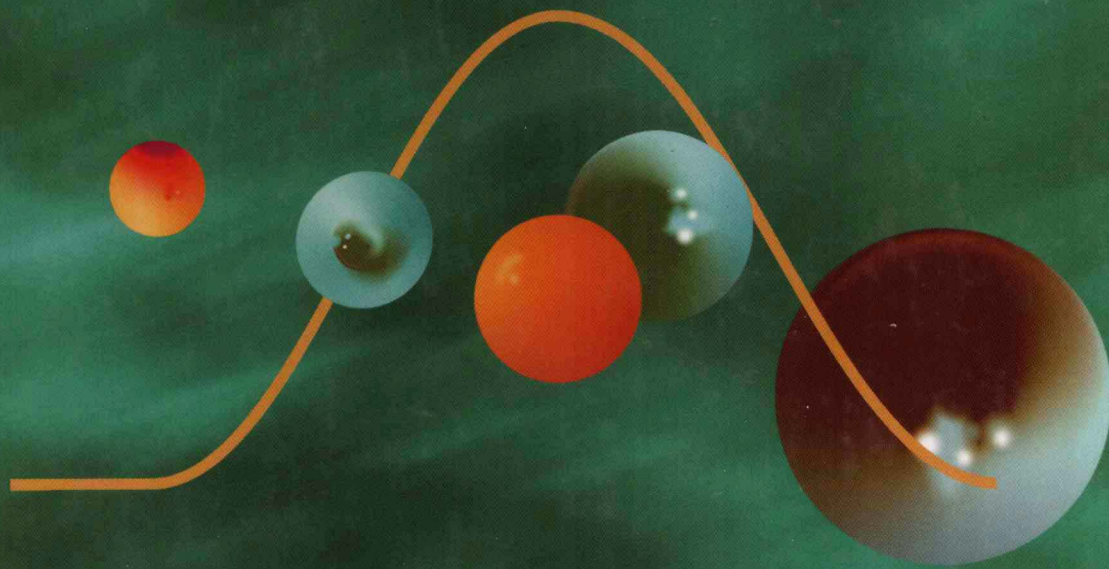


FOURTH EDITION

RESEARCH METHODS IN PHYSICAL ACTIVITY



JERRY R. THOMAS
JACK K. NELSON

RESEARCH METHODS IN PHYSICAL ACTIVITY

Fourth Edition

**Jerry R. Thomas, EdD
Jack K. Nelson, EdD**



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800-747-4457

e-mail: humank@hkusa.com

Canada: Human Kinetics, 475 Devonshire Road, Unit 100, Windsor, ON N8Y 2L5

800-465-7301 (in Canada only)

e-mail: orders@hkcanada.com

Europe: Human Kinetics, 107 Bradford Road, Stanningley

Leeds LS28 6AT, United Kingdom

+44 (0) 113 255 5665

e-mail: hk@hkeurope.com

Australia: Human Kinetics, 57A Price Avenue, Lower Mitcham, South Australia 5062

08 8277 1555

e-mail: liaw@hkaustralia.com

New Zealand: Human Kinetics, Division of Sports Distributors NZ Ltd.

P.O. Box 300 226 Albany, North Shore City, Auckland

0064 9 448 1207

e-mail: blairc@hknewz.com

Preface

Well, here we are in the fourth edition of this book. It seems like only a short time ago that we were unhappy with what was available for our field in research methods and set out to write our own book. The first edition, *Introduction to Research Methods in Health, Physical Education, Recreation, and Dance* (1985), and the second and third editions, *Research Methods in Physical Activity* (1990, 1996), were both well received by the graduate students and faculty at many institutions in the United States and around the world—in Australia, Canada, Great Britain, and several other countries. The book was mainly used for the first graduate research methods course, which frequently is required of master's students. We use the term *physical activity* in the title. Our intent is to include exercise science, human performance, kinesiology, movement studies, physical education, sport science, and sport studies to be certain that the disciplines dealing with the study of physical activity and the professions frequently associated with it are encompassed. We intend the contents of this book to apply conceptually to any aspect of the study of physical activity, in the context of exercise, sports, physical education instruction, industry, physical rehabilitation, and so on.

This fourth edition is still designed for the beginning master's student enrolled in the first research methods course. Of course, we hope it is useful for everyone with an interest in conducting and understanding research on physical activity. Do not hesitate to buy a copy or two for your own use or as a gift for a friend. What a wonderful birthday, holiday, or anniversary gift a copy of this book would make. (Disclaimer: *We take no responsibility for any divorce that results from using this book as an anniversary present.*)

This fourth edition has been reorganized slightly from the first three editions. Part I provides a complete overview of the research process, including developing the problem, using the library, preparing a prospectus, and understanding ethical issues in research and scholarship. Part II covers statistical and measurement concepts in research: description, relationships among variables, differences among groups, nonparametric procedures, and measurement issues associated with dependent variables. Part III presents various types of research: historical, philosophic, research synthesis, survey, other descriptive techniques, exercise epidemiology, experimental, and qualitative research. Finally, part IV provides information on completing the research process and ways of presenting research. The appendixes include statistical tables, a brief history of the field, suggested ways to deal with statistical analysis and the total process of writing research reports, and sample forms for securing permission to use human and animal participants in research.

We have made a number of revisions to this fourth edition, all of which are improvements, we hope. Several individuals provided helpful reviews of previous editions in various journals; we carefully read and evaluated these, noting the positive and muttering under our breath about the negative. We can commiserate with Day (1983, xi), whose book a reviewer described as “both good and original.” Unfortunately, the reviewer went on to add that “the part that is good is not original and the part that is original is not good.” Many of you told us directly what you liked and things you would like to see changed, added, or deleted. (Note that we have avoided the word *disliked*, as we hope none of you disliked the third edition, although a few did remark disparagingly about our sense of humor or lack thereof.) Thus, in this edition we include some new jokes, funny figures and

tables, and humorous sayings, as well as retaining the old ones that scored above 7 (on a scale of 1 to 10) on the applause meter.

We have made minor revisions and updated information in each of the chapters of part I, "Overview of the Research Process." In part II, "Statistical and Measurement Concepts in Research," we have added more on evaluating data and statistical power. We have eliminated the multivariate chapter, as we thought that provided more detail than most graduate students needed. We incorporated enough information to understand the various multivariate procedures into the chapters on relationships among variables (chapter 7) and differences among groups (chapter 8). Also, we completely revised the nonparametric chapter (chapter 9) to use a new and better approach that is parallel with chapters 7 and 8. The measurement chapter (chapter 10) has also been somewhat revised and updated.

In part III, "Types of Research," Nancy Struna has revised her chapter on historical research (chapter 11), and Scott Kretchmar from Pennsylvania State University has revised his chapter on philosophic research (chapter 12). We have added a new chapter (chapter 16) on exercise epidemiologic research written by Barbara Ainsworth with Chuck Matthews from the University of South Carolina. The excellent contributions of these scholars and writers should serve to encourage more students with research interests in sport history, sport philosophy, and exercise epidemiology. The chapter on descriptive research was very long; thus, we decided to split it into two chapters: survey research (chapter 14) and other descriptive research (chapter 15). We have also revised and updated the other chapters on types of research, with particular attention to the qualitative research chapter. Finally, in part IV, we have combined two chapters from the previous edition (the proposal and results and discussion) into a single chapter on completing the research process. The last chapter on organizing and presenting research has some minor revisions.

We are also grateful to the literary executor of the late Sir Ronald A. Fisher, F.R.S., to Dr. Frank Yates, F.R.S., and to Longman Group Ltd., London, for permission to reprint tables A.3 and A.5 from their book *Statistical Tables for Biological, Agricultural and Medical Research* (6th ed., 1974).

As we indicated in the first three editions, we have had a little help from our friends. As often as possible, we give credit through citation to the published literature. "But how about the many ideas and procedures that one has picked up from discussions with colleagues? After the passage of time, one can no longer remember who originated what idea. After the passage of even more time, it seems to me that all of the really good ideas originated with me, a proposition which I know is indefensible" (Day, 1983, p. xv).

We believe this book provides the necessary information for both the consumer and the producer of research. Although no amount of knowledge about the tools of research can replace expertise in the content area, it is unlikely that good scholars in the study of physical activity can function apart from the effective use of research tools. Researchers, teachers, technicians, health workers, exercise leaders, sport managers, athletic counselors, and coaches need to understand the research process. If they do not, they are forced to accept information on face value or the recommendation of others. Although neither is necessarily bad, the ability to carefully evaluate and reach a valid conclusion is the mark of a professional.

We firmly believe that the topic of research need not be presented in a dry, pompous manner. As in any human enterprise, there are humorous occurrences in the field of research. In fact, attempts at being overly dignified and scholarly lead to amusing and sometimes ludicrous results. Therefore, we have interjected a few anecdotes and sketches as well as some "laws" and "corollaries" to emphasize various points. We hope you will find them as enjoyable as we have in preparing them for this fourth edition. Our attempts at humor are designed to enliven the reading but not distract from the content. Research processes are not mysterious events that graduate students should fear. To the contrary, research processes are useful tools that every academic and professional should have access to; they are, in fact, the very basis by which we make competent decisions.

Jerry R. Thomas
Jack K. Nelson

Dear Potential Graduate Student:

Before you begin this book, it is necessary to determine if you are or have potential to be a graduate student. Score yourself one point for each of the following statements that applies to you.

You Might Be a Graduate Student If . . .

- your carrel is better decorated than your apartment.
- you have ever brought a scholarly article to a bar.
- you rate coffee shops by the availability of outlets for your laptop.
- you have ever discussed academic matters at a sporting event.
- you actually have a preference between microfilm and microfiche.
- you find the reference lists for articles more interesting than the actual text.
- you reflexively start analyzing those Greek letters before you realize that it's a sorority sweatshirt, not an equation.
- you find yourself explaining to children that you are in the "20th grade."
- you look forward to taking some time off to do laundry.
- you have more photocopy cards than credit cards.
- you start referring to stories as "Snow White et al."
- you wonder if APA style allows you to cite talking to yourself as a "personal communication."

Scoring Scale

- > 5 Probably a graduate student
- > 8 Definitely a master's student, maybe a doctoral student
- >10 Postdoctoral student

Humorously yours,

Professors of Research Methods

Acknowledgments

As in any work, there are numerous people who contributed to this book and whom we should recognize. Many of these individuals are former students and colleagues who have said or done things that better developed our ideas as expressed in these pages. Also, a number of faculty members who have used previous editions have either written reviews or made suggestions to us that have improved the book. While we cannot list or even recall all of these contributions, we do know you made them, and we thank all of you.

In particular, we thank Karen French at the University of South Carolina, Dick Magill at Louisiana State University, and Kathi Thomas at Iowa State University for allowing us to use materials that were published jointly with them. Scott Kretchmar, Nancy Struna, Barb Ainsworth, and Chuck Matthews made an invaluable contribution with their chapters on research methods in philosophy, history, and exercise epidemiology, topics that we simply could not write about effectively. Finally, Janice Fryer, Assistant Professor of Library Science at Iowa State University, reviewed chapter 2, “Developing the Problem and Using the Literature,” and made several valuable suggestions.

If you adopt this book for your class, we hope you will make use of the class teaching materials available on the Human Kinetics Web site. Included are over 300 Microsoft PowerPoint® slides, learning activities, test questions, and other course materials. We thank Phil Martin from Arizona State University and Steve Silverman from Teacher’s College at Columbia University for their contributions to these materials.

Finally, we thank the staff at Human Kinetics, in particular Jennifer Clark, our developmental editor for this edition, for their support and contributions. They have sharpened our thinking and improved our writing.

Jerry R. Thomas
Jack K. Nelson

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PART I

Overview of the Research Process

*The researches of many have thrown much darkness
on the subject and if they continue,
soon we shall know nothing at all about it.
—attributed to Mark Twain*



This part provides you with an overall perspective of the research process. The introductory chapter defines and reviews the various types of research done in physical activity and gives you some examples. We define science as systematic inquiry, and we discuss the steps in the scientific method. This logical method answers the following four questions (Day 1983, 4), which constitute the parts of a typical thesis, dissertation, or research report:

1. What was the problem? Your answer is the introduction.
2. How did you study the problem? Your answer is the materials and methods.
3. What did you find? Your answer is the results.
4. What do these findings mean? Your answer is the discussion.

We also present alternative approaches for doing research relative to a more philosophic discussion of science and ways of knowing. In particular, we address qualitative research, the use of field studies, and methods of

introspection as strategies for answering research questions instead of relying on the traditional scientific paradigm as the only approach to research problems.

Chapter 2 suggests ways of developing a problem and using the literature to clarify the research problem, specify hypotheses, and develop the methodology. In particular, we propose a system for searching, reading, analyzing, synthesizing, organizing, and writing the review of literature.

The next two chapters in part I present the format of the research proposal with examples. This information is typically required of the master's or doctoral student before collecting data for the thesis or dissertation. Chapter 3 defines and delimits the research problem, including the introduction, statement of the problem, research hypotheses, operational definitions, assumptions and limitations, and significance. Chapter 4 covers methodology, or how to do the research. Included are the topics of participant selection, instrumentation or apparatus, procedures, and design and analysis. We emphasize the value of pilot work conducted before the research and how cause and effect may be established.

Chapter 5 discusses ethical issues in research and scholarship. We include information on misconduct in science; ethical considerations in research writing, working with advisors, and copyright; and the use of humans and animals in research.

Once you have completed part I, you should better understand the research process. Then comes the tricky part: learning all the details. We consider these details in part II ("Statistical and Measurement Concepts in Research"), part III ("Types of Research"), and part IV ("Writing the Research Report").

Introduction to Research in Physical Activity

*If it weren't for the last minute,
nothing would get done.*



Mention the word *research*, and depending on his or her background, each person will conjure up a different picture. One might think of searching the Internet or going to the library; another might visualize a lab filled with test tubes, vials, and perhaps little white rats. It is important, then, as we begin a text on the subject, to establish a common understanding of research. In this chapter we introduce you to the nature of research. We do this by discussing methods of problem solving and types of research. We explain the research process and relate it to the parts of a thesis. By the time you reach the end of chapter 1, you should understand what research really involves.

The Nature of Research

The object of research is to determine how things are as compared to how they might be. To achieve this, research implies a careful and systematic means of solving problems and involves five characteristics (Tuckman, 1978):

- **Systematic.** Problem solving is accomplished through the identification and labeling of variables and is followed by the design of research that tests the relationships among these variables. Data are then collected that, when related to the variables, allow the evaluation of the problem and hypotheses.
- **Logical.** Examination of the procedures used in the research process allows researchers to evaluate the conclusions drawn.
- **Empirical.** The researcher collects data on which to base decisions.
- **Reductive.** The researcher takes individual events (data) and uses them to establish general relationships.
- **Replicable.** The research process is recorded, enabling others to test the findings by repeating the research or to build future research on previous results.

Problems to be solved come from many sources and can entail resolving controversial issues, testing theories, and trying to improve present practice. For example, a popular topic of concern is obesity and methods of losing weight. Suppose we want to investigate

applied research

Type of research that has direct value to practitioners but in which the researcher has limited control over the research setting.

hydrostatic weighing

Technique that measures body composition in which body density is computed by the ratio of an individual's weight in air and the loss of weight underwater.

this by comparing the effectiveness of two exercise programs in reducing fat. Of course, we know that caloric expenditure results in the loss of fat, so we will try to find out which program does this better under specified conditions. (Note: Our approach here is to give a simple, concise overview of a research study. We do not intend it to be a model of originality or sophistication.)

This study is definitely an example of **applied research** (more on this in the next section). Rather than try to measure the calories expended and so on, we approach it strictly from a programmatic standpoint. Say that we are operating a health club and that we offer aerobic dance and jogging classes for people who want to lose weight. Our research question is: Which program is more effective in reducing fat?

Suppose that we have a pool of participants to draw from and that we can randomly assign two thirds of them to the two exercise programs and one third to a control group. We have their scout's honor that no one is on a drastic diet or engaging in any other strenuous activities while the study is in progress. Both the aerobic dance and the jogging classes are one hour long and are held five times a week for 10 weeks. The same enthusiastic and immensely qualified instructor teaches both classes.

Our measure of fatness is the sum of skinfold measurements taken at eight body sites. Of course, we could use other measures, such as percentage of fat estimated from **hydrostatic weighing** (or total body water or some other estimate of fatness). However, we can defend our measures as valid and reliable indicators of fatness, and skinfolds are functional field measures. We measure all the participants, including those in the control group, at the beginning and the end of the 10-week period. During the study we try to ensure that the two programs are similar in procedural aspects, such as motivational techniques and the aesthetics of the surroundings. In other words, we do not favor one group by cheering them on but not encouraging the other; nor do we have one group exercise in an air-conditioned, cheerful, and healthful facility while the other has to sweat it out in some dingy room or parking lot. It is very important that we try to make the programs as similar as possible in every respect except the experimental treatments. The control group does not engage in any regular exercise.

After we have measured all the participants on our criterion of fatness at the end of the 10-week program, we are ready to analyze our data. We want to see how much change in skinfold thickness has occurred and whether there are differences between the two types of exercise. Because we are dealing with samples of people (from a whole universe of similar people), we need to use some type of statistics to establish how confident we can be in our results. In other words, we need to determine the significance of our results. Suppose the mean (average) scores for the groups are as follows:

- Aerobic dance = -21 mm
- Jogging = -25 mm
- Control = +8 mm

These values (which we made up) represent the average change in the combined skinfold thicknesses of the eight body sites. The two experimental groups lost fat, but the control group actually showed increased skinfold thicknesses over the 10-week period.

We decide to use the statistical technique of analysis of variance with repeated measures. We find a significant *F* ratio, indicating that significant differences exist among the three groups. Using a follow-up test procedure, we discover that both exercise groups are significantly different from the control group. But we find no significant difference between the aerobic dance and the jogging groups. (Many of you may not have the foggiest idea what we are talking about with the statistical terms *F* ratio and significance, but don't worry about it. All this is explained later. This book is about these kinds of things.)

Our conclusion from this study is that both aerobic dance and jogging are effective (apparently equally so) in bringing about a loss in fatness of overweight people (like the ones in our study) over 10 weeks. Although these results are reasonable, please remember that this is only an example. We can also pretend that this study was published in a prestigious journal and that we won the Nobel Prize.

Research Continuum

Research in our field can be placed on a continuum with applied research at one extreme and **basic research** at the opposite extreme. The research extremes have certain characteristics generally associated with them. Applied research tends to address immediate problems, to use so-called real-world settings, to use human participants, and to have limited control over the research setting, but to give results that are of direct value to practitioners. At the other extreme, basic research usually deals with theoretical problems. It uses the laboratory as the setting, frequently uses animals as subjects, carefully controls conditions, and produces results that have limited direct application. Christina (1989) suggested that basic and applied forms of research are useful in informing each other as to future research directions. Table 1.1 demonstrates how research problems in motor learning might vary along a basic to applied continuum depending on their goal and approach.

basic research

Type of research that may have limited direct application but in which the researcher has careful control of the conditions.

Table 1.1 Levels of Relevance of Motor Learning Research for Finding Solutions to Practical Problems in Sport

Level 1 Least direct relevance Basic research	Level 2 Moderate direct relevance Applied research	Level 3 Most direct relevance Applied research
Ultimate goal Develop theory-based knowledge appropriate for understanding motor learning in general with no requirement to demonstrate its relevance for solving practical problems.	Ultimate goal Develop theory-based knowledge appropriate for understanding the learning of sport skills in sport settings with no requirement to find immediate solutions to learning problems in sport.	Ultimate goal Find immediate solutions to learning problems in sport with no requirement to demonstrate or develop theory-based knowledge at either level 1 or level 2.
Main approach Test hypotheses in a laboratory setting using experimenter-designed motor tasks.	Main approach Test hypotheses in a sport setting or in a laboratory setting similar to it using sport skills or motor tasks that have properties of those skills.	Main approach Test solutions to specific learning problems in sport in the settings described under the applied research at level 2.

From "Whatever Happened to Applied Research in Motor Learning?" by R.W. Christina. In *Future Directions in Exercise and Sport Science Research* (p. 418) by J.S. Skinner et al. (Eds.), 1989, Champaign, IL: Human Kinetics. Copyright 1989 by James S. Skinner. Reprinted with permission.

To some extent, the strengths of applied research are the weaknesses of basic research, and vice versa. Considerable controversy exists in the literature on psychology, education, and physical activity (for examples, see Christina, 1989; Martens, 1979, 1987; Siedentop, 1980; J.R. Thomas, 1980) about whether research should be more basic or more applied. This issue, labeled **ecological validity**, deals with two concerns: Is the research setting perceived by the research participant in the way intended by the experimenter? Does the setting have enough of the real-world characteristics to allow generalizing to reality?

Of course, most research is neither purely applied nor purely basic but incorporates some degree of both. We believe that systematic efforts are needed in the study of physical activity to produce research that moves back and forth across Christina's (1989) levels of research (table 1.1). Excellent summaries of this type of research and the accumulated knowledge are provided in three edited volumes representing exercise physiology, sport psychology, and motor behavior: *Physical Activity, Fitness, and Health* (Bouchard, Shepard, & Stephens, 1994), *Handbook of Sport Psychology* (Singer, Hausenblas, & Janelle, 2001), and *Cognitive Issues in Motor Expertise* (Starkes & Allard, 1993). An expert prepared each chapter in these books to summarize theories as well as basic and applied research about

ecological validity

The extent to which research emulates the real world.