experimental researchers) attempt to eliminate alternative explanations. If this is not accomplished and there are multiple possible explanations for a given result, the investigation has not been efficiently designed and a meaningful interpretation cannot be expected. Such an essential relationship between study design and study outcome also points up something that will be reflected throughout this text. Although the total research process is composed of several component functions, a crucial relationship ties each component together into an integrated operation. A serious weakness in any part of the research method threatens the worth of the total effort. Consequently, each segment must be addressed with equal seriousness and with consideration for its bearing on every other segment.

Chapter Summary

- Research ideas emerge from many different sources including journal articles, literature reviews, previous studies, and combinations of these plus personal experiences.
- Justifications for conducting studies may include the fact that a topic has not been investigated before, previous studies contained flaws in their methods, and studies have not been conducted with a particular group of participants, and they always include the reasons why the topic is important for the educational well-being of students.
- Distilling a research idea involves refining the topic into an increasingly specific and focused statement until it can be summarized into an explicit research question or set of research questions.
- Descriptive research questions ask "what is" and describe a group of participants, a setting, or a procedure. Difference questions make comparisons between groups, between times (e.g., before and after a treatment), or between groups that have received different treatments. Relationship questions explore the degree to which two or more phenomena relate or vary together in a group, such as measured intelligence and reading scores.
- Operational definitions during idea distillation include specifically defining the steps to be taken in implementing the study; describing what measurements are to be taken; and writing down the details of participant characteristics, the settings where data are to be collected, and all other factors important to actually conducting the study.
- Null hypotheses predict no differences (for difference questions) or no relationship (for relationship questions), while directional hypotheses predict which group will perform better or that there will be a relationship between measures.
- The design or plan for a study will include very specific details about what type of question is being asked, what the experimental variable is for a difference question, and what the criterion measure will be in specific terms. The design will also outline steps to be taken to maximize data reliability, exactly who the participants are, and details of an operational script for the researcher to follow in conducting the study.
- Data collection will involve administering the questionnaire if one is being used, administering a test, and observing or conducting an interview with the participants. Specific pre-implementation planning should be written down completely and pilot or practice sessions should be conducted with individuals that are similar to the intended participants.
- The data analysis to be used will depend on the type of question being studied, the type of data collected, and the number of participants in the study. Selecting a data analysis at this point in the study will be aimed at noting that there are different analyses for each type of question and that selection is based on these factors. Interpreting results will involve constructing a descriptive statement of what happened and what it may mean in light of the literature reviewed and its implications for teaching or other educational practice.

Key Terms

Data analysis. Refers to a step in the research process where the investigator summarizes data collected and prepares it in a format to determine what occurred. For quantitative studies, data analysis will mean summarizing the numbers, whereas for qualitative studies, it will involve reviewing the narrative data to determine trends.

Data collection. The data collection phase of research refers to the actual execution of the investigation and involves recording data in some form. This may include the process of administering a questionnaire, conducting an interview, or presenting a math test or other type of test to a participant and recording responses.

Data reliability. Refers to how dependable the information is that the investigator collects. When a researcher repeatedly observes a behavior, how consistent is his or her recording of what occurred? The level of consistency will impact the reliability of the data.

Descriptive question. Descriptive questions ask "What is . . . ?" or "What does . . . ?": For example, what does this culture look like, what does this group look like, or at what level does a particular group of participants perform?

Difference question. Difference questions make comparisons and ask the question, "Is there a difference?" Comparisons may be made either between groups (e.g., between two groups of children receiving different math instruction) or between measurements within a single group (i.e., pre- and posttest performance by the same group).

Directional hypothesis. The directional hypothesis predicts a difference and the direction of that difference; for example, "Participants receiving treatment Method A will make significantly more correct responses than those receiving treatment Method B."

Hypothesis. A statement used in research to help clarify the research question. It is presented as a declarative statement of prediction. Two basic formats are used, the *null hypothesis* and the *directional hypothesis.*

Literature reviews. Literature reviews are articles or chapters in which an author has read and interpreted the published research studies on a given topic such as reading comprehension.

Null hypothesis. The null hypothesis predicts no difference; for example, "Participants will not differ in mean correct responses as a function of treatment method."

Participants. A term that refers to the individuals on whom the data are collected in a study.

Relationship question. Relationship questions explore the degree to which two or more phenomena relate or vary together such as intelligence level and reading skills.

Research idea. Topics identified by researchers that represent interesting areas for investigation. Research ideas often involve rather general topics, which are then refined into a more detailed, focused, and specific research question.

Student Study Site

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Simulation Feedback

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Simulation Feedback 2.1

Although a variety of approaches may be taken with any given problem distillation, the most obvious in relation to the instructions would appear to be as follows:

1. The beginning point is the idea statement, "Assess the effects of variation in teaching experience on material evaluation."

2. The experimental variable is *teaching experience.* This means that differing amounts of teaching experience will be involved in the subject characteristics. Probably one would want two or three levels of teaching experience represented, such as beginning teachers in their first year of teaching, teachers in their third year of experience, and teachers in their fifth year. Pressing this explanation a bit further, one may wish to constitute three groups of teachers, each with a different amount of experience. The diagram below presents a pictorial illustration of this experimental variable.

3. From the diagram below, it is evident that the three groups will be compared with regard to some variable. This leads to the principle of operational definition. Several parts of the idea require definition; one part is material evaluation, which is what will be measured. The subjects will be evaluating some material, and the researcher will be determining if the different amounts of experience (the experimental variable) influence the way in which the material is evaluated. In other words, do teachers who are in their first year of teaching, as a group, evaluate material differently from those in their third year of teaching or those in their fifth year? It will be necessary to define in operational terms what the material and the evaluation are to be. Exactly how will the researcher record or assess the teachers' evaluation of the material? You can see that this moves into the realm of what is to be measured. Are you going to have the teachers rate the material on some scale such as the following?

Excellent		Average		Poor
1	2	3	4	5

Begin thinking in operational terms as you distill the problem.