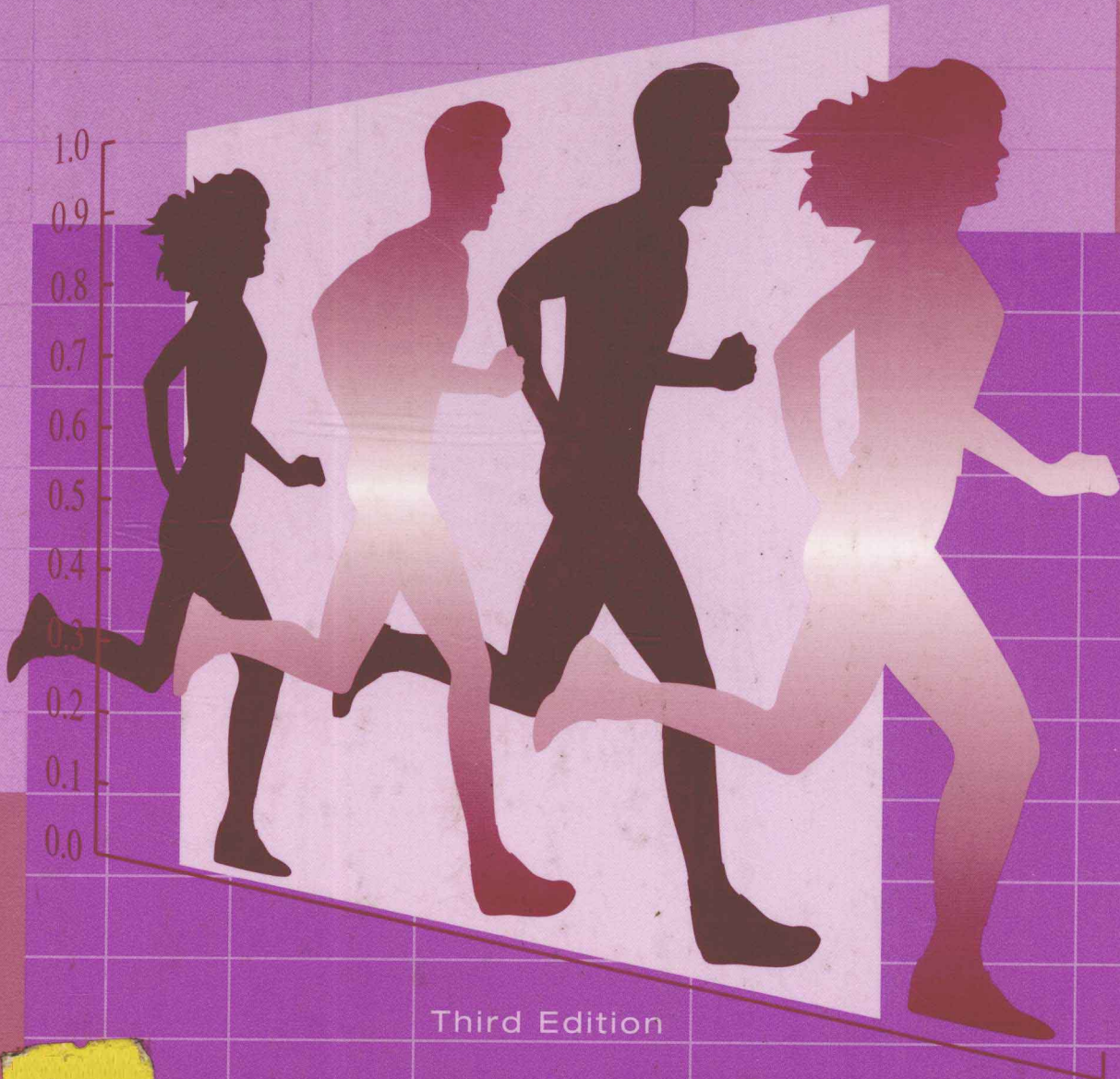


# Measurement and Evaluation in Physical Education and Exercise Science



Third Edition

Douglas N. Hastad Alan C. Lacy

THIRD EDITION

# MEASUREMENT AND EVALUATION

In Physical Education and Exercise Science

DOUGLAS N. HASTAD  
UNIVERSITY OF WISCONSIN-LA CROSSE

ALAN C. LACY  
INDIANA STATE UNIVERSITY

Allyn and Bacon  
Boston London Toronto Sydney Tokyo Singapore

*Publisher:* Joseph E. Burns  
*Composition and Prepress Buyer:* Linda Cox  
*Manufacturing Buyer:* Megan Cochran  
*Cover Administrator:* Jenny Hart  
*Electronic Composition:* Publishers' Design and Production Services, Inc.



Copyright © 1998 by Allyn & Bacon  
A Viacom Company  
Needham Heights, Massachusetts 02194

Internet: [www.abacon.com](http://www.abacon.com)  
America Online: keyword:College Online

All rights reserved. No part of the material protected by this copyright notice may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, recording, or by any information storage and retrieval system, without the written permission of the copyright owner.

Previous editions copyright © 1989, 1994 by Gorsuch Scarisbrick, Publishers.

### **Library of Congress Cataloging-in-Publication Data**

Hastad, Douglas N.

Measurement and evaluation in physical education and exercise  
science / Douglas N. Hastad, Alan C. Lacy. — 3rd ed.

p. cm.

Includes bibliographical references and index.

ISBN 0-205-27977-5 (casebound)

1. Physical fitness—Testing. 2. Physical education and training—  
Testing. I. Lacy, Alan C. II. Title.

GV436.H35 1998

613.7—dc21

97-43905  
CIP

Printed in the United States of America.

10 9 8 7 6 5 4 3 2 1      02 01 00 99 98 97

# **M**EASUREMENT AND **EVALUATION**

To my wife, Nancy, and our wonderful children, Jacob and Rebekah.  
D.N.H.

To Patti, Sarah, Thomas, Clyde, and Lena Mary—many thanks for  
your unconditional love and support in my life.  
A.C.L.

# Preface

*Measurement and Evaluation in Physical Education and Exercise Science*, Third Edition, links theory and practice and provides a practical approach to measurement and evaluation in physical education (grades K–12) and in nonschool exercise environments.

As with the second edition, one of the commitments of this text is to emphasize how the processes of measurement and evaluation can and should be used as vital tools to enhance physical education and exercise programs in nonschool settings. Future teachers will learn to set and meet teaching goals; accurately measure and evaluate students, including those with special needs; and create and administer effective programs. This text articulates clearly the role of measurement and evaluation in developing curriculum and in assessing it. The third edition has been expanded to include a more indepth discussion about process versus product outcomes in physical education. And, provides the reader up-to-day information and suggestions regarding outcomes in physical education.

This third edition broadens the discussion about the role of measurement and evaluation in nonschool exercise settings. Chapter 13 addresses the needs of practitioners who will work in adult and youth exercise environments such as hospitals, health clubs, sports medicine programs, YMCA and YWCA's, recreation programs, and the corporate world. This text includes discussions of tests, equipment, goals, training, and venues relevant to contemporary measurement and evaluation techniques used outside the school setting.

The text as a whole has been updated and revised to include new tests, norms, and techniques. As before, Chapter 1 provides an introduction to and a historical perspective for the use of measurement and evaluation in physical education programs. Current trends are identified and discussed. Chapter 2 stresses the rationale for including measurement and evaluation procedures as part of the curriculum decision-making process. This chapter reviews the four learning domains of physical education, discusses the roles of needs assessment and of measurement and evaluation in curriculum development, provides useful application statements, and differentiates between qualitative and quantitative assessment.

Chapter 3 takes a "cookbook" approach to statistics, focusing less on theory and more on approaching data collection and analysis in a sequential manner appropriate to the needs of the students. More information on tests of differences has been added. Chapter 4 addresses criteria for test selection and discusses the concepts of validity, reliability, and objectivity for



both quantitative and qualitative measurement and evaluation. Practical concerns in selecting, planning, and administering tests are also included.

To maintain knowledge consistent with current thought and technology, several other key topics have been selected. Chapters 5–8 introduce the most widely used, valid, and reliable field-based tests and test batteries that have been proven successful in measuring performance in the health-related physical fitness domain, psychomotor domain, cognitive domain, and affective domain. Techniques presented in these chapters can be used as part of the day-to-day operation of a physical education program or the nonschool fitness environment.

Chapter 9 discusses the many aspects to be considered when incorporating measurement and evaluation procedures into the grading scheme. The advantages and disadvantages of a variety of grading systems are thoroughly covered. Chapter 10 focuses on the use of systematic observation to improve instruction—a topic not usually included in standard measurement and evaluation textbooks. This important topic receives thorough attention, and various approaches used to evaluate behaviors in activity settings are identified and explained. This chapter has been expanded to include discussion of self-evaluation of instruction in school and non-school settings.

Chapter 11, written by Garth Tymeson, a well-known authority in the field of adapted physical education, is devoted to assessment and evaluation techniques for youths with disabilities and details the most popular field-based tests. This chapter is aimed specifically at the implementation of P.L. 94-142, which requires practitioners who work with individuals with disabilities to be more accountable in the assessment and evaluation of students.

Chapter 12 presents *models* of measurement and evaluation as they apply to school settings. Information on authentic assessment has been added. This information will assist teachers (1) in incorporating measurement strategies from each of the four learning domains and (2) in developing a sound model on which to base evaluation of the program and justification of subsequent instructional modifications. Case studies apply the information, illustrating different teaching situations. This edition includes the addition of case studies which utilize qualitative measurement techniques.

As mentioned above, Chapter 13 is expanded and addresses the use of measurement and evaluation in nonschool settings. Students should be aware that increasing numbers of jobs involve such settings and that the success of fitness programming and exercise prescription in nonschool settings is very dependent upon techniques described in this chapter. The chapter characterizes four categories of adult fitness and exercise programs and describes various movement and fitness tests utilized in nonschool settings.

Because technological advances have made personal computers a useful tool to physical educators, Chapter 14 updates the reader about current computing technology, software considerations, and applications that can be used by professionals in the measurement and evaluation process.

As with the second edition, chapters begin with concise objectives and a list of key words. They conclude with a summary and a series of discussion questions designed to assist students in synthesizing information presented in the chapter. The third edition continues to provide a practical and useful Instructor's Research Manual. This manual contains discussion points, lecture outlines, a test bank of true/false, multiple choice, and essay questions, overhead transparency masters, and other helpful teaching aids.

## Acknowledgments

There are many individuals who have made contributions to this textbook. Without their help, all of the changes and improvements in the third edition would not have been possible.

We appreciate the efforts and suggestions made by each of the reviewers: Richard Clower, Western Maryland College; Emma Gibbons, Texas A & M University; Julee Illner, Southern Illinois University at Carbondale; and Charles Jackson, The College of William and Mary. Our thanks also to reviewers of past editions.

The initiation of this project was made possible by the support of Colette Kelly, Gay Pauley, and their coworkers at GSP. Over the years, we had a great working relationship with them. Their contributions during the revision process and the support they provided in past editions is greatly appreciated. We thank them and wish them well in future endeavors.


Since GSP was acquired by Allyn and Bacon, we have had the opportunity to get to know and work with many new people. Our appreciation goes to Joe Burns, Mary Beth Finch, Sara Sherlock, and Suzy Spivey for their hard work and good counsel during the transitional phase and final production stages of this textbook. We look forward to working with them in the future.

We also acknowledge Dr. Garth Tymeson of University of Wisconsin—La Cross. He is the author of Chapter 11, which deals with measuring students with special needs. Thank you for contributing your time and expertise in the original writing and subsequent revisions of this chapter. Last but not least, special thanks is given to Dr. Robert P. Pangrazi of Arizona State University. He has provided continual guidance and support not only to this textbook but also in many other professional endeavors.



# Contents

*Preface*      *xvii*

	<b>1</b>	<b>INTRODUCTION TO MEASUREMENT AND EVALUATION</b>	<b>1</b>
		<i>Key Terms</i>	1
		<i>Objectives</i>	1
		Historical Perspective of Measurement and Evaluation	3
		Current Trends	7
		Increased Accountability	7
		Importance of Health-Related Physical Fitness	8
		Altering Physical Fitness Patterns	9
		Increased Sophistication of Measurement Instruments	10
		Advent of Private Physical Activity-Based Programs	11
		More Rigorous Program Standards	12
		New Assessment Tools for All Ages and Abilities	12
		Subjective Techniques	13
		Use of Systematic Observation Instruments	13
		Competency-Based Testing	14
		Authentic Assessment and Portfolios	14
		Research	15
		Computers	15
		Future Directions	15
		Definitions of Test, Measurement, and Evaluation	16
		Test	16
		Measurement	17
		Evaluation	17
		Relationships among Test, Measurement, and Evaluation	18
		Use of Measurement and Evaluation in Physical Education	19
		Student Performance	19
		Teacher Performance	21
		Use of Measurement and Evaluation in the Nonschool, Exercise Setting	23
		<i>Summary</i>	24
		<i>Discussion Questions</i>	25
		<i>References</i>	25
		<i>Representative Readings</i>	26

## **2 LINKING PROGRAM DEVELOPMENT WITH MEASUREMENT AND EVALUATION 27**

<i>Key Terms</i>	27
<i>Objectives</i>	27
The Four Learning Domains of Physical Education	29
Health-Related Physical Fitness Domain	29
Psychomotor Domain	30
Cognitive Domain	31
Affective Domain	31
Needs Assessment	32
Program Development	34
Phase 1 Establishing a Realistic Philosophical Approach	35
Phase 2 Developing Attainable Program Goals	36
Phase 3 Determining Unit Outcomes	37
Phase 4 Establishing Performance-Based Objectives	38
Phase 5 Evaluation and Improving the Program	39
<i>Summary</i>	41
<i>Discussion Questions</i>	41
<i>References</i>	42
<i>Representative Readings</i>	42

## **3 BASIC STATISTICS 43**

<i>Key Terms</i>	43
<i>Objectives</i>	43
Levels of Measurement	44
Nominal Level	45
Ordinal Level	45
Interval Level	47
Ratio Level	47
Frequency Distributions	47
Simple Frequency Distribution	48
Grouped Frequency Distribution	48
Graphical Representation of Data	50
Symmetry and Skewness	53
Measures of Central Tendency	56
Mode	56
Median	57
Mean	58
Measures of Variability	60
Range	61
Interpercentile Range	61

Variance	62
Standard Deviation	63
Properties of the Normal Curve	68
Standard Scores	69
Percentile Rank	69
Z-Scores	73
T-Score	76
Correlation	77
Spearman Rho Rank-Order Correlation	79
Pearson Product-Moment Correlation	81
Regression	83
Tests for Differences between Groups	85
t-test for Independent Samples	86
t-test for Dependent Samples	88
Simple Analysis of Variance (ANOVA)	90
Summary	91
Discussion Questions	91
References	92
Representative Readings	92

## 4 CRITERIA FOR TEST SELECTION 93

Key Terms	93
Objectives	93
Validity	94
Face Validity	95
Content Validity	95
Construct Validity	96
Concurrent Validity	96
Predictive Validity	97
Reliability	97
Test-Retest Reliability	98
Alternate Form Reliability	98
Split-Half or Odd-Even Reliability	99
Objectivity	100
Relationship between Validity, Reliability, and Objectivity	101
Administrative Concerns in Test Selection	102
Relevance	102
Educational Value	103
Economy	104
Time	104
Enjoyment	104

Norms	105
Discrimination	107
Independence	107
Sex Appropriateness	108
Reliance on Another's Performance	108
Safety	109
Testing Large Groups	110
Ease of Scoring, Interpreting, and Reporting	110
Planning Test Administration	111
Securing Materials and Preparing the Testing Area	111
Knowledge of the Test	112
Recording the Scores	113
Training Testers	114
Practicing Test Items	114
Warming Up	115
Standardizing Instructions	115
Converting, Interpreting, and Evaluating the Results	116
<i>Summary</i>	117
<i>Discussion Questions</i>	118
<i>References</i>	118
<i>Representative Readings</i>	118

## 5 MEASURING THE HEALTH-RELATED PHYSICAL FITNESS DOMAIN 121

<i>Key Terms</i>	121
<i>Objectives</i>	121
Health-Related Physical Fitness	123
Test Batteries to Measure Health-Related Physical Fitness	125
Measuring Cardiorespiratory Fitness	137
Measuring Muscular Strength and Endurance	150
Strength Tests Using Weight Machines	159
Measuring Flexibility	164
Measuring Body Composition	172
Basic Anthropometric Measurements	179
Valuing and Assessing the Process of Physical Activity	183
Physical Education Environment	184
Exercise Science Environment	184
<i>Summary</i>	185
<i>Discussion Questions</i>	185
<i>References</i>	185
<i>Representative Readings</i>	188

## **6 MEASURING THE PSYCHOMOTOR DOMAIN 191**

<i>Key Terms</i>	191
<i>Objectives</i>	191
Skill-Related Physical Fitness	194
Uses of Skill-Related Physical Fitness Tests	194
Measuring Agility	
Measuring Balance	203
Measuring Speed and Reaction Time	212
Test Batteries to Measure Skill-Related Physical Fitness	215
Sports Skills Tests	229
Team Sports	230
Individual and Dual Sports	252
<i>Summary</i>	265
<i>Discussion Questions</i>	265
<i>References</i>	265
<i>Representative Readings</i>	267

## **7 MEASURING THE COGNITIVE DOMAIN 273**

<i>Key Terms</i>	273
<i>Objectives</i>	273
Measuring Cognitive Achievement	275
School Settings	275
Nonschool Settings	277
Planning the Written Test	277
Matching Test Items to Objectives	277
Taxonomy of Educational Objectives	278
Knowledge	279
Comprehension	279
Application	280
Analysis	280
Synthesis	280
Evaluation	280
Table of Specifications	281
Selection of Test Items	284
True-False	285
Matching	285
Multiple-Choice	286
Completion Items	287
Short-Answer Questions	288
Essay	288
Administering the Written Test	291

Assembling the Test	291
Giving the Test	292
Grading the Test	292
Analyzing the Test	293
Quantitative Item Analysis	293
Qualitative Item Analysis	297
Sources for Test Questions	298
Other Sources	299
Summary	299
Discussion Questions	300
References	301
Representative Readings	301

## 8 MEASURING THE AFFECTIVE DOMAIN 303

Key Terms	303
Objectives	303
Measuring Attitude Toward Physical Activity	306
Review of Literature	306
Data Gathering and Analysis	307
Uses of Attitudinal Scales	311
Problems Associated with Attitudinal Testing	311
Tests	312
Measuring Self-Concept	329
Review of the Literature	330
Data Gathering and Analysis	331
Tests	331
Measuring Social Competence	335
Data Gathering and Analysis	335
Problems Associated with Measuring Social Variables	340
Summary	342
Discussion Questions	342
References	342
Representative Readings	344

## 9 GRADING 345

Key Terms	345
Objectives	345
Controversies of Grading	346
To Grade or Not to Grade	347
Issues in Grade Determination	349



Methods of Grading	357
Norm-Referenced Approach	358
Criterion-Referenced Approach	364
Other Methods to Determine Grades	367
Reporting Student Performance Data	372
Report Card	373
Student Portfolios	373
Personal Letter	374
Conference	375
Graphic Profile	376
Summary	377
Discussion Questions	378
References	378
Representative Readings	379

## 10 USING SELF-EVALUATION TO IMPROVE INSTRUCTION 381

Key Terms	381
Objectives	381
Traditional Methods of Observation	384
Eyeballing	384
Note Taking	384
Checklists	385
Rating Scales	385
Systematic Observation Methodology	388
Data Recording Procedures	389
Event Recording	391
Interval Recording	394
Duration Recording	397
Group Time Sampling	400
Validity and Reliability of Systematic Observation	404
Validity	404
Reliability	404
Using Systematic Observation for Self-Evaluation	407
Practice Time	408
Instructional Time	409
Management Time	409
Response Latency	410
Instructor Movement	410
Specific Instructional Behaviors	412
Selected Instruments for Systematic Observation	416
All-Purpose Event-Recording Form (Instructor Behaviors)	417

All-Purpose Duration-Recording Form (Student Time Analysis)	417
Group Time Sampling Form (Class Analysis)	420
General Supervision Instrument	421
System for Observing Fitness Instructions (SOFIT)	
Arizona State University Observation Instrument (ASUOI)	425
Academic Learning Time-Physical Education (ALT-PE)	426
<i>Summary</i>	430
<i>Discussion Questions</i>	431
<i>References</i>	431

## 11 ASSESSING INDIVIDUALS WITH DISABILITIES 433

<i>Key Terms</i>	433
<i>Objectives</i>	433
Linking Curriculum Development and Measurement of Students with Disabilities	436
Phase 1: Establishing a Realistic Philosophical Approach	436
Phase 2: Developing Attainable Program Goals	436
Phase 3: Determining Unit Outcomes	437
Phase 4: Establishing Performance-Based Objectives	438
Phase 5: Evaluating and Improving the Program	438
The Importance of an Individualized Program	438
Preliminary Considerations for Testing	439
Tests for Students with Disabilities	444
Physical/Motor Fitness Tests	444
Fundamental Motor Patterns	455
Putting it All Together: The Individualized Education Program (IEP)	462
The Written IEP Document	463
<i>Summary</i>	473
<i>Discussion Questions</i>	473
<i>References</i>	474
<i>Representative Readings</i>	475

## 12 MEASUREMENT AND EVALUATION IN SCHOOL SETTINGS 479

<i>Key Terms</i>	479
<i>Objectives</i>	479
NASPE Projects—New Visions for Assessment	480
Guidelines for Effective Measurement and Evaluation	485

Variables Affecting Measurement and Evaluation Models	486
Characteristics and Interests of Students	487
Class Size	489
Class Time	489
Personnel Support	489
Technological Support	490
State and Local Mandates	490
Curricular Content	490
Examples of Measurement and Evaluation Models	493
Case Study #1	494
Case Study #2	495
Case Study #3	497
Case Study #4	497
Case Study #5	499
Case Study #6	501
Case Study #7	501
Case Study #8	503
Summary	505
Discussion Questions	505
References	506
Representative Readings	506

### 13 MEASUREMENT AND EVALUATION IN NONSCHOOL SETTINGS 507

Key Terms	507
Objectives	507
The Role of Measurement and Evaluation in the Nonschool Setting	509
Characteristics of Nonschool Fitness and Exercise Programs	510
Athletic Training	511
Corporate and Community Exercise and Fitness Programs	513
Hospital- and University-Based Health and Fitness Programs	513
Therapeutic Recreation	515
Considerations for Measurements and Evaluation in Adult Fitness Environments	516
Tests Used in the Nonschool Exercise Setting	518
Testing Maximal Oxygen Uptake	518
Other Tests	521
Summary	537
Discussion Questions	537
References	538
Representative Readings	538