HOW TO DESIGN AND EVALUATE RESEARCH IN EDUCATION, ELEVENTH EDITION

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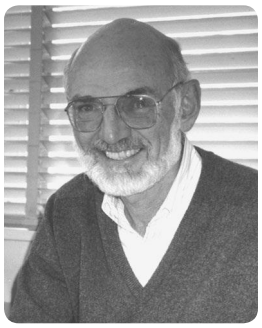
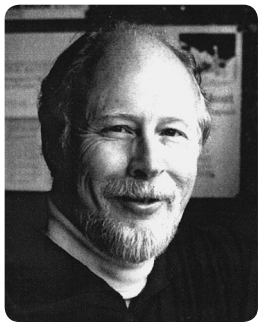


Courtesy of Norman E. Wallen

was Professor Emeritus of Interdisciplinary Studies in Education, and Director of the Research and Development Center, College of Education, San Francisco State University. He received his PhD from Stanford University and taught courses in research methodology for more than 30 years. In 1997, he received the James A. Michener prize in writing for his writings about the social studies and the social sciences. His recent work centered on advising and assisting faculty and students in generating and developing research projects.



Courtesy of Norman E. Wallen

is Professor Emeritus of Interdisciplinary Studies in Education at San Francisco State University. An experienced researcher, he received his PhD from Syracuse University and taught courses in statistics and research design to master's and doctoral students for many years. He is a former member of the City Council of Flagstaff, Arizona, and the Executive Committee, Grand Canyon Chapter of the Sierra Club.

Courtesy of Helen H. Hyun

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To Marianne, Ava, and Jeff for all their support

CONTENTS IN BRIEF

CONTENTS

How to Design and Evaluate Research in Education is directed to students taking their first course in educational research. Because this field continues to grow so rapidly with regard to both the knowledge it contains and the methodologies it employs, the authors of any introductory text are forced to carefully define their goals as a first step in deciding what to include in their book. In our case, we continually kept three main goals in mind. We wanted to produce a text that would:

1. Provide students with the basic information needed to understand the research process, from idea formulation through data analysis and interpretation.
2. Enable students to use this knowledge to design their own research study on a topic of personal interest.
3. Allow students to read and understand educational research literature.

The first two goals are intended to satisfy the needs of those students who must plan and carry out a research project as part of their course requirements. The third goal is aimed at students whose course requirements include learning how to read and understand the research of others. Many instructors, ourselves included, build all three goals into their courses, since each one seems to reinforce the others. It is hard to read and fully comprehend the research of others if you have not yourself gone through the process of designing and evaluating a research project. Similarly, the more you read and evaluate the research of others, the better equipped you will be to design your own meaningful and creative research. In order to achieve the above goals, we have developed a book with the following characteristics.

Goal one, to provide students with the basic information needed to understand the research process, has resulted in a nine-part book plan. Part 1 (Chapter 1) introduces students to the nature of educational research, briefly overviews each of the seven methodologies discussed later in the text, and presents an overview of the research process as well as criticisms of it.

Part 2 (Chapters 2 through 9) discusses the basic concepts and procedures that must be understood before one can engage in research intelligently or critique it meaningfully. These chapters explain variables, definitions, ethics, sampling, instrumentation, validity, reliability, and internal validity. These and other concepts are covered thoroughly, clearly, and relatively simply. Our emphasis throughout is to show students, by means of clear and appropriate examples, how to set up a research study in an educational setting on a question of interest and importance.

Part 3 (Chapters 10 through 12) describes in some detail the processes involved in collecting and analyzing data.

Part 4 (Chapters 13 through 17) describes and illustrates the methodologies most commonly used in quantitative educational research. Many key concepts presented in Part 2 are considered again in these chapters in order to illustrate their application to each methodology. Finally, most of the methodology chapters conclude with a carefully chosen study from the published research literature. Each study is analyzed by the authors with regard to both its strengths and weaknesses. Students are shown how to read and critically analyze a study they might find in the literature.

Part 5 (Chapters 18 through 20) and Part 6 (Chapters 21 through 22) discuss qualitative research. Part 5 begins the coverage by describing qualitative research, its philosophy, and essential features. It has been expanded to include various types of qualitative research. This is followed by an expanded treatment of both data collection

and analysis methods. Part 6 presents the qualitative methodologies of ethnography and historical research. As with the quantitative methodology chapters, most of them are followed by a carefully chosen research report from the published research literature, along with our analysis and critique.

Part 7 (Chapter 23) discusses Mixed-Methods Studies, which combine quantitative and qualitative methods. Again, as in other chapters, the discussion is followed by our analysis and critique of a research report we have chosen from the published research literature.

Part 8 (Chapter 24) describes the assumptions, characteristics, and steps of action research. We include classroom examples of action research questions to bring the subject to life.

Part 9 (Chapter 25) shows how to prepare a research proposal or report (involving a methodology of choice) that builds on the concepts and examples developed and illustrated in previous chapters.

To achieve our second goal of helping students learn to apply their knowledge of basic processes and methodologies, we organized the first 12 chapters in the same order that students normally follow in developing a research proposal or conducting a research project. Then we concluded each of these chapters with a research exercise that includes a fill-in problem sheet. These exercises allow students to apply their understanding of the major concepts of each chapter. When completed, these accumulated problem sheets will have led students through the step-by-step processes involved in designing their own research projects. Although this step-by-step development requires some revision of their work as they learn more about the research process, the gain in understanding that results as they slowly see their proposal develop "before their eyes" justifies the extra time and effort involved.

Problem Sheet templates are available electronically at McGraw Hill Connect®.

Our third goal, to enable students to read and understand the literature of educational research, has led us to conclude several of the methodology chapters with an annotated study that illustrates a particular research method. At the end of each study we analyze its strengths and weaknesses and offer suggestions on how it might be improved. Similarly, at the end of our chapter on writing research proposals and reports, we include a student research proposal that we have critiqued with marginal comments. This annotated proposal has proved an effective means of helping students understand both sound and questionable research practices.

Because students are typically anxious about the content of research courses, we have taken extraordinary care not to overwhelm them with dry, abstract discussions, and we have adopted an informal writing style. More than in any text to date, our presentations are laced with clarifying examples and with summarizing charts, tables, and diagrams. Our experience teaching research courses for more than 40 years has convinced us there is no such thing as having "too many" examples in a basic text.

In addition to the many examples and illustrations that are embedded in the text, we have built the following pedagogical features into the book: (a) a graphic organizer for each chapter; (b) chapter objectives; (c) chapter-opening examples; (d) end-of-chapter summaries; (e) key terms with page references; (f) discussion questions; and (g) an extensive end-of-book glossary.

A number of key additions, new illustrations, and improved or refined examples, terminology, and definitions have been incorporated in this edition to further meet the goals of the text. The References have been updated throughout to include the latest research and have been reformatted to reflect use of APA style, Research Exercises and Problem Sheets have been revised with more effective questions.

The Research Reports all have newly added margin comments intended to help students apply the text's concepts and also practice evaluating published studies on diverse topics.

How manipulatives affect the mathematics achievement of students in Nigerian schools.

'Belonging means you can go in': Children's perspectives and experiences of membership in kindergarten.

Students' perceptions of factors influencing their desire to major or not major in science.

How to Design and Evaluate Research in Education helps students become critical consumers of research

and prepares them to conduct and report their own research.

Chapter-opening Features: Each chapter begins with an illustration that visually introduces a topic or issues related to the chapter. This is followed by an outline of chapter content, chapter learning objectives, the *Interactive and Applied Learning* feature that lists related supplementary material, and a related vignette.

More About Research, Research Tips,* and *Controversies in Research: These informative sections help students to think critically about research while illustrating important techniques in educational research.

End-of-Chapter Learning Supports: The chapters conclude with a reminder of the supplementary resources available, a detailed Main Points section, a listing of Key Terms, and Questions for Discussion.

Chapters 1–12 include a **Research Exercise** and a **Problem Sheet** to aid students in the construction of a research project.

Chapters 13–14, 19, and 21–23 include an actual **Research Report** that has been annotated to highlight concepts discussed in the chapter.

How to Design and Evaluate Research in Education provides a comprehensive introduction to research that is brought to life through practical resources and examples for doing and reading research.

***Research Tips* boxes** provide practical suggestions for doing research.

The **Annotated Research Reports** at the conclusion of Chapters 13–14, 19, and 21–23 present students with research reports and author commentary on how the study authors have approached and supported their research.

Research Exercises and **Problems Sheets** at the conclusion of Chapters 1–13 are tools for students to use when creating their own research projects.

***Using Excel* boxes** show how these software programs can be used to calculate various statistics.

Chapter 24: ***Action and Teacher Research*** details how classroom teachers can and should do research to improve their teaching.

Chapter 25: ***Preparing Research Proposals and Reports*** walks the reader through proposal and report preparation.

Resources on the Online Learning Center Web site (see listing below) provide students with a place to start when gathering research tools.

The 11th edition of *How to Design and Evaluate Research in Education* is now available online with Connect®, McGraw Hill's integrated assignment and assessment platform. Connect also offers SmartBook for the new edition, which is the first adaptive reading experience proven to improve grades and help students study more effectively. All of the title's website and ancillary content is also available through Connect, including:

A full Test Bank of multiple-choice questions that test students on central concepts and ideas in each chapter.

An Instructor's Manual for each chapter with full chapter outlines, sample test questions, and discussion topics.

Lecture Slides for instructor use in class.

Directly and indirectly, many people have contributed to the preparation of this text. We will begin by acknowledging the students in our research classes, who, over the years, have taught us much. Also, we wish to thank the reviewers of this edition, whose generous comments have guided the preparation of this edition.

They include:

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We would also like to thank our spouses and children for their unflagging support during the highs and lows that inevitably accompany the preparation and updating of a text of this magnitude.

Jack R. Fraenkel

Norman E. Wallen

Helen H. Hyun

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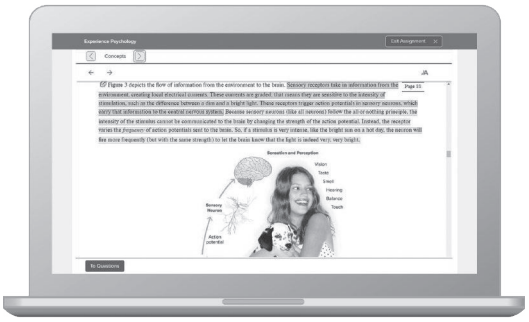

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- Jordan Cunningham,
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Welcome to How to Design and Evaluate Research in Education.

This comprehensive introduction to research methods was designed to present the basics of educational research in as interesting and understandable a way as possible. To accomplish this, we've created the following features for each chapter.

Each chapter opens with an illustrative depiction of a key concept that will be covered in the chapter.

Next, a chapter outline lists the topics to follow.

This special feature lists the practice activities and resources related to the chapter that are available in the student supplements.

Locating and Reviewing the Literature

Define the Problem as Precisely as Possible
Look Through One or Two Secondary Sources
Select the Appropriate General Reference Tools
Formulate Search Terms
Search Using General Reference Tools

Obtain Primary Sources

Researching the World Wide Web

Studying this chapter should enable you to:

Describe briefly why a literature review is of value.
Name the steps a researcher goes through in conducting a review of the literature.
Describe briefly the kinds of information contained in a general reference and give an example of such a source.
Explain the difference between a primary and a secondary source and give an example of each type.
Explain what is meant by the phrase "search term" and how it differs from the term "descriptor," and how both terms are used in literature searches.
Conduct both a manual and electronic search of the literature on a topic of interest to you after a small amount of "hands-on" computer time and a little help from a librarian.
Write a summary of your literature review.
Explain what a meta-analysis is.

After, or while, reading this chapter:

Go to McGraw Hill Connect® to:

Read the Guide to Electronic Research

Go to your online Student Mastery Activities book to do the following activities:

Activity 3.1: Library Worksheet
Activity 3.2: Where Would You Look?
Activity 3.3: Do a Computer Search of the Literature

fter a career in the military, Phil Gomez is in his first year as a teacher at an adult school in Logan, Utah. He teaches U.S. history to students who did not graduate from high school but who now are trying to obtain a diploma. He has learned the hard way, through trial and error, that there are a number of techniques that simply put students to sleep. He sincerely wants to be a good teacher, but he is having trouble getting his students interested in the subject. As he is the only history teacher in the school, the other teachers are not of much help.

He wants to get some ideas, therefore, about other approaches, strategies, and techniques that he might use. He decides to do an Internet search to see what he can find out about effective strategies for teaching high school history. His first search yields 12,847 hits! Phil is overwhelmed and at a loss for which sources to view. Should he look at books? Journal articles? Websites? Government documents? Unpublished reports? Where should he look for the most valid resources? And how could his searching be done more systematically?

In this chapter, you will learn some answers to these (and related) questions. When you have finished reading, you should have a number of ideas about how to conduct a systematic or "planned" search of the educational literature.

The chapter text begins with a practical example—a dialogue between researchers or a peek into a classroom—related to the content to follow.

Chapter objectives prepare the student for the chapter ahead.

Department of Health and Human Services Revised Regulations for Research with Human Subjects

he following HHS guidelines currently allow for exemption from IRB review for certain projects. However, please make sure to check with your IRB for their exempt research guidelines.

1. Research conducted in established or commonly accepted educational settings, involving normal educational practices, such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.
2. Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.
3. Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (b)(2) of this section, if: (i) the human subjects are elected or appointed public officials or candidates for public office; or (ii) federal statute(s) require(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.
4. Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.
5. Research and demonstration projects which are conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine: (i) Public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.
6. Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the Food and Drug Administration or approved by the Environmental Protection Agency or the Food Safety and Inspection Service of the U.S. Department of Agriculture.

U.S. Department of Health and Human Services, 45CFR 46.101(b)(1)–(6).

Research activities involving human subjects that are **exempt** from IRB review are identified in 45CFR 46.101(b)(1)–(6). (Institutions and IRBs may not create new categories of exempt research under 45 CFR Part 46.) Institutions should have a clear policy in place on who shall determine what research is exempt under .46.101(b).

*Source: Exempt Research and Research That May Undergo Expedited Review, www.hhs.gov/ohrp/policy/hsdc95-02.html

These boxes take a closer look at important topics in educational research. See a full listing of these boxes, starting on page xv.

These boxes provide practical pointers for doing research. See a full listing of these boxes on page xv.

Key Terms to Define in a Research Study

Terms necessary to ensure that the research question is sharply focused

Terms that individuals outside the field of study may not understand
Terms that have multiple meanings
Terms that are essential to understanding what the study is about
Terms to provide precision in specifications for instruments to be developed or located

c. At least half of every class period open for students to work on projects of their own choosing at their own pace
d. Several (more than three) sets of different kinds of educational materials available for every student in the class to use
e. Nontraditional seating–students sit in circles, small groupings of seats, or even on the floor to work on their projects
f. Frequent (at least two per week) discussions in which students are encouraged to give their opinions and ideas on topics being read about in their textbooks

3. As measured by the "Math Interest" questionnaire
4. As shown by attention to math tasks in class
5. As reflected by achievement in mathematics
6. As indicated by records showing enrollment in mathematics electives
7. As shown by effort expended in class
8. As demonstrated by number of optional assignments completed
9. As demonstrated by reading math books outside class
10. As observed by teacher aides using the "Mathematics Interest" observation record*

Ethical or Not?

n September 1998, a U.S. District Court judge halted a study begun in 1994 to evaluate the effectiveness of the U.S. Job Corps program. For two years, the researchers had randomly assigned 1 out of every 12 eligible applicants to a control group that was denied service for three years–a total of 6,000 applicants. If applicants refused to sign a waiver agreeing to participate in the study, they were told to reapply two years later. The class action lawsuit alleged psychological, emotional, and economic harm to the control subjects. The basis for the judge's decision was a failure to follow the federal law that required the methodology to be subject to public review. A preliminary settlement pledged to locate all of the control subjects by the year 2000, invite them into the Job Corps (if still eligible), and pay each person $1,000.*

In a letter to the editor† of *Mother Jones* in April 1999, however, Judith M. Gueron, the President of Manpower Demonstration Research Corporation (*not* the company awarded the evaluation grant) defended the study on two grounds: (1) since there were only limited available openings for the program, random selection of qualified applicants "is arguably fairer" than first-come, first-served; and (2) the alleged harm to those rejected is unknown, since they were free to seek other employment or training.

What do you think?

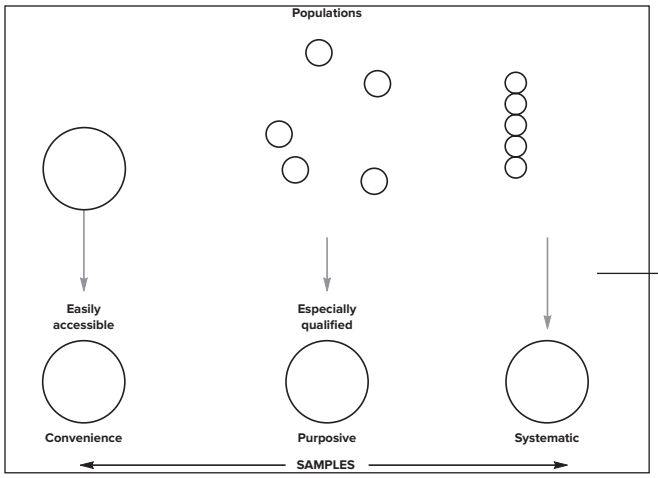
*Price, J. (1999, January/February). Job Corps lottery. *Mother Jones,* 21–22.
†Backtalk. (1999, April). *Mother Jones,* 13.

These boxes highlight a controversy in research to provide you with a greater understanding of the issue. See a full listing of these boxes on page xvi.

a study. In qualitative studies, however, the relationship between research and participant evolves over time. As Bogdan and Biklen suggest, doing qualitative research with informants can be "more like having a friendship than a contract. The people who are studied have a say in regulating the relationship and they continuously make decisions about their participation."[4] As a result, Bogdan and Biklen offer the following suggestions for qualitative researchers that might be considered when the criteria used by an IRB may not apply:[5]

1. Avoid research sites where informants may feel coerced to participate in the research.
2. Honor the privacy of informants–find a way to recruit informants so that they may choose to participate in the study.
3. Tell participants who are being interviewed how long the interview will take.
7. Tell the truth when findings are written up and reported. Mail in a separate card indicating that they completed the questionnaire.

One further legal matter should be mentioned. Attorneys, physicians, and members of the clergy are protected by laws concerning privileged communications (i.e., they are protected by law from having to reveal information given to them in confidence). Researchers do not have this protection. It is possible, therefore, that any subjects who admit, on a questionnaire, to having committed a crime could be arrested and prosecuted. As you can see, it would be a risk therefore for the participants in a research study to admit to a researcher that they had participated in a crime. If such information is required to attain the goals of a study, a researcher can avoid the problem by omitting all forms of identification



Numerous figures and tables explain or extend concepts presented in the text.

Published research reports are included at the conclusion of methodology chapters. The reports have been annotated to illustrate important points.

From: (2000, Summer). *The Journal of Psychohistory* 28(1), 62–71.

Vivian C. Fox
Worcester State College

This paper is concerned with a crucial period of self-actualization in the life of Lydia Ann Stow (1823–1904), an early nineteenth century Massachusetts woman who illustrates the interactions between adolescent development and the dynamics of reforms in education and feminism. The term "self-actualization" is adopted from Frederic L. Bender, who defines this Marxian concept as "the development of one's talents and abilities and, the pursuit of one's life interests in and through one's work."[1] Although self-actualization appears to be a highly individualized process, it always occurs in a larger social context. It is crucial to emphasize this in Lydia Stow's case since the most relevant context for her self-actualization was highly transitional in two important respects, namely, the development of educational theory and practice, and the evolution in the status of women.

The major source for describing Stow's self-actualization is the set of four Journals which she kept during the period of her training in Massachusetts as a professional teacher at the Lexington Normal School, and for about two years thereafter (July 8, 1839–February 23, 1843).[2]

In this paper I undertake a brief description of the contextual events before proceeding to an analysis of the Journals. I would like to start with school reform.

The process of school reform *that played such an important role* in Lydia's life was itself a reflection of a panoply of post-Revolution concerns. To some, the advent of technology was altering New England's predominantly rural work patterns through the construction of factories and railroads. Cities were growing larger, more varied, and increasingly sinister with vast numbers of immigrant-strangers, prostitutes and salesmen of magical drug products. The new arrivals were, moreover, largely untrained, uneducated and non-Anglo-Saxon men who appeared quickly to acquire political power at the ballot box. In view of these cascading changes, many wondered whether the glorious achievements of the Revolution could be maintained.[3]

To some, the appropriate response to these issues was in the direction of ensuring an educated citizenry. Leaders in this movement emerged in the Northeast, particularly in Massachusetts. Such Massachusetts men as Horace Mann, James G. Carter, Edward Everett, Edmund Dwight, Cyrus Peirce, and Henry Barnard who was from New York, supported the idea that a key to confronting post-Revolutionary challenges was in the field of educational reform.[4]

James G. Carter, for example, while Chairman of the Committee on Education of the Massachusetts House of Representatives, successfully established himself as the architect of an educational renaissance that included creation of a state-wide Board of Education. Horace Mann was appointed in 1837 as the first Secretary of the Board.[5]

Mann immediately launched a crusade, which continued during his twelve years of incumbency, from which his ideas spread throughout the nation. His accomplishments included a proliferation of the common schools, an expansion of their curriculum, and the training of

teachers in new approaches to teaching which encompassed a new philosophy of learning and moral discipline.[6]

He accepted the Republican view, moreover, that popular education was necessary for the intellectual and monetary enhancement of citizens which would contribute to the general well-being of the Republic. His beliefs emphasized that the new Republic required a high standard of morality in order to eliminate, as he put it, "the long catalogue of human ills."[7]

Central to achieving educational reform and progress was the provision of professional training for school teachers. Prior to this time, little or no training was required and persons with a minimal amount of education could take charge of classrooms.

Many of the ideas of Mann and his colleagues were obtained from Europe, especially from Prussia. Unlike its European counterparts, however, professional teacher training in what were called the Normal Schools (a title derived from the French École Normale) was open to females. In 1838 Massachusetts adopted a law authorizing the establishment of three Normal Schools. The first appeared in Lexington in 1839, and in accordance with the statute it was open only to females. The other two, in Barre and Bridgewater in 1840, were co-educational. Lydia was a member of the first class to enroll in Lexington.

Speaking for many reformers, Horace Mann emphasized the importance of employing female teachers.

> *Education . . . is woman's work. . . . Let woman, then be educated to the highest practicable point; not only because it is her right, but because it is essential to the world's progress. Let her voice be a familiar voice in the schools and the academies, and in halls of learning and science.*[8]

Mann was not, of course, the first to recognize appropriate roles for women in the educational enterprise. By the last part of the eighteenth century, for example, New England clergymen, struck by the greater church attendance of women, intoned that females were purer and more delicate than men, and advocated greater exposure to education for them as caretakers of the very young.[9] From the latter part of the eighteenth century, then, sons as well as daughters came to be under the pedagogy of their mothers, unlike in the prior period when fathers became responsible for the education of boys when they reached the age of seven. The assumption that women had special moral strengths—that they were "angels in the house"—gave them important credentials for both domestic and professional teaching roles.[10]

The call for women's education grew stronger as post-Revolutionary ideology expressed the sentiment that in a Republic, school education must become available to all citizens, both male and female. Boston, for example, allowed girls to be educated in its grammar school in 1789; and Dedham, Lydia's hometown, had already anticipated this as early as the 1750s. In a highly unusual development, one Mary Green was so successful a teacher that she was added to the permanent Dedham teaching staff.[11]

Clearly, when Lydia enrolled at Lexington she was riding the crest of unique educational opportunities. As detailed in the next section, this enhanced status of women as educators of the young was also strongly strengthened by demographic and economic conditions of the time.

Now I want to discuss the matter of gender reform.

At the same time that Mann and the other reformers were reconstructing the field of education so as to create new opportunities for women, their legal, social and economic circumstances generally were, paradoxically, much against the enhancement of their

We do not find a clear statement of purpose. In part because of the publication in which the study appears, *The Journal of Psychohistory,* we think the purpose could have been stated as, for example, "to enhance our understanding of the ways in which societal conditions and personal characteristics interact in producing valued qualities such as 'self-actualization.'" The justification implied in the introduction is that the life of Lydia Stow is important to understand; this is elaborated later under "Gender Reform."

There are no problems of risk, deception, or confidentiality.

A clear definition of *self-actualization* is given in the introduction. This is particularly important because not all definitions of this term include "pursuit of one's life interests in and through one's work." Other terms such as *self-improvement* and *concerned and active citizen* are probably clear enough in context.

There is no presentation of previous research, presumably because there is none that is directly relevant. If our interpretation of the author's purpose is correct, it may be that other biographies would be pertinent. There is no mention of other biographies of Stow. If they exist, they might have provided additional evidence.

None is stated. The "interaction" hypothesis is clearly implied; it appears likely that it conceptually preceded the analysis of the information.

The sampling issue is quite different in historical research as compared with other types of research. There typically is no population of persons to be sampled. It could be argued that a population of events exists, but if so, they are likely to be so different that selection among them makes more sense if done purposefully, in other words, a purposive sample. In this study, a population of persons could have been specified, though it's not clear what its characteristics would be–perhaps "nineteenth-century women who made a significant impact on education." A sample of such women would greatly increase the generalizability of findings but would, presumably, involve major problems in locating suitable source material.

There is no instrumentation in the sense that we discuss it in this text. The "instrument" in this case is the researcher's talent for locating, evaluating, and analyzing pertinent sources. The concept of reliability usually has little relevance to historical data, because each item is not meaningfully considered to be a sample across either content or time. In this study, however, comparison of journal statements pertaining to the same topic (e.g., self-confidence) could be made across the early two journals and, again, across the later two. These comparisons would give an indication of the consistency of these statements.

Validity, on the other hand, is paramount. It is addressed by evaluating sources and by comparing different sources regarding the same specifics. In this study, data are from two types of source. Secondary sources are used extensively in the sections on school reform and gender reform. The source of information about Stow is a primary one, her four journals. Some of the secondary sources could, it seems, have been used as cross-checks for validity, but this apparently was not done. The validity of the author's summaries of this information is supported, in some instances, by quotations from the journals and from other primary sources.

External criticism does not appear to be an issue with respect to the journals or, presumably, other references. The question of internal criticism is somewhat difficult to deal with, because the journals must be evaluated in terms of the writer's feelings and perceptions rather than events. Here, we are highly dependent on the researcher's summaries.

There is little to be said about procedures except that some discussion of the plans that the researcher developed and followed for analyzing the documents, particularly the journals, would be useful, especially so that readers could evaluate the presumed selection

Each research report is critiqued by the authors, with both its strengths and weaknesses discussed.

The chapter ends with a listing of the review resources available for students on McGraw Hill Connect®.

Go back to the feature at the beginning of the chapter for a listing of interactive and applied activities. Go to to take quizzes, practice with key terms, and review chapter content.

Main Points

Ethics refers to questions of right and wrong.

There are a number of ethical principles that all researchers should be aware of and apply to their investigations.

The basic ethical question for all researchers to consider is whether any physical or psychological harm could come to anyone as a result of the research.

All subjects in a research study should be assured that any data collected from or about them will be held in confidence.

The term *deception,* as used in research, refers to intentionally misinforming the subjects of a study as to some or all aspects of the research topic.

Plagiarism is the act of misrepresenting someone else's work as one's own.

Unintentional plagiarism can be avoided through the proper use and citation of published and unlisted sources.

Children as research subjects present problems for researchers that are different from those of adult subjects. Children are more vulnerable, have fewer legal rights, and often do not understand the meaning of *informed consent.*

Before any research involving human beings can be conducted at an institution that receives federal funds, it must be reviewed by an institutional review board (IRB) at the institution.

The federal agency that has the major responsibility for establishing the guidelines for research studies that involve human subjects is the Department of Health and Human Services.

Bulleted main points highlight the key concepts of the chapter.

Generalizing is possible in qualitative research, but it is of a type different from that found in quantitative studies. Most likely it will be done by interested practitioners.

The identities of all participants in a qualitative study should be protected, and they should be treated with respect.

Aspects of both qualitative and quantitative research often are used together in a study. Increased attention is being given to such mixed-methods studies. Whether qualitative or quantitative research is the most appropriate boils down to what the researcher wants to find out.

Key Terms

Key terms are listed with page references.

For Discussion

1. What do you see as the greatest strength of qualitative research? the biggest weakness?
2. Are there any topics or questions that could *not* be studied using a qualitative approach? If so, give an example. Is there any type of information that qualitative research cannot provide? If so, what might it be?
3. Qualitative researchers are sometimes accused of being too subjective. What do you think a qualitative researcher might say in response to such an accusation?
4. Qualitative researchers say that "complete" objectivity is impossible. Would you agree? Explain your reasoning.
5. "The essence of all good research is understanding, rather than an attempt to prove something." What does this statement mean?
6. "All researchers are biased to at least some degree. The important thing is to be aware of one's biases!" Is just being "aware" enough? What else might one do?
7. Qualitative researchers often say that "the whole is greater than the sum of its parts." What does this statement mean? What implications does it have for educational research?

End-of-chapter questions are designed for in-class discussion.

The research exercise explains how to fill in the Problem Sheet that follows.

Individually, the problem sheets allow students to apply their understanding of the major concepts of each chapter. As a whole, they walk students through each step of the research process.

The Research Question

Using Problem Sheet 2, restate the research problem you listed in Research Exercise 1 in a sentence or two, and then formulate a research question related to this problem. Now list all the key terms in the question that you think are not clear and need to be defined. Define each of these terms both constitutively and operationally, and then state why you think your question is an important one to study.

The Research Question

1. My research question(s) is/are: _____

2. The following are key terms in the problem or question that are not clear and thus need to be defined:

   a. _____ d. _____

   b. _____ e. _____

   c. _____ f. _____

3. Here are my constitutive definitions for these terms: _____

4. Here are my operational definitions for these terms: _____

5. My rationale for investigating this question/problem (why I would argue that it is an important question to investigate) is as follows: _____

An electronic version of this Problem Sheet that you can fill in and print, save, or e-mail is available on McGraw Hill Connect®.

Remote proctoring and browser-locking capabilities, hosted by Proctorio within Connect, provide control of the assessment environment by enabling security options and verifying the identity of the student.

Seamlessly integrated within Connect, these services allow instructors to control students' assessment experience by restricting browser activity, recording students' activity, and verifying students are doing their own work.

Instant and detailed reporting gives instructors an at-a-glance view of potential academic integrity concerns, thereby avoiding personal bias and supporting evidence-based claims.

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Implementing High-Quality Online Instruction and Assessment through Preconfigured Courseware

In consultation with the Online Learning Consortium (OLC) and our certified Faculty Consultants, McGraw Hill has created pre-configured courseware using OLC's quality scorecard to align with best practices in online course delivery. This turnkey courseware contains a combination of formative assessments, summative assessments, homework, and application activities, and can easily be customized to meet an individual's needs and course outcomes. For more information, visit https://www.mheducation.com/highered/olc.

Tegrity in Connect is a tool that makes class time available 24/7 by automatically capturing every lecture. With a simple one-click start-and-stop process, you capture all computer screens and corresponding audio in a format that is easy to search, frame by frame. Students can replay any part of any class with easy-to-use, browser-based viewing on a PC, Mac, iPod, or other mobile device.

Educators know that the more students can see, hear, and experience class resources, the better they learn. In fact, studies prove it. Tegrity's unique search feature helps students efficiently find what they need, when they need it, across an entire semester of class recordings. Help turn your students' study time into learning moments immediately supported by your lecture. With Tegrity, you also increase intent listening and class participation by easing students' concerns about note-taking. Using Tegrity in Connect will make it more likely you will see students' faces, not the tops of their heads.

Available within Connect, Test Builder is a cloud-based tool that enables instructors to format tests that can be printed, administered within a Learning Management System, or exported as a Word document of the test bank. Test Builder offers a modern, streamlined interface for easy content configuration that matches course needs, without requiring a download.

Test Builder allows you to:

- access all test bank content from a particular title.
- easily pinpoint the most relevant content through robust filtering options.
- manipulate the order of questions or scramble questions and/or answers.
- pin questions to a specific location within a test.
- determine your preferred treatment of algorithmic questions.
- choose the layout and spacing.
- add instructions and configure default settings.

Test Builder provides a secure interface for better protection of content and allows for just-in-time updates to flow directly into assessments.

Available within Connect and Connect Master, the Writing Assignment tool delivers a learning experience to help students improve their written communication skills and conceptual understanding. As an instructor you can assign, monitor, grade, and provide feedback on writing more efficiently and effectively.

Application-Based Activities in Connect are highly interactive, assignable exercises that provide students a safe space to apply the concepts they have learned to real-world, course-specific problems. Each Application-Based Activity involves the application of multiple concepts, allowing students to synthesize information and use critical thinking skills to solve realistic scenarios.

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The Nature of Research

Studying this chapter should enable you to:

Explain what is meant by the term "educational research" and give two examples of the kinds of topics educational researchers might investigate.
Explain why a knowledge of scientific research methodology can be of value to educators.
Name and give an example of four ways of knowing other than the method used by scientists.
Explain what is meant by the term "scientific method."
Give an example of six different types of research methodologies used by educational researchers.
Describe briefly what is meant by critical research.
Describe the differences among descriptive, associational, and intervention-type studies.
Describe briefly the difference between basic and applied research.
Describe briefly the difference between quantitative and qualitative research.
Describe briefly what is meant by mixed-methods research.
Describe briefly the basic components involved in the research process.

Go to McGraw Hill Connect® to:

Learn More About Why Research Is of Value

After, or while, reading this chapter:

Go to your online Student Mastery Activities book to do the following activities:

Activity 1.1: Empirical vs. Nonempirical Research
Activity 1.2: Basic vs. Applied Research
Activity 1.3: Types of Research
Activity 1.4: Assumptions
Activity 1.5: General Research Types

"

r. Rodriguez? I'm Molly Levine. I called you about getting some advice about the master's degree program in your department."

"Hi, Molly. Nice to meet you. Come on in. How can I help you?"

"Well, I'm thinking about enrolling in the master's degree program in marriage and family counseling, but first I want to know what the requirements are."

"I see. It's always wise to know what you're getting into. To obtain the degree, you'll need to take a number of courses, and there is also an oral exam once you have completed the required coursework. You'll also have to complete a small-scale study."

"What do you mean?"

"You will actually have to conduct some research."

"Wow! What does that involve? What do you mean by research, anyway? And how does one do it? What kinds of research are there?"

To find out the answers to Molly's questions, as well as a few others, read this chapter.

Some Examples

A high school principal in San Francisco wants to improve the morale of her faculty who are required to teach remotely.

The director of the gifted student program in Denver would like to know what happens during a typical week in an English class for advanced placement students.

An elementary school counselor in Boise wishes he could get more students to open up to him about their anxieties and problems.

A tenth-grade biology teacher in Atlanta wonders if flipped classrooms are more effective than lectures in motivating students to learn biological concepts.

A physical education teacher in Tulsa wonders if ability in one sport correlates with ability in other sports.

A seventh-grade student in Philadelphia asks her counselor what she can do to improve her study habits.

The president of the local PTA in Little Rock, parent of a sixth-grader at Cabrillo School, wonders how social media could be used to increase parent participation at the school.

Each of these examples, although fictional, represents a typical question or concern facing many of us in education today. Together, these examples suggest that teachers, counselors, administrators, parents, and students continually need information to do their jobs. Teachers need to know what kinds of materials, strategies, and activities best help students learn. Counselors need to know what problems hinder or prevent students from learning and how to help them with these problems. Administrators need to know how to provide an environment for happy and productive learning. Parents need to know how to help their children succeed in school. Students need to know how to study in order to learn as much as they can.

Ways of Obtaining Information

How can educators, parents, and students obtain the information they need? Many ways of obtaining information, of course, exist. One can consult experts, review books and articles, question or observe colleagues with relevant experience, examine one's own past experience, or even rely on intuition. All these approaches suggest possible ways to proceed, but the answers they provide are not always reliable. Experts may be mistaken; source documents may contain no insights of value; colleagues may have no experience in the matter; and one's own experience or intuition may be irrelevant or misunderstood.

This is why a knowledge of scientific research methodology can be of value. The scientific method provides us with another way of obtaining information—information that is as accurate and reliable as we can get. Let us compare it, therefore, with some of the other ways of knowing.

Sensory Knowledge

We see, we hear, we smell, we taste, we touch. Most of us have seen fireworks on the Fourth of July, heard the whine of a jet airplane's engines overhead, smelled a rose, tasted chocolate ice cream, and felt the wetness of a rainy day. The information we take in from the world through our senses is the most immediate way we have of knowing something. Using sensory experience as a means of obtaining information, the director of the gifted-student program mentioned at the start of this chapter, for example, might visit an advanced placement English class to see and hear what happens during a week or two of the semester.

Sensory data, to be sure, can be refined. Seeing the temperature on an outdoor thermometer can refine our knowledge of how cold it is; a top-quality audio system can help us hear Beethoven's Fifth Symphony with greater clarity; similarly, smell, taste, and touch can all be enhanced, and usually need to be. Many experiments in sensory perception have revealed that we are not always wise to trust our senses too completely. Our senses can (and often do) deceive us: The gunshot we hear becomes a car backfiring; the water we see in the road ahead is but a mirage; the hamburger we thought we tasted turns out to be soy-based meat.

Sensory knowledge is undependable; it is also incomplete. The data we take in through our senses do not account for all (or even most) of what we seem to feel is the range of human knowing. To obtain reliable knowledge, therefore, we cannot rely on our senses alone but must check what we think we know with other sources.

Common Knowledge

One such source is the opinions of others. Not only can we share our sensations with others, we can also check on the accuracy and authenticity of these sensations: Does this soup taste salty to you? Isn't that John over there? Did you hear someone cry for help? Smells like mustard, doesn't it?

Obviously, there is a great advantage to checking with others about whether they see or hear what we do. It can help us discard what is untrue and manage our lives more intelligently by focusing on what is true. If, while hiking in the woods, I do not hear the sound of an approaching automobile but several of my companions do and alert me to it, I can proceed with caution. All of us frequently discount our own sensations when others report that we are missing something or "seeing" things incorrectly. Using agreement with others as a means of obtaining information, the tenth-grade biology teacher in Atlanta, for example, might check with her colleagues to see if they find flipped classrooms more effective than lectures in motivating their students to learn.

The problem with such common knowledge is that it, too, can be wrong. A majority vote of a committee is no guarantee of the truth. My friends might be wrong about the presence of an approaching automobile, or the automobile they hear may be moving away from rather than toward us. Two groups of eyewitnesses to an accident may disagree as to which driver was at fault. Hence, we need to consider some additional ways to obtain reliable knowledge.

Expert Knowledge

Perhaps there are particular individuals we should consult—experts in their field, people who know a great deal about what we are interested in finding out. We are likely to believe a noted heart specialist, for example, if he says that Uncle Charlie has a bad heart. Surely, a person with a PhD in economics knows more than most of us do about what makes the economy tick. And shouldn't we believe our family dentist if she tells us that back molar has to be pulled? To use expert opinion as a means of obtaining information, perhaps the physical education teacher in Tulsa should ask a noted authority in the physical education field whether ability in one sport correlates with ability in another.

Well, maybe. It depends on the credentials of the experts and the nature of the question about which they are being consulted. Experts, like all of us, can be mistaken. For all their study and training, what experts know is still based primarily on what they have learned from reading and thinking, from listening to and observing others, and from their own experience. No expert, however, has studied or experienced all there is to know in a given field, and thus even an expert can never be totally sure. All any expert can do is give us an opinion based on what he or she knows, and no matter how much this is, it is never all there is to know. This assertion was never more true than in the 2016 U.S. presidential election in which political experts predicted a Hillary Clinton landslide victory over Donald Trump. President Trump's subsequent win came as a surprise to most election experts. Let us consider, then, another way of knowing: logic.

We also know things logically. Our intellect—our capability to reason things out—allows us to use sensory data to develop a new kind of knowledge. Consider the famous syllogism:

All human beings are mortal.
Sally is a human being.
Therefore, Sally is mortal.

To assert the first statement (called the *major premise*), we need only generalize from our experience about the mortality of individuals. We have never experienced anyone who was not mortal, so we state that all human beings are. The second statement (called the *minor premise*) is based entirely on sensory experience. We come in contact with Sally and classify her as a human being. We don't have to rely on our senses, then, to know that the third statement (called the *conclusion*) must be true. Logic tells us it is. As long as the first two statements are true, the third statement must be true.

Take the case of the counselor in Philadelphia who is asked to advise a student on how to improve her study habits. Using logic, she might present the following argument: Students who take notes on a regular basis in class find that their grades improve. If you take notes on a regular basis, then your grades should improve as well.

This is not all there is to logical reasoning, of course, but it is enough to give you an idea of another way of knowing. There is a fundamental danger in logical reasoning, however: It is only when the major and minor premises of a syllogism are *both* true that the conclusion is guaranteed to be true. If either of the premises is false, the conclusion may or may not be true.*

There is still another way of knowing to consider: the method of science.

When many people hear the word *science,* they think of things like white lab coats, laboratories, test tubes, or space exploration. Scientists are people who know a lot, and the term *science* suggests a tremendous body of knowledge. What we are interested in here, however, is science as a method of knowing. It is the

that is important to researchers.

What is this method? Essentially it involves testing ideas in the public arena. Almost all of us are capable of making connections—of seeing relationships and associations—among the sensory information we experience. Most of us then identify these connections as "facts"—items of knowledge about the world in which we live. We may speculate, for example, that our students may be less attentive in class when we lecture than when we engage them in discussion. A physician may guess that people who sleep between six and eight hours each night will be less anxious than those who sleep more or less than that amount. A counselor may feel that students read less than they used to because they spend most of their free time on social media. But in each of these cases, we do not really know if our belief is true. What we are dealing with are only guesses or hunches, or as scientists would say, hypotheses.

What we must do now is put each of these guesses or hunches to a rigorous test to see if it holds up under more controlled conditions. To investigate our speculation on attentiveness scientifically, we can observe carefully and systematically how attentive our students are when we lecture and when we hold a class discussion. The physician can count the number of hours individuals sleep, then measure and compare their anxiety levels. The counselor can compare the reading habits of students with their daily social media use.

Such investigations, however, do not constitute science unless they are made public. This means that all aspects of the investigation are described in sufficient detail so that the study can be repeated by anyone who questions the results—provided, of course, that those interested possess the necessary competence and resources. Private procedures, speculations, and conclusions are not scientific until they are made public.

*In the note-taking example, the major premise (all students who take notes on a regular basis in class improve their grades) is probably *not* true.

There is nothing very mysterious, then, about how scientists work in their quest for reliable knowledge. In reality, many of us proceed this way when we try to reach an intelligent decision about a problem that is bothering us. These procedures can be boiled down to five distinct steps.

1. First, there is a problem of some sort—some disturbance in our lives that disrupts the normal or desirable state of affairs. Something is bothering us. For most of us who are not scientists, it may be a tension of some sort, a disruption in our normal routine. Examples would be if our students are not as attentive as we wish or if we have difficulty making friends. To the professional scientist, it may be an unexplained discrepancy in one's field of knowledge, a gap to be closed. Or it could be that we want to understand the practice of human sacrifice in terms of its historical significance.
2. Second, steps are taken to define more precisely the problem or the questions to be answered, to become clearer about exactly what the purpose of the study is. For example, we must think through what we mean by *student attentiveness* and why we consider it insufficient; the scientist must clarify what is meant by *human sacrifice* (e.g., how does it differ from murder?).
3. Third, we attempt to determine what kinds of information would solve the problem. Generally speaking, there are two possibilities: study what is already known or carry out a piece of research. As you will see, the first is a prerequisite for the second; the second is a major focus of this text. In preparation, we must be familiar with a wide range of possibilities for obtaining information, so as to get firsthand information on the problem. For example, the teacher might consider giving a questionnaire to students or having someone observe during class. The scientist might decide to examine historical accounts or spend time in societies where the practice of human sacrifice exists (or has until recently). Spelling out the details of information gathering is a major aspect of planning a research study.
4. Fourth, we must decide, as far as it is possible, how we will organize the information that we obtain. It is not uncommon, in both daily life and research, to discover that we cannot make sense of all the information we possess (sometimes referred to as *information overload*). Anyone attempting to understand another society while living in it has probably experienced this phenomenon. Our scientist will surely encounter this problem, but so will our teacher unless she has figured out how to handle the questionnaire and/or observational information that is obtained.
5. Fifth, after the information has been collected and analyzed, it must be interpreted. While this step may seem straightforward at first, this is seldom the case. As you will see, one of the most important parts of research is to avoid kidding ourselves. The teacher may conclude that her students are inattentive because they dislike lectures, but she may be misinterpreting the information. The scientist may conclude that human sacrifice is or was a means of trying to control nature, but this also may be incorrect.

In many studies, there are several possible explanations for a problem or phenomenon. These are called *hypotheses* and may occur at any stage of an investigation. Some researchers state a hypothesis (e.g., "Students are less attentive during lectures than during flipped classrooms") right at the beginning of a study. In other cases, hypotheses emerge as a study progresses, sometimes even when the information that has been collected is being analyzed and interpreted. The scientist might find that instances of sacrifice seemed to be more common after such societies made contact with other cultures, suggesting a hypothesis such as: "Sacrifice is more likely when traditional practices are threatened."

We want to stress two crucial features of scientific research: freedom of thought and public procedures. At every step, it is crucial that the researcher be as open as humanly possible to alternative ways of focusing and clarifying the problem, collecting and analyzing information, and interpreting results. Further, the process must be as public as possible. It is not a private game to be played by a group of insiders. The value of scientific research is that it can be *replicated* (i.e., repeated) by anyone interested in doing so.*

The general order of the scientific method, then, is as follows:

Identifying a problem or question
Clarifying the problem
Determining the information needed and how to obtain it
Organizing the information
Interpreting the results

*This is not to imply that replicating a study is a simple matter. It may require resources and training—and it may be impossible to repeat any study in exactly the same way it was done originally. The important principle, however, is that public evidence (as opposed to private experience) is the criterion for belief.

In short, the essence of all research originates in curiosity—a desire to find out how and why things happen, including why people do the things they do, as well as whether or not certain ways of doing things work better than others.

A common misperception of science fosters the idea that there are fixed, once-and-for-all answers to particular questions. This contributes to a common, but unfortunate, tendency to accept, and rigidly adhere to, oversimplified solutions to very complex problems. While certainty is appealing, it is contradictory to a fundamental premise of science: All conclusions are to be viewed as tentative and subject to change, should new ideas and new evidence warrant revision. It is particularly important for educational researchers to keep this in mind, since the demand for final answers from parents, administrators, teachers, and politicians can often be intense. An example of how science changes is shown in the More About Research box on page 8.

For many years, there has been a strong tendency in Western culture to value scientific information over all other kinds. In recent years, the limitations of this view have become increasingly recognized and discussed. In education, we would argue that other ways of knowing, in addition to the scientific, should at least be considered.

As we have seen, there are many ways to collect information about the world around us. Figure 1.1 on page 10 illustrates some of these ways of knowing.

[illegible]

All of us engage in actions that have some of the characteristics of formal research, although perhaps we do not realize this at the time. We try out new methods of teaching, new materials, new textbooks. We compare what we did this year with what we did last year. Teachers frequently ask students and colleagues their opinions about school and classroom activities. Counselors interview students, faculty, and parents about school activities. Administrators hold regular meetings to gauge how faculty members feel about various issues. School boards query administrators, administrators query teachers, teachers query students and each other.

We observe, we analyze, we question, we hypothesize, we evaluate. But rarely do we do these things systematically. Rarely do we observe under controlled conditions. Rarely are our instruments as accurate and reliable as they might be. Rarely do we use the variety of research techniques and methodologies at our disposal.

The term can mean any sort of "careful, systematic, patient study and investigation in some field of knowledge."[1] is concerned with clarifying underlying processes, with the hypothesis usually expressed as a theory. Researchers engaged in basic research studies are not particularly interested in examining the effectiveness of specific educational practices. An example of basic research might be an attempt to refine one or more stages of Erickson's psychological theory of development. , on the other hand, *is* interested in examining the effectiveness of particular educational practices. Researchers engaged in applied research studies *may or may not* want to investigate the degree to which certain theories are useful in practical settings. An example might be an attempt by a researcher to find out whether a particular theory of how children learn to read can be applied to first graders who are nonreaders. Many studies combine the two types of research. An example would be a study that examines the effects of particular teacher behaviors on students while also testing a theory of personality.

Many methodologies fit within the framework of research. If we learn how to use more of these methodologies where they are appropriate and if we can become more knowledgeable in our research efforts, we can obtain more reliable information upon which to base our educational decisions. Let us look, therefore, at some of the research methodologies we might use. We shall return to each of them in greater detail in Parts 4 and 5.

Another distinction involves the difference between and . Although we shall discuss the basic differences between these two types of research more fully in Chapter 18, we will provide a brief overview here. In the simplest sense, quantitative data deal primarily with numbers, whereas qualitative data primarily involve words. But this is too simple and too brief. Quantitative and qualitative methods differ in their assumptions about the purpose of research itself, methods utilized by researchers, kinds of studies undertaken, role of the researcher, and degree to which generalization is possible.

Quantitative researchers usually base their work on the belief that the world is a *single reality* that can be approximated by careful study. Qualitative researchers, on the other hand, are likely to assume that the world is

Chaos Theory

The origins of what is now known as are usually traced to the 1970s. Since then, it has come to occupy a prominent place in mathematics and the natural sciences and, to a lesser extent, in the social sciences.

Although the physical sciences have primarily been known for their basic laws, or "first principles," it has long been known by scientists that most of these laws hold precisely only under ideal conditions that are not found in the "real" world. Many phenomena, such as cloud formations, waterfall patterns, and even the weather, elude precise prediction. Chaos theorists argue that the natural laws that are so useful in science may, in themselves, be the exception rather than the rule.

Although precise prediction of such phenomena as the swing of a pendulum or what the weather will be at a particular time is in most cases impossible, repeated patterns, according to a major principle of chaos theory, can be discovered and used, even when the content of the phenomena is chaotic. Developments in computer technology, for example, have made it possible to translate an extremely long sequence of "data points," such as the test scores of a large group of individuals, into colored visual pictures of fascinating complexity and beauty. Surprisingly, these pictures show distinct patterns that are often quite similar across different content areas, such as physics, biology, economics, astronomy, and geography. Even more surprising is the finding that certain patterns recur as these pictures are enlarged. The most famous example is the "Mandlebrot Bug," shown in Photographs 1.1 and 1.2. Note that Photograph 1.2 is simply a magnification of a portion of Photograph 1.1. The tiny box in the lower left corner of Photograph 1.1 is magnified to produce the box in the upper left-hand corner of Photograph 1.2. The tiny box within this box is then, in turn, magnified to produce the larger portion of Photograph 1.2, including the reappearance of the "bug" in the lower right corner. The conclusion is that even with highly complex data (think of trying to predict the changes that might occur in a cloud formation), predictability exists if patterns can be found across time or when the scale of a phenomenon is increased.

We hope that this brief introduction has not only stimulated your interest in what has been called, by some, the third revolution in science during the twentieth century (the theory of relativity and the discovery of quantum mechanics being the first two), but also that it helps to make sense out of what we view as some implications for educational research. What are these implications?*

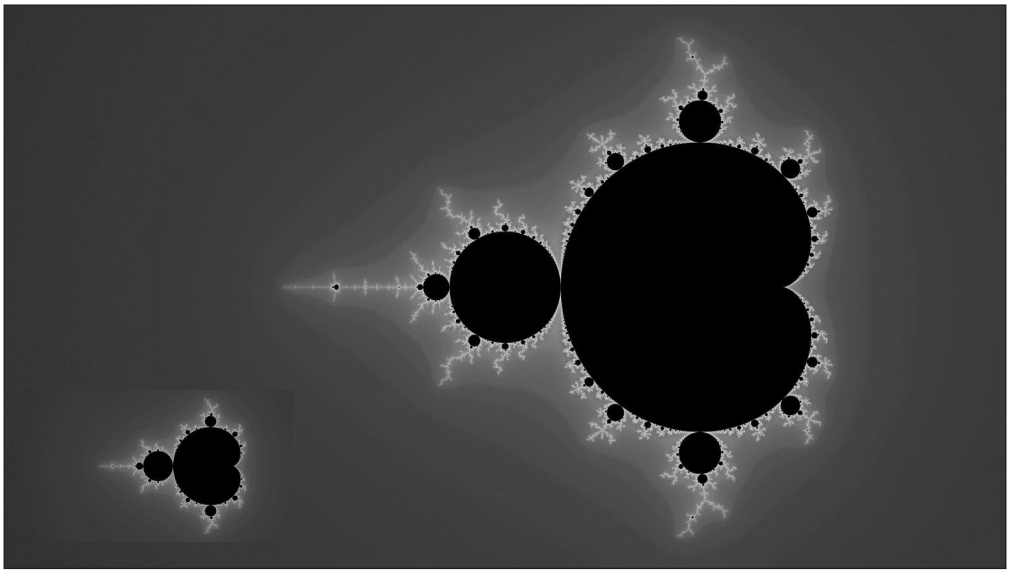
If chaos theory is correct, the difficulty in discovering widely generalizable rules or laws in education, let alone the social sciences in general, may not be due to inadequate concepts and theories or to insufficiently precise measurement and methodology, but may simply be an unavoidable fact about the world. Another implication is that whatever "laws" we do discover may be seriously limited in their applicability—across geography, across individual and/or group differences, and across time. If this is so, chaos theory provides support for researchers to concentrate on studying topics at the local level—classroom, school, agency—and for repeated studies over time to see if such laws hold up.

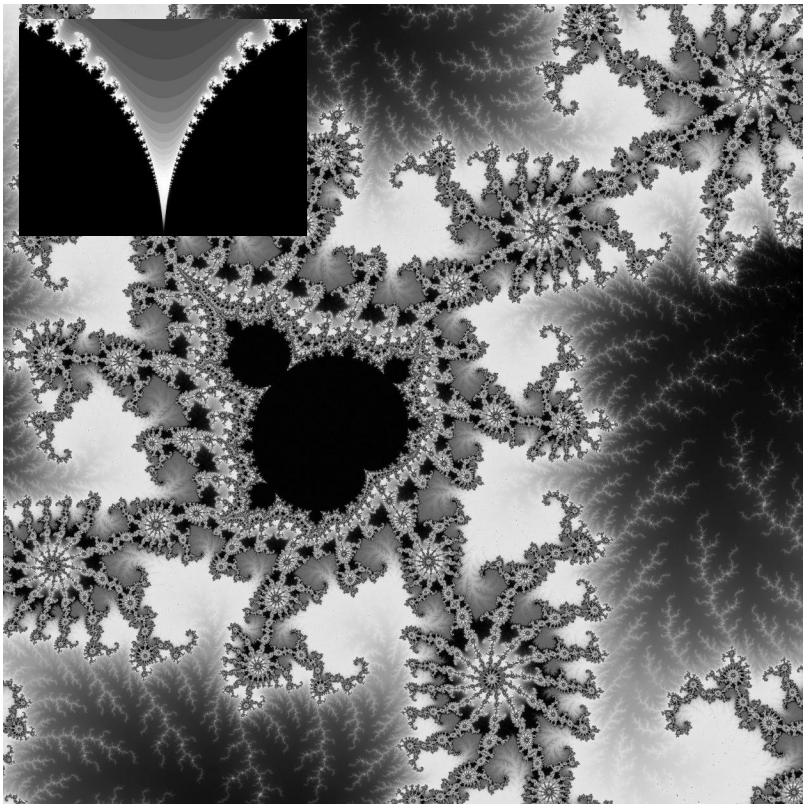
Another implication is that educators should pay more attention to the intensive study of the exceptional or the unusual, rather than treating such instances as trivial, incidental, or "errors." Yet another implication is that researchers should focus on predictability on a larger scale—that is, looking for patterns in individuals or groups over larger units of time. This would suggest a greater emphasis on long-term studies rather than the easier-to-conduct (and cheaper) short-time investigations that are currently the norm.

Not surprisingly, chaos theory has its critics. In education, the criticism is not of the theory itself, but more with misinterpretations and/or misapplications of it.† Chaos theorists do not say that all is chaos; quite the contrary, they say that we must pay more attention to chaotic phenomena and revise our conceptions of predictability. At the same time, the laws of gravity still hold, as, with less certainty, do many generalizations in education.

*For more extensive implications in the field of psychology, see Duke, M. P. (1994). Chaos theory and psychology: Seven propositions. *Genetic, Social and General Psychology Monographs, 120,* 267–286.

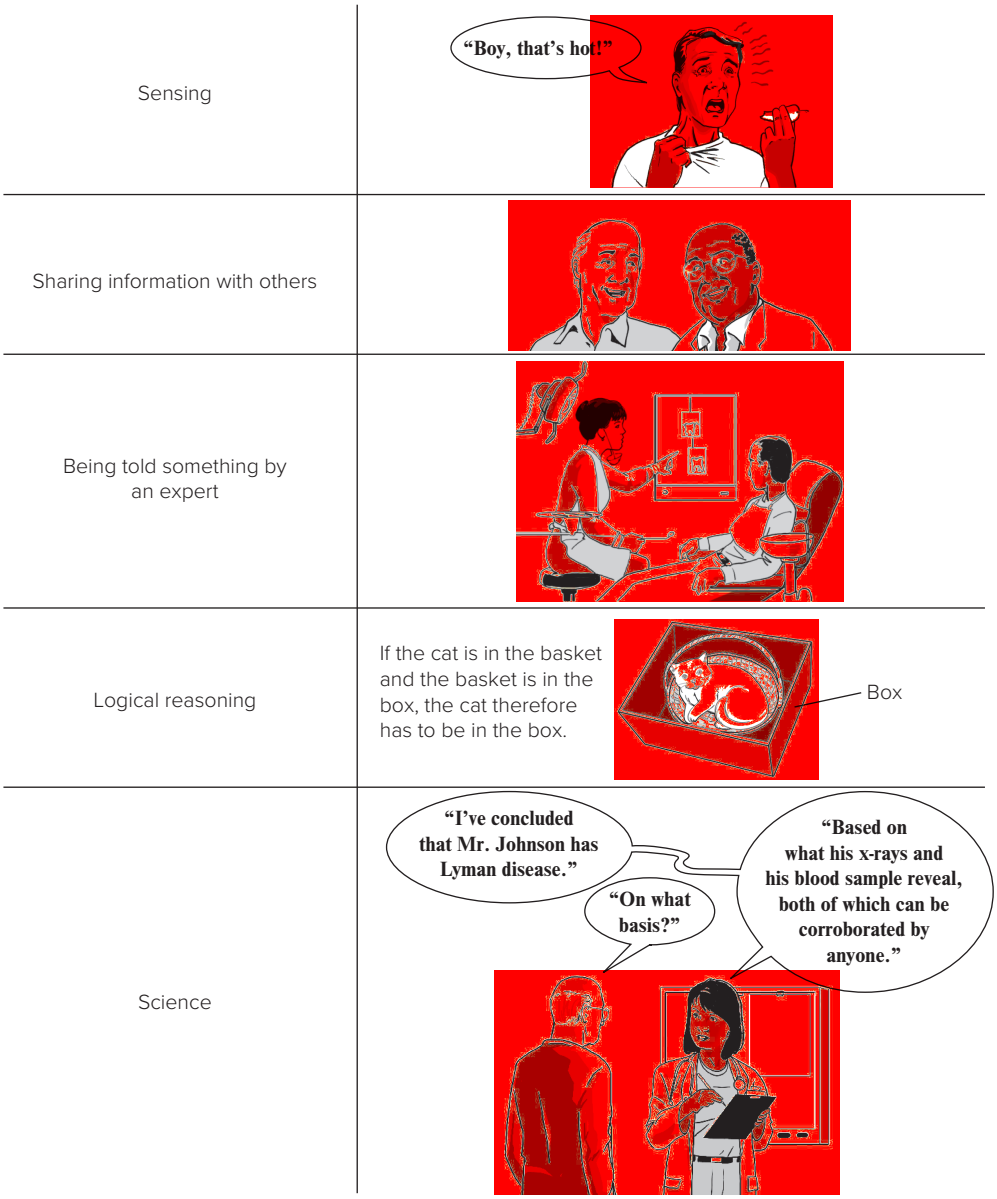
†See Hunter, W., Benson, J., & Garth, D. (1997). Arrows in time: The misapplication of chaos theory to education. *Journal of Curriculum Studies, 29,* 87–100.





The Mandlebrot Bug

(top) The Mandlebrot Bug iserp/Shutterstock; (bottom) Mandelbrot fractal Laguna Design/Science Photo Library/Alamy Stock Photo; (inset) Mathematical fractal structure wancl/123RF



Ways of Knowing

made up of *multiple realities,* socially constructed by different individual views of the same situation.

When it comes to the purpose of research, quantitative researchers seek to establish relationships between variables and look for and sometimes explain the *causes* of such relationships. Qualitative researchers, on the other hand, are more concerned with understanding situations and events from the viewpoint of the participants. Accordingly, the participants often tend to be directly involved in the research process itself.

Quantitative research has established widely agreed-on general formulations of steps that guide researchers in their work. Quantitative research designs tend to be *preestablished.* Qualitative researchers have a much greater flexibility in both the strategies and techniques they use and the overall research process itself. Their designs tend to *emerge* during the course of the research.

The ideal researcher role in quantitative research is that of a *detached* observer, whereas qualitative researchers tend to become *immersed* in the situations in which they do their research. The prototypical study in the quantitative tradition is the experiment; for qualitative researchers, it is an ethnography.

Lastly, most quantitative researchers want to establish generalizations that transcend the immediate situation or particular setting. Qualitative researchers, on the other hand, often do not even try to generalize beyond the particular situation, but may leave it to the reader to assess applicability. When they do generalize, their generalizations are usually very limited in scope.

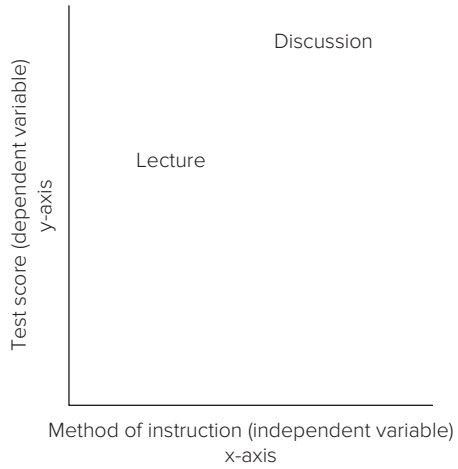
Many of the distinctions just described, of course, are not absolute. Sometimes researchers will use both qualitative and quantitative approaches in the same study. This kind of research is referred to as .
Its advantage is that by using multiple methods, researchers are better able to gather and analyze considerably more and different kinds of data than they would be able to using just one approach. Mixed-methods studies can emphasize one approach over the other or give each approach roughly equal weight.

Consider an example. It is often common in surveys to use closed-ended questions that lend themselves to quantitative analysis (such as through the calculation of percentages of different types of responses), and also open-ended questions that permit qualitative analysis (such as following up a response that interviewees give to a particular question with further questions by the researcher to encourage them to elaborate and explain their thinking).

Studies in which researchers use both quantitative and qualitative methods are becoming more common, as we will see in Chapter 23.

is the most conclusive of scientific methods. Because the researcher actually establishes different treatments and then studies their effects, results from this type of research are likely to lead to the most clear-cut interpretations.

Suppose a history teacher is interested in the following question: How can I most effectively teach important concepts (such as democracy or colonialism) to my students? The teacher might compare the effectiveness of two or more methods of instruction (usually called the *independent variable*) in promoting the learning of historical concepts. After systematically assigning students to contrasting forms of history instruction (such as inquiry versus programmed units), the teacher could compare the effects of these contrasting methods by testing students' conceptual knowledge. Student learning in each group could be assessed by an objective test or some other measuring device. If the average scores on the test (usually called the *dependent variable*) differed, they would give some idea of the effectiveness of the various methods. A simple graph could be plotted to show the results, as illustrated in Figure 1.2.



Example of Results of Experimental Research: Effect of Method of Instruction on History Test Scores[a]

[a]Many of the examples of data presented throughout this text, including that shown in Figure 1.2, are hypothetical. When actual data are shown, the source is indicated.

In the simplest sort of experiment, two contrasting methods are compared and an attempt is made to control for all other (extraneous) variables—such as student ability level, age, grade level, time, materials, and teacher characteristics—that might affect the outcome under investigation. Methods of such control could include holding the classes during the same or closely related periods of time, using the same materials in both groups, comparing students of the same age and grade level, and so on.

Of course, we want to have as much control as possible over the assignment of individuals to the various treatment groups, to ensure that the groups are similar. But in most schools, systematic assignment of students to treatment groups is difficult, if not impossible, to achieve. Nevertheless, useful comparisons are still possible. You might wish to compare the effect of different teaching methods (e.g., lectures versus flipped classrooms) on student achievement or attitudes in two or more *intact* history classes in the same school. If a

difference exists between the classes in terms of what is being measured, this result can suggest how the two methods compare, even though the exact causes of the difference would be somewhat in doubt. We discuss this type of experimental research in Chapter 13.

Another form of experimental research, , involves the intensive study of a single individual (or sometimes a single group) over time. These designs are particularly appropriate when studying individuals with special characteristics by means of direct observation. We discuss this type of research in Chapter 14.

Another type of research is done to determine relationships among two or more variables and to explore their implications for cause and effect; this is called . This type of research can help us make more intelligent predictions.

For instance, could a math teacher predict which sorts of individuals are likely to have trouble learning the subject matter of algebra? If we could make fairly accurate predictions in this regard, then perhaps we could suggest some corrective measures for teachers to use to help such individuals so that large numbers of "algebra-haters" are not produced.

How do we do this? First, we need to collect various kinds of information on students that we think is related to their achievement in algebra. Such information might include their performance on a number of tasks logically related to the learning of algebra (such as computational skills, ability to solve word problems, and understanding of math concepts), their verbal abilities, their study habits, aspects of their backgrounds, their early experiences with math courses and math teachers, the number and kinds of math courses they've taken, and anything else that might conceivably point to how those students who do well in math differ from those who do poorly.

We then examine the data to see if any relationships exist between some or all of these characteristics and subsequent success in algebra. Perhaps those who perform better in algebra have better computational skills or higher self-esteem or receive more attention from the teacher. Such information can help us predict more accurately the likelihood of learning difficulties for certain types of students in algebra courses. It may even suggest specific ways to help students learn better.

In short, correlational research seeks to investigate the extent to which one or more relationships of some type exist. The approach requires no manipulation or intervention on the part of the researcher other than administering the instrument(s) necessary to collect the data desired. In general, one would undertake this type of research to look for and describe relationships that may exist among naturally occurring phenomena, without trying in any way to alter these phenomena. We talk more about correlational research in Chapter 15.

Another type of research is intended to determine the cause for or the consequences of differences between groups of people; this is called . Suppose a teacher wants to determine whether students from single-parent families do more poorly in her course than students from two-parent families. To investigate this question experimentally, the teacher would systematically select two groups of students and then assign each to a single- or two-parent family—which is clearly impossible (not to mention unethical!).

To test this question using a causal-comparative design, the teacher might compare two groups of students who already belong to one or the other type of family to see if they differ in their achievement. Suppose the groups do differ. Can the teacher definitely conclude that the difference in family situation produced the difference in achievement? Alas, no. The teacher can conclude that a difference does exist but cannot say for sure what caused the difference.

Interpretations of causal-comparative research are limited, therefore, because the researcher cannot say conclusively whether a particular factor is a cause or a result of the behavior(s) observed. In the example presented here, the teacher cannot be certain whether (a) any perceived difference in achievement between the two groups is due to the difference in home situation, (b) the parent status is due to the difference in achievement between the two groups (although this seems unlikely), or (c) some unidentified factor is at work. Nevertheless, despite problems of interpretation, causal-comparative studies are of value in identifying *possible* causes of observed variations in the behavior patterns of students. In this respect, they are very similar to correlational studies. We discuss causal-comparative research in Chapter 16.

Another type of research obtains data to determine specific characteristics of a group. This is called

. Take the case of a middle school principal who wants to find out how his faculty feels about his administrative policies. What do they like about his policies? What do they dislike? Why? Which policies do they like the best or least?

These sorts of questions can best be answered through a variety of survey techniques that measure faculty attitudes toward the policies of the administration. A *descriptive survey* involves asking the same set of questions (often prepared in the form of a written questionnaire or ability test) of a large number of individuals either by (e)mail, by phone, or in person. When answers to a set of questions are solicited in person, the research is called an *interview.* Responses are then tabulated and reported, usually in the form of frequencies or percentages of those who answer in a particular way to each of the questions.

The difficulties involved in survey research are mainly threefold: (a) ensuring that the questions are clear and not misleading, (b) getting respondents to answer questions thoughtfully and honestly, and (c) getting a sufficient number of the questionnaires completed and returned to enable making meaningful analyses. The big advantage of survey research is that it has the potential to provide us with a lot of information obtained from quite a large sample of individuals.

If more details about particular survey questions are desired, the principal (or someone else) can conduct personal interviews with faculty. The advantages of an interview (over a questionnaire) are that open-ended questions (those requiring a response of some length) can be used with greater confidence, particular questions of special interest or value can be pursued in depth, follow-up questions can be asked, and items that are unclear can be explained. We discuss survey research in Chapter 17.

In all the examples presented so far, the questions being asked involve *how well, how much,* or *how efficiently* knowledge, attitudes, or opinions and the like exist or are being developed. Sometimes, however, researchers may wish to obtain a more complete picture of the educational process than answers to these questions provide. When they do, some form of *qualitative research* is called for. Qualitative research differs from the previous (quantitative) methodologies in both its methods and its underlying philosophy. In Chapter 18, we discuss these differences, along with recent efforts to reconcile the two approaches.

Consider the subject of physical education. Just how do physical education teachers teach their subject? What kinds of things do they do as they go about their daily routine? What sorts of things do students do? In what kinds of activities do they engage? What explicit and implicit rules of games in PE classes seem to help or hinder the process of learning?

To gain some insight into such concerns, an
can be conducted. The emphasis in this type of research is on documenting or portraying the everyday experiences of individuals by observing and interviewing them and relevant others. An elementary classroom, for example, might be observed on as regular a basis as possible, and the students and teacher involved might be interviewed in an attempt to describe, as fully and as richly as possible, what goes on in that classroom. Descriptions (a better word might be *portrayals*) might depict the social atmosphere of the classroom; the intellectual and emotional experiences of students; the manner in which the teacher acts toward and reacts to students of different ethnicities, sexes, or abilities; how the "rules" of the class are learned, modified, and enforced; the kinds of questions asked by the teacher and students; and so forth. The data could include detailed prose descriptions by students of classroom activities, audio of teacher-student conferences, video of classroom discussions, examples of teacher lesson plans and student work, sociograms depicting "power" relationships in the classroom, and flowcharts illustrating the direction and frequency of certain types of comments (e.g., the kinds of questions asked by teacher and students of one another and the responses that different kinds produce).

In addition to ethnographic research, qualitative research includes *historical research* (see Chapter 22) and several other, less commonly used approaches. Casey,[2] for example, has identified 18 types of "narrative" methods. In Chapter 18, we discuss four of the most distinctive of these. These include *biography,* where the researcher focuses on important experiences in the life of an individual and interacts with the person to clarify meanings and interpretations (e.g., a study of the career of a high school principal). In *phenomenology,* the researcher focuses on a particular phenomenon (such as school board conflict), collects data through in-depth interviews with participants, and then identifies what is common to their perceptions. A third approach is the
, in which a single individual, group, or important example is studied extensively and varied data are

collected and used to formulate interpretations applicable to the specific case (e.g., a particular school board) or to provide useful generalizations. Lastly, *grounded theory* emphasizes continual interplay between raw data and the researcher's interpretations that emerge from the data. Its central purpose is to inductively develop a theory from data (e.g., a study of teacher morale in a particular school beginning with interviews and other types of data).

You are probably already familiar with . In this type of research, some aspect of the past is studied, either by perusing documents of the period or by interviewing individuals who lived during the time. The researcher then attempts to reconstruct as accurately as possible what happened during that time and to explain why it did.

For example, a curriculum coordinator in a large urban school district might want to know what sorts of arguments have been made in the past as to what should be included in the social studies curriculum for grades K–12. She could read what various social studies and other curriculum theorists have written on the topic and then compare their positions. The major problems in historical research are making sure that the documents or individuals really did come from (or live during) the period under study and, once this is established, ascertaining that what the documents or individuals say is true. We discuss historical research in more detail in Chapter 22.

differ from all the preceding methodologies in two fundamental ways. The first is that generalization to other persons, settings, or situations is of minimal importance. Instead of searching for powerful generalizations, action researchers (often teachers or other education professionals, rather than professional researchers) focus on getting information that will enable them to change conditions in a particular situation in which they are personally involved. The primary purpose of teacher research is to improve practice. Examples would include improving the reading capabilities of students in a specific classroom, reducing tensions between ethnic groups in the lunchroom at a particular middle school, or identifying better ways to serve special education students in a specified school district. Accordingly, any of the methodologies discussed earlier may be appropriate.

The second difference involves the attention paid to the active involvement of the subjects* in a study (i.e., those on whom data is collected), as well as those likely to be affected by the study's outcomes. Commonly used terms in action research, therefore, are *participants* or *stakeholders,* reflecting an intent to involve them directly in the research process as part of "the research team." The extent of participation varies from just helping to select instruments and/or collect data to helping to formulate the research purpose and question to actually participating in all aspects of the research investigation from start to finish. We discuss teacher and action research in some detail in Chapter 24.

There are many different kinds of evaluations depending on the object being evaluated and the purpose of the evaluation. is usually described as either *formative* or *summative*. are intended to improve the object being evaluated; they help to form or strengthen it by examining the delivery of the program or technology and the quality of its implementation. In contrast, seek to examine the effects or outcomes of an object by describing what happens after the delivery of the program or technology in order to assess whether the object caused the outcome.

An example of a formative evaluation product is a needs assessment report. A determines the appropriate audience for the program, as well as the extent of the need and what might work to meet the need. Summative evaluations can be thought of as either (a) outcome evaluations, which investigate whether the program or technology appeared to have caused demonstrable effects on specifically defined target outcomes, or (b) impact evaluations, which are broader and attempt to assess the overall effects (intended or unintended) of the program or technology as a whole.

Evaluators ask many different kinds of questions and often use a variety of methods to address them. For example, in summative evaluations, evaluators often use quasi-experimental research designs to assess the hypothesized causal effects of a program. Formative evaluations that examine program implementation may also include analysis of existing data sources, surveys, interviews, observational data, and focus groups.

*"Participant" is also readily used now instead of "subject."

Should Some Research Methods Be Preferred over Others?

everal researchers* have expressed their concern that the U.S. Department of Education is showing favoritism toward the narrow view that experimental research is, if not the only, at least the most respectable form of research and the only one worthy of being called scientific. Such a preference has implications for both the funding of school programs and educational research. As one writer commented, "How scared should we be when the federal government endorses a particular view of science and rejects others?"†

*Berliner, D. C. (2002). Educational research: The hardest science of all. *Educational Researcher, 31* (8), 18–20; Erickson, F. E., & Gutierrez, K. (2002). Culture, rigor, and science in educational research. *Educational Researcher, 31*(8), 21–24.

†St. Pierre, E. A. (2002). Science rejects postmodernism. *Educational Researcher, 31* (8), 25.

It must be stressed that each of the research methodologies described so briefly here has value for us in education. Each constitutes a different way of inquiring into the realities that exist within our classrooms and schools and into the minds and emotions of teachers, counselors, administrators, parents, and students. Each represents a different tool for trying to understand what goes on, and what works, in schools. It is inappropriate to consider any one or two of these approaches as superior to any of the others. The effectiveness of a particular methodology depends in large part on the nature of the research question one wants to ask and the specific context within which the particular investigation is to take place. We need to gain insights into what goes on in education from as many perspectives as possible, and hence we need to construe research in broad rather than narrow terms.

As far as we are concerned, research in education should ask a variety of questions, move in a variety of directions, encompass a variety of methodologies, and use a variety of tools. Different research orientations, perspectives, and goals should be not only allowed but also encouraged. The intent of this book is to help you learn how and when to use several of these methodologies.

Advances in communication and digital technology have affected education researchers both in terms of subject matter and access to information. From studying the effects of computer-assisted instruction and distance learning to using Web-based surveys for data collection, technology continues to have a major impact on educational research. Along with these dynamic changes are important learning and teaching issues for students and faculty alike. Some examples include developing electronic information retrieval skills and critical evaluation strategies for assessing online resources. In Chapter 3, we discuss approaches for conducting electronic, manual, or hybrid searches to locate relevant sources in electronic or paper/print format, and provide guidelines for critically evaluating different types of sources. In Chapter 17, we discuss the advantages and disadvantages of Internet-based survey research, an increasingly popular data collection mode among researchers and students.

[redacted]

It is useful to consider the various research methodologies we have described as falling within one or more general research categories: descriptive, associational, or intervention-type studies.

describe a given state of affairs as fully and carefully as possible. One of the best examples of descriptive research is found in botany and zoology, where each variety of plant and animal species is meticulously described and information is organized into useful taxonomic categories.

In educational research, the most common descriptive methodology is the survey, as when researchers summarize the characteristics (abilities, preferences, behaviors, and so on) of individuals or groups or (sometimes) physical environments (such as schools). Qualitative

approaches, such as ethnographic and historical methodologies are also primarily descriptive in nature. Examples of descriptive studies in education include identifying the achievements of various groups of students; describing the behaviors of teachers, administrators, or counselors; describing the attitudes of parents; and describing the physical capabilities of schools. The description of phenomena is the starting point for all research endeavors.

Descriptive research in and of itself, however, is not very satisfying, since most researchers want to have a more complete understanding of people and things. This requires a more detailed analysis of the various aspects of phenomena and their interrelationships. Advances in biology, for example, have come about, in large part, as a result of the categorization of descriptions and the subsequent determination of relationships among these categories.

Educational researchers also want to do more than simply describe situations or events. They want to know how (or if), for example, differences in achievement are related to such things as teacher behavior, student diet, student interests, or parental attitudes. By exploring such possible relationships, researchers are able to understand phenomena more completely. Furthermore, the identification of relationships enables one to make predictions. If researchers know that student interest is related to achievement, for example, they can predict that students who are more interested in a subject will demonstrate higher achievement in that subject than students who are less interested. Research that investigates relationships is often referred to as . Correlational and causal-comparative methodologies are the principal examples of associational research. Other examples include studying relationships (a) between achievement and attitude, between childhood experiences and adult characteristics, or between teacher characteristics and student achievement—all of which are correlational studies—and (b) between methods of instruction and achievement (comparing students who have been taught by each method) or between gender and attitude (comparing attitudes of males and females)—both of which are causal-comparative studies.

As useful as associational studies are, they too are ultimately unsatisfying because they do not permit researchers to "do something" to influence or change outcomes. Simply determining that student interest is predictive of achievement does not tell us how to change or improve either interest or achievement, although it does suggest that increasing interest would increase achievement. To find out whether one thing will have an effect on something else, researchers need to conduct some form of intervention study.

In , a particular method or treatment is expected to influence one or more outcomes. Such studies enable researchers to assess, for example, the effectiveness of various teaching methods, curriculum models, classroom arrangements, and other efforts to influence the characteristics of individuals or groups. Intervention studies can also contribute to general knowledge by confirming (or failing to confirm) theoretical predictions (for instance, that abstract concepts can be taught to young children). The primary methodology used in intervention research is the experiment.

Some types of educational research may combine these three general approaches. Although historical, ethnographic, and other qualitative research methodologies are primarily descriptive in nature, at times they may be associational if the investigator examines relationships. A descriptive historical study of college entrance requirements over time that examines the relationship between those requirements and achievement in mathematics is also associational. An ethnographic study that describes in detail the daily activities of an inner-city high school and also finds a relationship between media attention and teacher morale in the school is both descriptive and associational. An investigation of the effects of different teaching methods on concept learning that also reports the relationship between concept learning and gender is an example of a study that is both an intervention and an associational-type study.

is an attempt to reduce the limitations of individual studies by trying to locate all of the studies on a particular topic and then using statistical means to synthesize the results of these studies. In Chapter 3, we discuss meta-analysis in more detail. In subsequent chapters, we examine in detail the limitations that are likely to be found in various types of research. Some apply to all types, while others are more likely to apply to particular types.

Critical Analysis of Research

There are some who feel that researchers who engage in the kinds of research we have just described take a bit too much for granted—indeed, that they make a number

of unwarranted (and usually unstated) assumptions about the nature of the world in which we live. These critics (usually referred to as) raise a number of philosophical, linguistic, ethical, and political questions not only about educational research as it is usually conducted but also about all fields of inquiry, ranging from the physical sciences to literature.

In an introductory text, we cannot hope to do justice to the many arguments and concerns these critics have raised over the years. What we can do is provide an introduction to some of the major questions they have repeatedly asked.

The first issue is *the question of reality:* As any beginning student of philosophy is well aware, there is no way to demonstrate whether anything "really exists." There is, for example, no way to prove conclusively to others that I am looking at what I call a *pencil* (e.g., others may not be able to see it; they may not be able to tell where I am looking; I may be dreaming). Further, it is easily demonstrated that different individuals may describe the same individual, action, or event quite differently—leading some critics to the conclusion that there is no such thing as reality, only individual (and different) perceptions of it. One implication of this view is that any search for knowledge about the "real" world is doomed to failure.

We would acknowledge that what the critics say is correct: We cannot, once and for all, "prove" anything, and there is no denying that perceptions differ. We would argue, however, that our commonsense notion of reality (that what most knowledgeable persons agree exists is what is real) has enabled humankind to solve many problems—even the question of how to put a man on the moon.

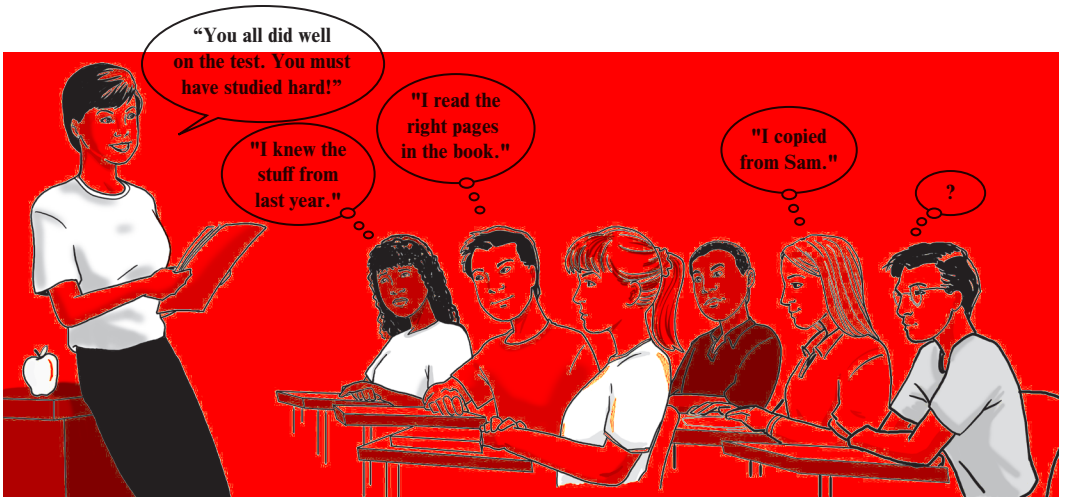
The second issue is *the question of communication*. Let us assume that we can agree that some things are "real." Even so, the critics argue that it is virtually impossible to show that we use the same terms to identify these things. For example, it is well known that the Inuit have many different words (and meanings) for the English word *snow*. To put it differently, no matter how carefully we define even a simple term such as *shoe,* the possibility always remains that one person's shoe is not another's. (Is a slipper a shoe? Is a shower clog a shoe?) If so much of language is imprecise, how then can relationships or laws—which try to indicate how various terms, things, or ideas are connected—be precise?

Again, we would agree. People often do not agree on the meaning of a word or phrase. We would argue, however (as we think would most researchers), that we can define terms clearly enough to enable different people to agree sufficiently about what words mean that they can communicate and thus get on with the acquisition of useful knowledge.

The third issue is *the question of values.* Historically, scientists have often claimed to be value free, that is, "objective," in their conduct of research. Critics have argued, however, that what is studied in the social sciences, including the topics and questions with which educational researchers are concerned, is never objective but rather socially constructed. Such things as teacher-student interaction in classrooms, the performance of students on examinations, the questions teachers ask, and a host of other issues and topics of concern to educators do not exist in a vacuum. They are influenced by the society and times in which people live. As a result, such topics and concerns, as well as how they are defined, inevitably reflect the *values* of that society. Further, even in the physical sciences, the choice of problems to study and the means of doing so reflect the values of the researchers involved.

Here, too, we would agree. We think that most researchers in education would acknowledge the validity of the critics' position. Many critical researchers charge, however, that such agreement is not sufficiently reflected in research reports. They say that many researchers fail to admit or identify "where they are coming from," especially in their discussions of the findings of their research.

The fourth issue is *the question of unstated assumptions.* An is anything that is taken for granted rather than tested or checked. Although this issue is similar to the previous issue, it is not limited to values but applies to both general and specific assumptions that researchers make with regard to a particular study. Some assumptions are so generally accepted that they are taken for granted by practically all social researchers (e.g., the sun will come out; the earth will continue to rotate). Other assumptions are more questionable. An example given by Krathwohl[3] clarifies this. He points out that if researchers change the assumptions under which they operate, this may lead to different consequences. If we assume, for example, that mentally limited students learn in the same way as other students but more slowly, then it follows that given sufficient time and motivation, they can achieve as well as other students. The consequences of this view are to give these individuals more time, to place them in classes where the competition is less intense, and to motivate them to achieve. If, on the other hand, we assume that they use different conceptual structures into which they fit what they learn, this assumption leads to a search for simplified conceptual structures they can learn



Is the Teacher's Assumption Correct?

that will result in learning that approximates that of other students. Frequently authors do not make such assumptions clear.

In many studies, researchers implicitly assume that the terms they use are clear, that their samples are appropriate, and that their measurements are accurate. Designing a good study can be seen as trying to reduce these kinds of assumptions to a minimum. Readers should always be given enough information so that they do not have to make such assumptions. Figure 1.3 illustrates how an assumption can often be incorrect.

The fifth issue is *the question of societal consequences.* Critical theorists argue that traditional research efforts (including those in education) predominantly serve political interests that are, at best, conservative or, at worst, oppressive. They point out that such research is almost always focused on improving existing practices rather than raising questions about the practices themselves. They argue that, intentional or not, the efforts of most educational researchers have served essentially to reinforce the status quo. A more extreme position alleges that educational institutions (including research), rather than enlightening the citizenry, have served instead to prepare them to be uncritical functionaries in an industrialized society.

We would agree with this general criticism but note that there have been a number of investigations of the status quo itself, followed by suggestions for improvement, that have been conducted and offered by researchers of a variety of political persuasions.

Let us examine each of these issues in relation to a hypothetical example. Suppose a researcher decides to study the effectiveness of a course in formal logic in improving the ability of high school students to analyze arguments and arrive at defensible conclusions from data. The researcher accordingly designs a study that is sound enough in terms of design to provide at least a partial answer as to the effectiveness of the course. Let us address the five issues presented in relation to this study.

1. *The question of reality:* The abilities in question (analyzing arguments and reaching accurate conclusions) clearly are abstractions. They have no physical reality per se. But does this mean that such abilities do not "exist" in any way whatsoever? Are they nothing more than artificial by-products of our conceptual language system? Clearly, this is not the case. Such abilities do indeed exist in a somewhat limited sense, as when we talk about the "ability" of a person to do well on tests. But is test performance indicative of how well a student can perform in real life? If it is not, is the performance of students on such tests important? A critic might allege that the ability to analyze, for example, is situation specific: Some people are good analyzers on tests; others, in public forums; others, of written materials; and so forth. If this is so, then the concept of a general ability to "analyze arguments" would be an illusion. We think a good argument can be made that this is not the case—based on commonsense experience and on some research findings. We must admit,

however, that the critic has a point (we don't know for sure how general this ability is), and one that should not be overlooked.

2. *The question of communication:* Assuming that these abilities do exist, can we define them well enough so that meaningful communication can result? We think so, but it is true that even the clearest definition does not always guarantee meaningful communication. This is often revealed when we discover that the way we use a term differs from how someone else uses the same term, despite previous agreement on a definition. We may agree, for example, that a "defensible conclusion" is one that does not contradict the data and that follows logically from the data, yet still find ourselves disagreeing as to whether or not a particular conclusion is a defensible one. Debates among scientists often boil down to differences as to what constitutes a defensible conclusion from data.
3. *The question of values:* Researchers who decide to investigate outcomes such as the ones in this study make the assumption that the outcomes are either desirable (and thus to be enhanced) or undesirable (and thus to be diminished), and they usually point out why this is so. Seldom, however, are the values (of the researchers) that led to the study of a particular outcome discussed. Are these outcomes studied because they are considered of highest priority? because they are traditional? socially acceptable? easier to study? financially rewarding?

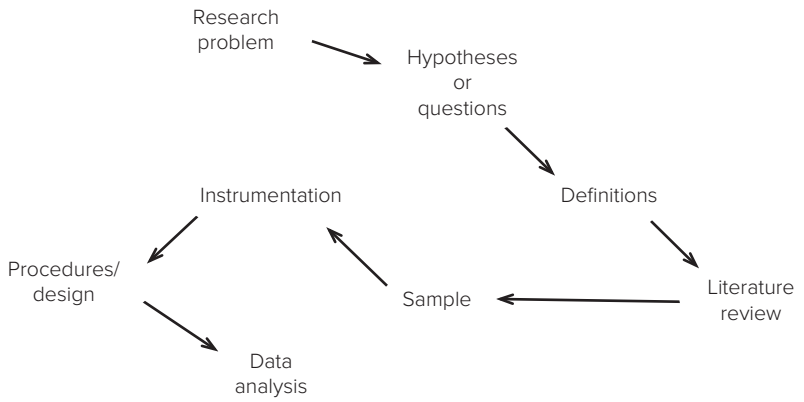
   The researcher's decision to study whether a course in logic will affect the ability of students to analyze arguments reflects his or her values. Both the outcomes and the method studied reflect Eurocentric ideas of value; the Aristotelian notion of the "rational man" (or woman) is not dominant in all cultures. Might some not claim, in fact, that we need people in our society who will question basic assumptions more than we need people who can argue well from these assumptions? While researchers probably cannot be expected to discuss such complex issues in every study, these critics render a service by urging all of us interested in research to think about how our values may affect our research endeavors.
4. *The question of unstated assumptions:* In carrying out such a study, the researcher is assuming not only that the outcome is desirable but also that the findings of the study will have some influence on educational practice. Otherwise, the study is nothing more than an academic exercise. Educational methods research has been often criticized for leading to suggested practices that, for various reasons, are unlikely to be implemented. While we believe that such studies should still be done, researchers have an obligation to make such assumptions clear and to discuss their reasonableness.
5. *The question of societal consequences:* Finally, let us consider the societal implications of a study such as this. Critics might allege that this study, while perhaps defensible as a scientific endeavor, will have a negative overall impact. How so? First by fostering the idea that the outcome being studied (the ability to analyze arguments) is more important than other outcomes (e.g., the ability to see novel or unusual relationships). This allegation has, in fact, been made for many years in education—that researchers have overemphasized the study of some outcomes at the expense of others.

   A second allegation might be that such research serves to perpetuate discrimination against the less privileged segments of society. If it is true, as some contend, that some cultures are more "linear" and others more "global," then a course in formal logic (being primarily linear) may increase the advantage already held by students from the dominant linear culture.[4] It can be argued that a fairer approach would teach a variety of argumentative methods, thereby capitalizing on the strengths of all cultural groups.

To summarize, we have attempted to present the major issues raised by an increasingly vocal part of the research community. These issues involve the nature of reality, the difficulty of communication, the recognition that values always affect research, unstated assumptions, and the consequences of research for society as a whole. While we do not agree with some of the specific criticisms raised by these writers, we believe the research enterprise is the better for their efforts.

A Brief Overview

Regardless of methodology, all researchers engage in a number of similar activities. Almost all research plans include, for example, a problem statement, a hypothesis, definitions, a literature review, a sample of subjects, tests or other measuring instruments, a description of procedures to be followed, including a time schedule, and a description of intended data analyses. We deal with each of these components in some detail throughout this book, but we want to give you a brief overview of them before we proceed.



The Research Process

Figure 1.4 presents a schematic of the research components. The solid-line arrows indicate the sequence in which the components are usually presented and described in research proposals and reports. They also indicate a useful sequence for planning a study (i.e., thinking about the research problem, followed by the hypothesis, followed by the definitions, and so forth). The broken-line arrows indicate the most likely departures from this sequence (e.g., consideration of instrumentation sometimes results in changes in the sample; clarifying the question may suggest which type of design is most appropriate). The nonlinear pattern is intended to point out that, in practice, the process does not necessarily follow a precise sequence. In fact, experienced researchers often consider many of these components simultaneously as they develop their research plan.

Statement of the research problem: The problem of a study sets the stage for everything else. The should be accompanied by a description of the background of the problem (what factors caused it to be a problem in the first place) and a rationale or justification for studying it. Any legal or ethical ramifications related to the problem should be discussed and resolved.

Formulation of an exploratory question or a hypothesis: Research problems are usually stated as questions, and often as hypotheses. A is a prediction, a statement of what specific results or outcomes are expected to occur. The hypotheses of a study should clearly indicate any relationships expected between the (the factors, characteristics, or conditions) being investigated and be so stated that they can be tested within a reasonable period of time. Not all studies are hypothesis-testing studies, but many are. In qualitative studies, stating a hypothesis is inappropriate due its exploratory nature. Increasingly so, however, qualitative researchers are using or "tentative hypotheses" to help guide their data collection and also possibly data analysis.

Definitions: All key terms in the problem statement and hypothesis or proposition should be defined as clearly as possible.

Review of the related literature: Other studies related to the research problem should be located and their results briefly summarized. The (of appropriate journals, reports, monographs, etc.) should shed light on what is already known about the problem and should indicate logically why the proposed study would result in an extension of this prior knowledge.

Sample: The * (the) or participants of the study and the larger group, or (to whom results are to be generalized), should be clearly identified. The sampling plan (the procedures by which the subjects will be selected) should be described.

Instrumentation: Each of the measuring or "data collection tools" (often referred to in qualitative research) used to collect data from the subjects should be described in detail, and a rationale should be given for its use.

*The term *subjects* is offensive to some because it can imply that those being studied are deprived of dignity. The term used to denote subjects in qualitative studies is *participants*. Due to differences in how findings are generalized in qualitative and quantitative studies, we feel the term *subjects* is more appropriate when discussing quantitative research, in general, and intervention studies in particular.

Procedures: The actual of the study—what the researcher will do (what, when, where, how, and with whom) from beginning to end, in the order in which they will occur—should be spelled out in detail (although this is not written in stone). This, of course, is much less feasible and appropriate in a qualitative study. A realistic time schedule outlining when various tasks are to be started, along with expected completion dates, should also be provided. All materials (e.g., textbooks) and/or equipment (e.g., computers) that will be used in the study should also be described. The general design or methodology (e.g., an experiment or a survey) to be used should be stated. In addition, possible sources of bias should be identified, and how they will be controlled should be explained.

Data analysis: Any statistical techniques, both descriptive and inferential, or coding techniques to be used in the should be described. The comparisons to be made to answer the research question should be made clear.

Go back to the feature at the beginning of the chapter for a listing of interactive and applied activities. Go to to take quizzes, practice with key terms, and review chapter content.

Main Points

The scientific method provides an important way to obtain accurate and reliable information.

There are many ways to obtain information, including sensory experience, agreement with others, expert opinion, logic, and the scientific method.
The scientific method is considered by researchers the most likely way to produce reliable and accurate knowledge.
The scientific method involves answering questions through systematic and public data collection and analysis.

Some of the most commonly used research methodologies in education are experimental research, correlational research, causal-comparative research, survey research, ethnographic research, historical research, teacher research, and action research.
Experimental research involves manipulating conditions and studying effects.
Correlational research involves studying relationships among variables within a single group and frequently suggests the possibility of cause and effect.
Causal-comparative research involves comparing known groups that have had different experiences to determine possible causes or consequences of group membership.
Survey research involves describing the characteristics of a group by means of such instruments as interview questions, questionnaires, and tests.
Ethnographic research concentrates on documenting or portraying the everyday experiences of people, using observation and interviews.