

Cambridge University Press

978-0-521-68421-7 - Cognitive Diagnostic Assessment for Education: Theory and Applications

Edited by Jacqueline P. Leighton and Mark J. Gierl

Frontmatter

[More information](#)

---

## Cognitive Diagnostic Assessment for Education

With the current push toward educational reform, there is great potential for innovation and change, particularly in large-scale testing. One area where change is possible is in cognitive diagnostic assessment (CDA). Researchers in educational measurement and cognitive psychology are finally in a position to design tests targeted specifically to providing valuable information about students' cognitive strengths and weaknesses. This book organizes into one volume what is known about CDA in education, including its conceptual and philosophical basis, methods, and applications. The complete list of topics includes educational demand, philosophical rationale, construct validity, cognitive methods, test construction, statistical models, and unresolved issues (e.g., how to best translate diagnostic information into teaching practices). The book presents a comprehensive and up-to-date examination of CDA in education.

Dr. Jacqueline P. Leighton is Associate Professor of Educational Psychology at the University of Alberta and a registered psychologist by the College of Alberta Psychologists. Her specialization is cognitive-based assessment, in particular the design of educational and psychological testing instruments to measure higher-level thinking skills. Professor Leighton's current research is focused on examining the usability of cognitive models for informing educational tests. She is a member of the American Educational Research Association, National Council on Measurement in Education, and Canadian Society for the Study of Education. Her research is funded by the Social Sciences and Humanities Research Council of Canada and the Natural Sciences and Engineering Council of Canada.

Dr. Mark J. Gierl is Professor of Educational Psychology and Director of the Centre for Research in Applied Measurement and Evaluation (CRAME) at the University of Alberta. His specialization is educational and psychological testing, with an emphasis on the application of cognitive principles to assessment practices. Professor Gierl's current research is focused on differential item and bundle functioning, cognitive diagnostic assessment, and assessment engineering. His research is funded by both the College Board and the Social Sciences and Humanities Research Council of Canada. Dr. Gierl holds the Canada Research Chair in Educational Measurement.

Cambridge University Press

978-0-521-68421-7 - Cognitive Diagnostic Assessment for Education: Theory and Applications

Edited by Jacqueline P. Leighton and Mark J. Gierl

Frontmatter

[More information](#)

# Cognitive Diagnostic Assessment for Education

*Theory and Applications*

Edited by

**JACQUELINE P. LEIGHTON**

*Associate Professor,  
Educational Psychology,  
University of Alberta*

**MARK J. GIERL**

*Professor and Canada Research Chair,  
Educational Psychology,  
University of Alberta*



**CAMBRIDGE**  
UNIVERSITY PRESS

Cambridge University Press  
978-0-521-68421-7 - Cognitive Diagnostic Assessment for Education: Theory and  
Applications  
Edited by Jacqueline P. Leighton and Mark J. Gierl  
Frontmatter  
[More information](#)

---

CAMBRIDGE UNIVERSITY PRESS  
Cambridge, New York, Melbourne, Madrid, Cape Town, Singapore, São Paulo

Cambridge University Press  
32 Avenue of the Americas, New York, NY 10013-2473, USA

[www.cambridge.org](http://www.cambridge.org)  
Information on this title: [www.cambridge.org/9780521865494](http://www.cambridge.org/9780521865494)

© Cambridge University Press 2007

This publication is in copyright. Subject to statutory exception  
and to the provisions of relevant collective licensing agreements,  
no reproduction of any part may take place without  
the written permission of Cambridge University Press.

First published 2007

Printed in the United States of America

*A catalog record for this publication is available from the British Library.*

*Library of Congress Cataloging in Publication data*

Cognitive diagnostic assessment for education: theory and applications / edited by  
Jacqueline P. Leighton, Mark J. Gierl.

p. cm.

Includes bibliographical references and index.

ISBN 978-0-521-86549-4 (hardback)

ISBN 978-0-521-68421-7 (paperback)

1. Educational tests and measurements. 2. Cognition – Testing. I. Leighton,  
Jacqueline P. II. Gierl, Mark J. III. Title.

LB3051.C622 2007

371.26'2 – dc22 2006035160

ISBN 978-0-521-86549-4 hardback

ISBN 978-0-521-68421-7 paperback

Cambridge University Press has no responsibility for  
the persistence or accuracy of URLs for external or  
third-party Internet Web sites referred to in this publication  
and does not guarantee that any content on such  
Web sites is, or will remain, accurate or appropriate.

Cambridge University Press

978-0-521-68421-7 - Cognitive Diagnostic Assessment for Education: Theory and Applications

Edited by Jacqueline P. Leighton and Mark J. Gierl

Frontmatter

[More information](#)

## Contents

<i>List of Contributors</i>	page vii
PART I. THE BASIS OF COGNITIVE DIAGNOSTIC ASSESSMENT	
1. Why Cognitive Diagnostic Assessment? <i>Jacqueline P. Leighton and Mark J. Gierl</i>	3
2. The Demand for Cognitive Diagnostic Assessment <i>Kristen Huff and Dean P. Goodman</i>	19
3. Cognitive Modeling of Performance on Diagnostic Achievement Tests: A Philosophical Analysis and Justification <i>Stephen P. Norris, John S. Macnab, and Linda M. Phillips</i>	61
4. Test Validity in Cognitive Assessment <i>Denny Borsboom and Gideon J. Mellenbergh</i>	85
PART II. PRINCIPLES OF TEST DESIGN AND ANALYSIS	
5. Construct Validity and Cognitive Diagnostic Assessment <i>Xiangdong Yang and Susan E. Embretson</i>	119
6. Verbal Reports as Data for Cognitive Diagnostic Assessment <i>Jacqueline P. Leighton and Mark J. Gierl</i>	146
7. Test Construction and Diagnostic Testing <i>Joanna S. Gorin</i>	173
PART III. PSYCHOMETRIC PROCEDURES AND APPLICATIONS	
8. Cognitive Foundations of Structured Item Response Models <i>André A. Rupp and Robert J. Mislevy</i>	205

Cambridge University Press

978-0-521-68421-7 - Cognitive Diagnostic Assessment for Education: Theory and Applications

Edited by Jacqueline P. Leighton and Mark J. Gierl

Frontmatter

[More information](#)

vi

Contents

9. Using the Attribute Hierarchy Method to Make Diagnostic Inferences About Examinees' Cognitive Skills	242
<i>Mark J. Gierl, Jacqueline P. Leighton, and Stephen M. Hunka</i>	
10. The Fusion Model Skills Diagnosis System	275
<i>Louis A. Roussos, Louis V. DiBello, William Stout, Sarah M. Hartz, Robert A. Henson, and Jonathan L. Templin</i>	
11. Using Information from Multiple-Choice Distractors to Enhance Cognitive-Diagnostic Score Reporting	319
<i>Richard M. Luecht</i>	
12. Directions for Future Research in Cognitive Diagnostic Assessment	341
<i>Mark J. Gierl and Jacqueline P. Leighton</i>	
<i>Author Index</i>	353
<i>Subject Index</i>	359

Cambridge University Press

978-0-521-68421-7 - Cognitive Diagnostic Assessment for Education: Theory and Applications

Edited by Jacqueline P. Leighton and Mark J. Gierl

Frontmatter

[More information](#)

---

## List of Contributors

**Denny Borsboom** Assistant Professor of Psychology, University of Amsterdam

**Louis V. DiBello** Research Professor of Psychology, University of Illinois at Chicago

**Susan E. Embretson** Professor of Psychology, Georgia Institute of Technology

**Mark J. Gierl** Professor of Educational Psychology and Director of the Centre for Research in Applied Measurement and Evaluation, University of Alberta

**Dean P. Goodman** Assessment Consultant

**Joanna S. Gorin** Assistant Professor of Psychology in Education, Arizona State University

**Sarah M. Hartz** Resident, Department of Psychiatry, University of Iowa

**Robert A. Henson** Assistant Professor of Education Research and Methodology, University of North Carolina at Greensboro

**Kristen Huff** Senior Director, K-12 Research & Psychometrics, The College Board, New York

**Stephen M. Hunka** University Professor of Educational Psychology, University of Alberta

Cambridge University Press  
978-0-521-68421-7 - Cognitive Diagnostic Assessment for Education: Theory and Applications  
Edited by Jacqueline P. Leighton and Mark J. Gierl  
Frontmatter  
[More information](#)

---

viii

*List of Contributors*

**Jacqueline P. Leighton** Associate Professor of Educational Psychology, Centre for Research in Applied Measurement and Evaluation, University of Alberta

**Richard M. Luecht** Professor of Education Research and Methodology, University of North Carolina at Greensboro

**John S. Macnab** Teacher, Jasper Place School, Edmonton Public Schools

**Gideon J. Mellenbergh** Professor of Psychology, University of Amsterdam

**Robert J. Mislevy** Professor of Measurement, Statistics, and Evaluation, University of Maryland

**Stephen P. Norris** Professor of Educational Policy Studies and Director of the Centre for Research in Youth, Science Teaching and Learning, University of Alberta

**Linda M. Phillips** Professor of Elementary Education and Director of the Canadian Centre for Research on Literacy, University of Alberta

**Louis A. Roussos** Senior Psychometrician, Measured Progress

**William Stout** Professor of Statistics, University of Illinois at Urbana-Champaign

**André A. Rupp** Professor, Institute for Educational Progress (IQB), Humboldt-Universität zu Berlin

**Jonathan L. Templin** Assistant Professor of Psychology, University of Kansas

**Xiangdong Yang** Research Associate, Center for Educational Testing and Evaluation, University of Kansas