PRIORITIES *in* PRACTICE

The Essentials of Mathematics, Grades 7–12

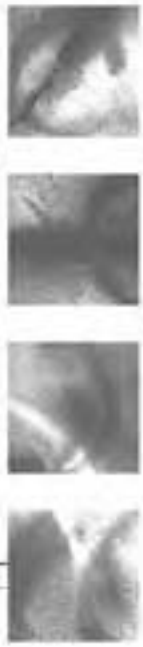
Effective Curriculum, Instruction, and Assessment

Kathy Checkley

PRIORITIES *in* PRACTICE

The Essentials of Mathematics, Grades 7–12

Effective Curriculum, Instruction, and Assessment



Kathy Checkley

ASCD Association for Supervision and Curriculum Development • Alexandria, Virginia USA

Association for Supervision and Curriculum Development
1703 N. Beauregard St. • Alexandria, VA 22311-1714 USA
Telephone: 1-800-933-2723 or 1-703-578-9600 • Fax: 1-703-575-5400
Web site: www.ascd.org • E-mail: member@ascd.org
Author guidelines: www.ascd.org/write

About the Author: Kathy Checkley has been a journalist for more than 25 years and has spent the past 12 years focusing on issues in education.

Gene R. Carter, *Executive Director;* Michelle Terry, *Deputy Executive Director, Program Development;* Nancy Modrak, *Director of Publishing;* Julie Houtz, *Director of Book Publishing;* John Wilcox, *Director of Newsletters and Special Publications;* John Franklin, *Project Manager;* Kathy Checkley, *Author;* Mary Beth Nielsen, *Director of Editorial Services;* Lisa Post, *Associate Editor;* Gary Bloom, *Director, Design and Production Services;* Georgia Park, *Senior Designer;* Keith Demmons, *Typesetter;* Vivian Coss, *Production Coordinator*

Printed in the United States of America.

ISBN-13: 978-1-4166-0413-6 ISBN-10: 1-4166-0413-8
ASCD product no.: 106129 s9/06

Also available as an e-book through ebrary, netLibrary, and many online booksellers (see Books in Print for the ISBNs).

Quantity discounts for the paperback edition only: 10–49 copies, 10%; 50+ copies, 15%; for 1,000 or more copies, call 800-933-2723, ext. 5634, or 703-575-5634. For desk copies: member@ascd.org.

Library of Congress Cataloging-in-Publication Data
Checkley, Kathy.
The essentials of mathematics, grades 7–12 : effective curriculum, instruction, and assessment / Kathy Checkley.
p. cm. -- (Priorities in practice)
Includes bibliographical references and index.
ISBN-13: 978-1-4166-0413-6 (pbk. : alk. paper)
ISBN-10: 1-4166-0413-8 (pbk. : alk. paper) 1. Mathematics--Study and teaching (Middle school) 2. Mathematics--Study and teaching (Secondary) 3. Teacher participation in curriculum planning. 4. Educational leadership. I. Title. II. Series.

QA135.6.C524 2006
510.71'2--dc22
2006016138

13 12 11 10 09 08 07 06 1 2 3 4 5 6 7 8 9 10 11 12 13

PRIORITIES *in* PRACTICE

The Essentials of Mathematics, Grades 7–12

- Acknowledgments v
- Introduction vii
1. Trends 1
2. Considering Curriculum 18
3. Bringing the Curriculum to Life in the Classroom 39
4. Nurturing the Struggling Mathematical Mind 82
5. Implications for Professional Development 98
- Looking Forward 112
- References and Resources 117
- Index 125

Acknowledgments

Many thanks! This book could not have been written without the kindness, patience, and generosity of all the teachers and educators interviewed.

Special thanks go to

• Jason Cushner, for reading the initial draft of this book and pointing out any errors or misconceptions.

• Cathy Seeley, who was always willing to take a few minutes to help clarify thinking.

• John Franklin, for his professionalism and constructive advice throughout this project.

• My John and Laura—with your support, all is possible.

At the time the book was being written, educators interviewed could be reached at the following locations.

John Bakelaar, Whitten Middle School, Jackson, Mississippi*
Patrick Bathras, Severn Middle School, Arnold, Maryland
Wesley Brown, Prince George's County (Maryland) School District
Carol Corbett Burris, South Side High School, Roxville Center, New York
Ken Cameron, Glendale (Arizona) Union High School District
Jeffrey Chaffee, Remington Middle School, Franklin, Massachusetts*
Carrie Chiappetta, Scofield Magnet Middle School, Stamford, Connecticut

Jason Cushner, The Watershed School, Boulder, Colorado*
Nancy Foote, Higley (Arizona) Unified School District*
John Holloway, Educational Testing Service, Princeton, New Jersey
Ilana Horn, University of Washington
Warren Jacobson, Glendale (Arizona) Union High School District
Don Karlgaard, Brainerd High School, Minnesota*
Matthew Perini, Silver Strong & Associates, Ho-Ho-Kus, New Jersey
Barbara J. Reys, University of Missouri
Kristen Scanlon, Fayetteville (Arkansas) School District*
Debra Scarpelli, Slater Junior High School, Pawtucket, Rhode Island*
William Schmidt, Michigan State University
Cory Shinkle, Glendale (Arizona) Union High School District
Cathy Seeley, National Council of Teachers of Mathematics, Reston, Virginia
Joseph S. Siddiqui, Maine School of Science and Mathematics, Limestone*
Harvey F. Silver, Silver Strong & Associates, Ho-Ho-Kus, New Jersey
James Slosson, Yelm High School, Olympia, Washington

*These teachers received a 2003 Presidential Award for Excellence in Mathematics and Science Teaching.

Introduction

I advise my students to listen carefully the moment they decide to take no more mathematics courses. They might be able to hear the sound of closing doors.

—James Caballero, "Everybody a Mathematician?"
CAIP Quarterly

A new graduation requirement in the Prince George's County (Maryland) School District is keeping Wesley Brown busy.

The mandate stipulates that public school students who entered 9th grade in the fall of 2003 must take and pass the Maryland High School Assessments—which include the Algebra/Data Analysis Assessment. So Brown, a Region 1 mathematics resource teacher, spends his days working with teachers at four different high schools, helping them hone their instructional skills. "We have core learning goals, things our students must know to be successful," says Brown. "We want to help teachers be innovative" in helping students attain those learning objectives, he says.

Maryland is one of twenty states with mandatory exit exams—and five more states plan to phase in such tests by 2009, according to a Center on Education Policy report (Gayler, Chudowsky, Hamilton, Kober, & Yeager, 2004).

Brown thinks Maryland's Algebra/Data Analysis Assessment reflects a concern held by many educators and business leaders "that students don't graduate with the mathematics knowledge they need to be successful in continued schooling or their careers." Indeed, according to a report released by Public Agenda, many business organizations, including the

Unites States Chamber of Commerce, warn that American high school students "are not sufficiently skilled and knowledgeable about science and math in general" (Johnson, 2006, p. 1). When students lack these skills, notes the report, they put their future careers in jeopardy, as well as the ability for the United States to remain economically competitive with other nations.

Brown, therefore, is helping teachers help students learn their basic skills. "And algebra is the new basic," he says.

"Students are starting to realize that if they want better jobs and better opportunities, they need higher-level math," says John Bakelaar, assistant principal at Whitten Middle School in Jackson, Mississippi. And educators are starting to realize, he says, "that we need to make higher-level courses—Statistics, Calculus, and Trigonometry—available to all students."

Still, although most educators embrace more challenging math courses for all students and a majority of parents do believe that today's students should learn advanced algebra and calculus, most parents and students are generally happy with the status quo, according the Public Agenda's report. In fact, the number of parents who worry whether schools are teaching enough math and science has decreased since the mid-1990s.

Education, business, and government leaders, therefore, must now help parents and other stakeholders understand this paradox, says Public Agenda. These leaders must point out that failing to improve mathematics instruction for all threatens too many students' futures (*see p. ix*).

This push for public awareness comes none too soon for Nancy Foote, a mathematics teacher on assignment in Higley, Arizona. Indeed, when Foote attended a symposium held at film director George Lucas's Skywalker Ranch, she asked a congressman why mathematical illiteracy is okay. "I think there is a lot of lip service being paid to the fact that we, as a country, are falling behind in math," but not enough action is being taken, she says. For her part, Foote never misses an opportunity to tell her students that "it's not okay to not know math."

Harvey F. Silver and Richard W. Strong agree. "Math opens up career paths, empowers consumers, makes meaningful all kinds of data, from

Math Education: A National Imperative?

According to many educators, business leaders, and government policymakers, a sound mathematics education is key to a student's career success and to U.S. competitiveness. Even so, a prevailing ambivalence about whether all students need to become skilled in the subject may suggest otherwise.

Ask parents if they want their children to learn math, and they'll always answer yes, says Barbara J. Reys, distinguished professor of mathematics education at the University of Missouri. She adds that parents, however, will also say, "I wasn't good at math." Some parents also believe that not all students can learn mathematics and that "if they don't, it's okay," says Reys.

This vacillation may stem from parents' own unfavorable experiences with math in school, states Reys. It can also result from another kind of angst: Unlike with reading, "it's not too long before kids are studying math that's beyond what their parents studied. Parents are [then] out of the picture," she observes. Educators, too, have communicated mixed signals about how necessary it is for all students to learn mathematics, especially upper-level subjects like algebra and calculus. "Until recently, many people thought about mathematics as a discipline that is comprehensible to only a select, talented few," write Lynn T. Goldsmith and Ilene Kantrov in *Guiding Curriculum Decisions for Middle-Grades Mathematics*. "Instructional traditions paid little attention to helping students make sense of the mathematical ideas they encountered," the authors state (2001, p. 37).

Fortunately, the societal acceptance of poor mathematics achievement is waning. Dissatisfaction with poor math performance has "become intense and it is growing," write the authors of *Mathematical Proficiency for All Students*. "Every student now needs competency in mathematics," the RAND Mathematics Study Panel asserts (RAND Mathematics Study Panel, 2003, p. 2).

This goal is vital, because educational and career opportunities, as well monetary success, are directly linked to mathematics achievement, say researchers. Studies find, in fact, that

• Students who completed higher-level mathematics courses in high school were more likely to earn a bachelor's degree. A longitudinal study conducted by Clifford Adelman, a senior research analyst for the U.S. Department of Education, found that 8 percent of high school graduates with Algebra 1 under their belts earned a bachelor's degree by age 30. In contrast, 80 percent of those who completed Calculus in high school earned a bachelor's degree by age 30 (Adelman, 1999).

• More than half of workers earning more than $40,000 a year had completed two or more credits at the Algebra 2 level or higher, according to Anthony P. Carnevale and Donna M. Desrochers who analyzed data from the National Educational Longitudinal Survey (Carnevale & Desrochers, 2002).

• Taking higher-level math courses can boost a young person's earnings potential after high school, Heather Rose and Julian R. Betts report in *Math Matters: The Links Between High School Curriculum, College Graduation, and Earnings*. Rose and Betts found that after controlling for students' demographic, family, and high school characteristics, one extra course in algebra or geometry is associated with 6.3 percent high earnings (Rose & Betts, 2001).

Source: Adapted with permission from *Priorities in Practice: The Essentials of Mathematics, K–6*, (pp. 5, 10, 11), by K. Checkley, 2006, Alexandria, VA: ASCD.

basketball statistics to political polls to the latest trends in the stock market," they write in the foreword to *Styles and Strategies for Teaching Middle School Mathematics* (2003, p. 5).

For all these positive outcomes, however, Silver and Strong note a troubling reality: the longer a majority of students are in school, the less they trust in their ability to do math. In fact, the authors point out, more

than three quarters of all students who graduate from high school don't believe that they are among the "special realm" of people who can be successful in a field that requires in-depth mathematics knowledge.

And that's a serious problem. "If we send an army of math-haters out into today's competitive global culture, we are short-changing millions of students by severely limiting their chances of future success," Silver and Strong warn.

One response would be to create an army of math-lovers—among students, teachers, administrators, and parents. The question is, How?

Luckily, we have some answers in this book.

- Teachers show how they are striving for equity. The stakes are high and every student needs to attain a higher level of mathematics understanding. The exemplary educators featured in this book share some proven strategies for helping them do so.
- Teachers share innovative lessons that address standards and help students see how math can be used in the world.
- Education experts discuss the research that influences how curriculum is developed and how instructional choices are made.
- Teachers and educators explore ways to vary instruction to meet their students' unique learning needs.
- Professional development experts, including teachers, discuss the kinds of learning experiences that teachers want and need.

We hope this book will help educators address the challenge of providing a sound mathematics education for all students.