chapter 2

The Research Problem



LEARNING OBJECTIVES

After studying this chapter, you will be able to:

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

Photo above by Marlene Somsak

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

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

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

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

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

2-1 Sources of Problems

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

2-1a Experience

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

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

2-1b Related Literature

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

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

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

2-1c Theory

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

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

2-1d Noneducation Sources

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

2-1e Qualitative Research Problems

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

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Table 2.1 Differences between Quantitative and Qualitative Research Problems

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

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

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

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

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

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

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

2-2 Evaluating Research Problems

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

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

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

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

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

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

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

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

THINK ABOUT IT 2.1

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

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

Answers

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

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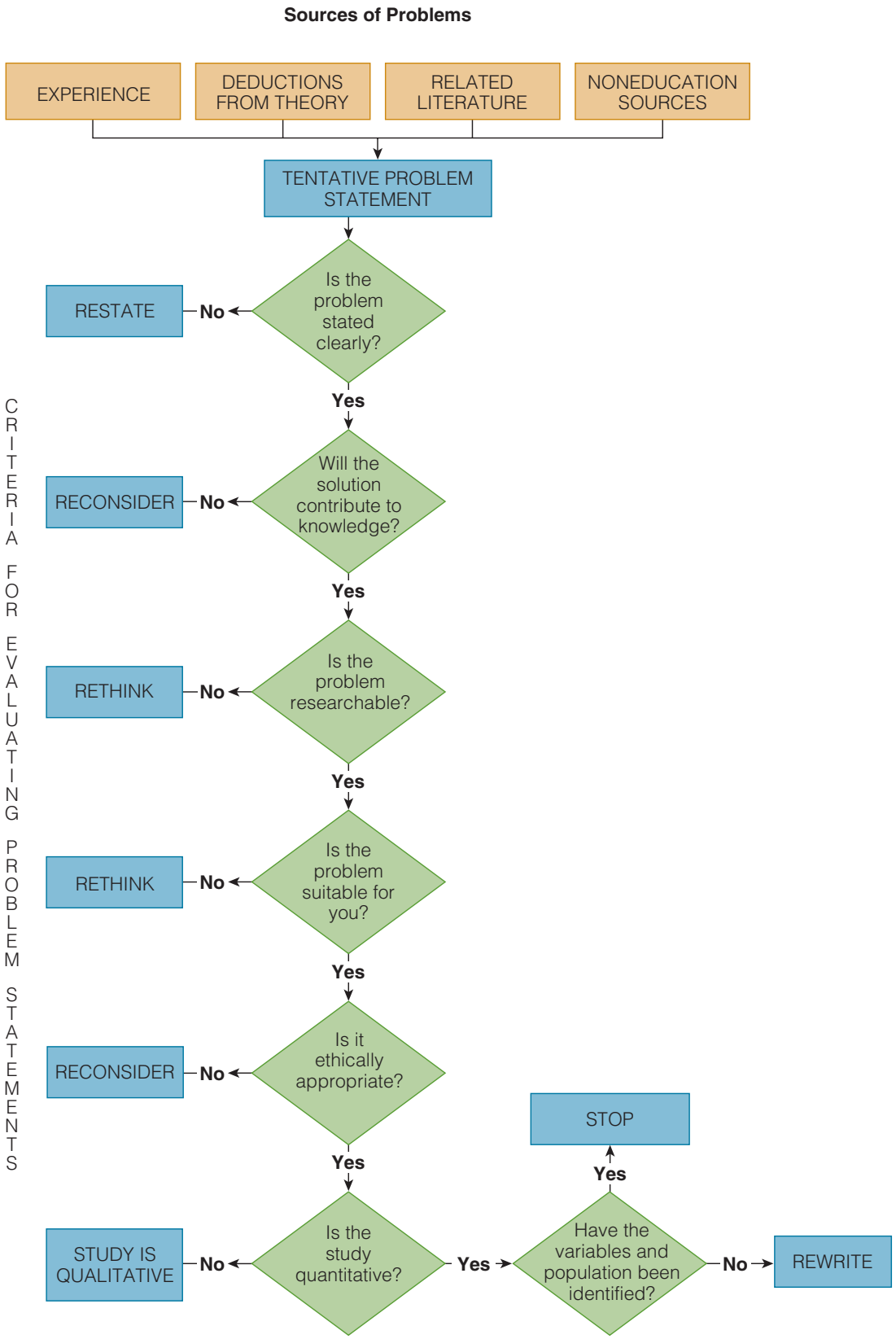


Figure 2.1 Developing a Research Problem

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2-3 The Research Question

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

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

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

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

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

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

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

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

2-4 The Hypothesis in Research

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

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

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

2-4a Purpose of the Hypothesis

The main purposes of the hypothesis in quantitative research are:

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

2-4b Characteristics of a Usable Hypothesis

Characteristics of a usable hypothesis include:

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

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

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THINK ABOUT IT 2.2

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

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

Answer

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

2-4c Types of Hypotheses

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

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

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

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

2-4d The Null Hypothesis

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

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

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

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

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

Testing a Null Hypothesis

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

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

2-5 The Quantitative Research Plan

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

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

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

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

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

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

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

2-5a Example of a Research Plan

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

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

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

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

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

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

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

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

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

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RESEARCH IN THE PUBLIC EYE

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

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

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

1. The main research question: "Will elementary school students who have mindfulness classes improve in terms of focus, ability to pay attention, academic performance and even empathy. ?????
2. Hypothesis: ???

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

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

Summary

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

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

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

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

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

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

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

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

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

Key Concepts

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

Exercises

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

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

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

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

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

Answers

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

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

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

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

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