

## SCHOOLING ACROSS THE GLOBE

Schooling matters. The authors' professional pursuits for over 25 years have been focused on measuring one key aspect of schooling: the curriculum – what students are expected to study and what they spend their time studying. This documents their conviction that schools and schooling play a vital and defining role in what students know and are able to do with respect to mathematics and science.

This research examines 17 international studies of mathematics and science to provide a nuanced comparative education study. Whilst including multiple measures of students' family and home backgrounds, these studies measure the substance of the curriculum students study which has been shown to have a strong relationship with student performance. Such studies have demonstrated the inter-relatedness of student background and curriculum. Student background influences their opportunities to learn and their achievements, yet their schooling can have even greater significance.

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# SCHOOLING ACROSS THE GLOBE

*What We Have Learned from 60 Years  
of Mathematics and Science International Assessments*

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**David E. Wiley**

*We dedicate this book to my mentor at the University of Chicago who taught me what it means to thoughtfully and cleverly analyze data as opposed to just doing statistical analyses. He brought that mind-set to work on the Third International Mathematics and Science Study where my colleagues, Richard Houang and Leland Cogan, also came to appreciate his deep understanding of schooling and his clever approach to data analysis.*

– **Bill Schmidt**

*We also write this book to clarify the possibility for all children to experience both excellence and equality in their schooling. This includes those closest to us.*

Keara	Ava
Frederick	Joella
Zoe	Norah
Shane	Grace
Arnold	Wesley
Carolyn	Audrey
Jaclynne	Ashley
Dylyn	Elayna
Reegyn	Jackson
Maegan	

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## *Series Editor's Foreword*

In the last several decades, globalization has influenced the lives of all people. Business and education, as well as scientific disciplines, have all experienced the need to understand and work with people whose political, social, cultural, and linguistic origins are often very different. This has been true of psychology, education, and other social science disciplines. These developments also have important implications for the development and use of measures of human individual differences. Business and educational institutions using tests and institutions interested in certifying or accrediting test users have all experienced the challenges and opportunities generated by increased globalization.

Recognizing the need for the education of psychometricians and users of tests, Jean Cardinet spearheaded the formation of the International Test Commission (ITC) in the late 1960s and early 1970s. It was formally established in 1978. Current members include scholars and institutions from most of the European and North American countries as well as some countries in the Middle and Far East, Africa, and South America.

The major goals of the ITC are the exchange of information among members and furthering cooperation on problems related to the construction, distribution, and use of psychological measures and diagnostic tools. To accomplish these goals, the ITC has initiated a number of educational activities. The ITC has also developed and published guidelines on quality control in scoring; test analysis and reporting of test scores; adapting tests for use in various linguistic and cultural contexts; test use in general; and computer-based and internet-delivered testing; as well as a test taker's guide to technology-based testing. The ITC publishes a journal, *International Journal of Testing*. This peer-reviewed journal seeks to publish papers of interest to a cross-disciplinary international audience in the area of testing and measurement. In 2016, the ITC led the effort to produce the *International Handbook of Testing and Assessment*.

In 2013, the ITC proposed to Cambridge University Press a series of books on issues related to the development and use of tests. The goal of the series is to advance theory, research, and practice in the areas of international testing and assessment in psychology, education, counseling, organizational behavior, human resource management, and related disciplines. This series seeks to explore topics in more depth than was possible in the *Handbook* or in any single volume. The series will explore the national and cultural idiosyncrasies of test use and how they affect the psychometric quality of assessments and the decisions made on the basis of those measures. As such, we hope the series will contribute to the quality of measurement, but that it will also facilitate the work of professionals who must use practices or measures with which they may be unfamiliar or adapt familiar measures to a local context. We have asked both ITC members and other scholars familiar with a topic and who are also familiar with the global situation related to various topics to be the editors and contributors to individual volumes.

We are especially pleased to see this series develop and are confident that the books in this series will contribute to the effectiveness of testing and assessment throughout the world. Certainly, this volume on the international measurement of student achievement and the opportunity to learn contains a wealth of information on how to conduct educational assessments born of the authors' experience conducting seventeen international studies of mathematics and science achievement as well as student background and opportunity. The volume is a detailed examination of the role of schooling in these areas that spans twenty-five years. It includes chapters that address issues of student participation and how students' achievement, background, and learning opportunities have been measured in these studies. Seeing a compilation of this work by the outstanding scholars who have led these efforts in a single volume is truly exciting. We are hopeful that it will contribute to similar efforts in the future and that it will serve to enable educators to develop and use assessments to improve the education of their students.

We hope to publish a book at least biennially and encourage scholars who might be interested in developing a book proposal that addresses assessment in an international context to talk with the series editor, the ITC President, or other ITC leaders.

**Neal Schmitt**

## *Preface*

Schooling matters. Our professional pursuits for more than twenty-five years have been focused on measuring one key aspect of schooling: the curriculum – what students are expected to study and what they spend their time studying. This we have done in an effort to document our conviction that schools and schooling play a vital and defining role in what students know and are able to do with respect to mathematics and science.

And yet, this assertion has been questioned, even today. Results from the extensive study of education conducted by Coleman and his colleagues in the early 1960s seemed to suggest that students' home and family background were far more important in determining what they knew as measured by academic assessments than their school experiences. If true, then policies aimed at ensuring equitable distribution of economic and other resources would be the important operative policy levers for improving overall student achievement.

However, another line of research, represented by the seventeen international studies of mathematics and science that are the focus of this book, provides a more nuanced perspective. While including multiple measures of student family and home background, these studies have also measured in multiple ways the substance of the learning opportunities students have had, and these have demonstrated a strong relationship with student performance. Furthermore, these studies have been able to document the interrelatedness of student background and learning opportunities. Student background matters to their learning opportunities and their achievement, yet their learning opportunities (schooling) matter even more.

This volume is both an extension and a continuation of our research examination of the role of schooling through international assessments of mathematics and science spanning the past twenty-five years. The chapters are organized in three major parts. Part I, "The Historical Development of Modern International Comparative Assessments," provides the historical, theoretical, and methodological context. Part II, "Conducting

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*Preface*

International Assessments in Mathematics and Science,” has chapters that delve into issues of participation and how students’ achievement, background, and learning opportunities have been measured in these studies. Part III, “The Lessons Learned from International Assessments of Mathematics and Science,” is our perspective on what has been learned from these studies together with a few concluding thoughts around the future for them.

## *Acknowledgments*

We gratefully acknowledge the International Association for the Evaluation of Educational Achievement (IEA) and the Organisation for Economic Co-operation and Development (OECD) under whose auspices the seventeen studies that serve as the basis for this book were conducted. Their tireless attention to detail has provided the field with high quality data by which to examine the role of schooling worldwide.

It is also with deep appreciation that we acknowledge Richard Wolfe, who read the entire manuscript and provided a carefully thought-out set of comments. Jack Schville was also kind enough to provide comments on the book.

Finally, it is with the utmost admiration and appreciation that we acknowledge our editor, Jennifer Cady. She worked tirelessly and meticulously over the last year to produce the drafts of the book. But, more than that, she reads with understanding, so she is able to catch not only errors of syntax and grammar but those of substance as well; for example, catching inconsistencies between tables and references in the text. Thank you, Jenn.



*Abbreviations*

ACER –	Australian Council for Educational Research
CASMIN –	Comparative Analysis of Social Mobility in Industrial Nations
CCSSM –	Common Core State Standards for Mathematics
CERI –	Center for Educational Research and Innovation
ESCS –	Economic, social, and cultural status
ETS –	Educational Testing Service
FIMS –	First International Mathematics Study
FISS –	First International Science Study
GDP –	Gross domestic product
IBE –	International Bureau of Education
ICCS –	International Civic and Citizenship Study
ICT –	Information and Communication Technology
IEA –	International Association for the Evaluation of Educational Achievement
IGP –	International Grade Placement
ILO –	International Labor Organization
INES –	Education Indicators Program
IRT –	Item Response Theory
ISCED –	International Standard Classification of Education
ISCO –	International Standard Classification of Occupations
ISEI –	International Socioeconomic Index
KMK –	Ständige Konferenz der Kultusminister der Länder
NAEP –	National Assessment of Educational Progress
NCES –	National Center for Educational Statistics
NCTM –	National Council of Teachers of Mathematics
OECD –	Organisation for Economic Co-operation and Development
OTL –	Opportunity to learn
PE –	performance expectations

*List of Abbreviations*

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Pilot –	Pilot Twelve-Country Study
PIRLS –	Progress in International Reading Literacy Study
PISA –	Programme for International Student Assessment
SES –	Socioeconomic status
SIMS –	Second International Mathematics Study
SISS –	Second International Science Study
SMSO –	Survey of Mathematics and Science Opportunity
TALIS –	Teaching and Learning International Survey
TCMA –	Test Curriculum Match Analysis
TEDS-M –	Teacher Education and Development Study in Mathematics
TIMSS –	Third International Mathematics and Science Study
TIMSS-95 –	Third International Mathematics and Science Study
TIMSS-R –	Third International Mathematics and Science Study Repeat
TRENDS –	Trends in International Mathematics and Science Study
UIE –	UNESCO Institute of Education
UNESCO –	The United Nations Educational, Scientific and Cultural Organization
US –	United States
USOE –	US Office of Education