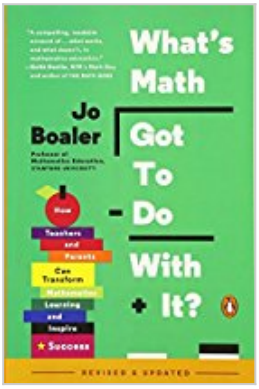

What's Math Got to Do with It?: How Teachers and Parents Can Transform Mathematics Learning and Inspire Success

By Jo Boaler

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“Highly accessible and enjoyable for readers who love and loathe math.” —*Booklist*

A critical read for teachers and parents who want to improve children’s mathematics learning, *What’s Math Got to Do with It?* is “an inspiring resource” (*Publishers Weekly*). Featuring all the important advice and suggestions in the original edition of *What’s Math Got to Do with It?*, this revised edition is now updated with new research on the brain and mathematics that is revolutionizing scientists’ understanding of learning and potential.

As always Jo Boaler presents research findings through practical ideas that can be used in classrooms and homes. The new *What’s Math Got to Do with It?* prepares teachers and parents for the Common Core, shares Boaler’s work on ways to teach mathematics for a “growth mindset,” and includes a range of advice to inspire teachers and parents to give their students the best mathematical experience possible.

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Editorial Review

Review
"For any parent who's ever heard a child declare, 'I hate math.'"
-Jim Trelease, author of *The Read-Aloud Handbook*

" Parents and educators alike will count this book an inspiring resource."
-Publishers Weekly

" Highly accessible and enjoyable for readers who love and loathe math."
-Booklist

About the Author
DR. JO BOALER is a professor of mathematics education at Stanford University. The author of seven books and numerous research articles, she serves as an advisor to several Silicon Valley companies and is a White House presenter on girls and STEM (Science, Technology, Engineering, and Math). She recently formed youcubed.org to give teachers and parents the resources and ideas they need to inspire and excite students about mathematics.

“Without doubt, this is the most important book parents should read before choosing a school for their child, and teachers should read when considering ways to improve their math teaching. A compelling, readable account of years of research into what works, and what doesn’t, in mathematics education.”

—Keith Devlin, PhD, Stanford University mathematician, award-winning author of The Math Gene and thirty-one other books, and the Math Guy on NPR

“Jo Boaler vividly shows us—rather than just telling us—what terrific math instruction looks like and, equally important, how sharply it differs from how the subject is usually taught. What’s Math Got to Do with It? is the first book I recommend to teachers and parents who want to understand the harms of conventional ways of teaching math as well as the benefits of realistic alternatives.”

—Alfie Kohn, author of The Schools Our Children > Deserve and Feel-Bad Education

“There is so much wisdom packed into this engaging little book. Boaler sensibly addresses current hot topics—the Common Core, mind-set, ability grouping, gender differences—but goes way behind them to consider the nature of mathematics itself and offers a wealth of practical advice to parents, teachers, and policy makers. More than ever, we need books on education like his one.”

—Mike Rose, author of Possible Lives: The Promise of Education in America

“What’s Math Got to Do with It? comes the closest of anything that I have read to a manifesto that I would provide to parents to help them better understand the importance of good teaching of interesting and complex mathematics.”

—Journal for Research in Mathematics Education

“Jo Boaler shows that math is understandable, and that it can be fun to get your head around it—but that it’s often taught in ways that make it dry and deadly. She points to the beauty and joy of mathematics, and ways that math classrooms can become centers of lively mathematical thinking. American children deserve a richer mathematical diet than we’ve given them, and Boaler shows how and why.”

—Alan H. Schoenfeld, Elizabeth and Edward Conner Professor of Education, University of California, Berkeley

“This extraordinary book shows teachers and parents the path to teaching children to enjoy math while they develop deep and flexible understanding. The author practices what she preaches; using systematic research she and others have conducted on two continents, she makes learning about math teaching accessible and fun.”

—Deborah Stipek, I. James Quillen Dean and Professor of Education, Stanford University

“Jo Boaler makes a powerful case for a problem-solving approach to teaching mathematics, and she presents the research to back it up. This book should be read by anyone concerned about the education of our children.”

—Deborah Schifter, principal research scientist, Education Development Center, Inc.

“Jo Boaler explains with insight and clarity why so many students dislike mathematics and what the rest of us can do about it. Her solutions are comprehensive, grounded in research, and powerfully applied by parents, teachers, and anyone else with an interest in mathematics.”

—Dan Meyer, Apple Distinguished Educator and one of Tech & Learning’s 30 Leaders of the Future

WHAT’S MATH GOT TO DO WITH IT?

Jo Boaler is a professor of mathematics education at Stanford University and the cofounder of YouCubed. She is also the editor of the Research Commentary section of The Journal for Research in Mathematics Education (JRME) and author of the first Massive Open Online Course (MOOC) on mathematics teaching and learning. Former roles have included being the Marie Curie Professor of Mathematics Education in England. She is the recipient of several awards, an adviser to Silicon Valley companies, and a White House presenter on girls and STEM (science, technology, engineering, and mathematics) education. She is a regular contributor to national television and radio in the United States and the UK. Her research has appeared in newspapers around the world including the Wall Street Journal, the Times (London), and the Telegraph (UK).

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Acknowledgments

This book has been a journey of opportunities. Over recent years I have been able to learn from some of America's most inspirational teachers and their students, and to work alongside visionary friends and colleagues who have broadened and enriched my thinking. I am deeply grateful to many people in California, particularly at Stanford University and in Bay Area schools, who made this book possible.

This book was conceived at a very special place: the Center for Advanced Study in the Behavioral Sciences in California, a place devoted to the generation of ideas. I had given a presentation to the other fellows at the center, a group of scholars who worked in different areas of social science research, on the results of my studies of mathematics learning. The group responded strongly, with expressions of shock and dismay, and they urged me to get my results out to the general public. They convinced me to write a book proposal for a broader audience and many people—in particular Susan Shirk, Sam Popkin, and David Clark—supported me along the way.

From that point I was greatly encouraged by my agent Jill Marsal and Kathryn Court, of Penguin Books, both of whom believed in the book, which meant a lot to me. I wrote the book in the stimulating environment of Stanford's Graduate School of Education, surrounded by a group of graduate students who served as critics and supporters. I would personally like to thank all of my doctoral students, past and present, who contributed to the mathematics education group at Stanford.

I have learned a great deal from some truly inspirational teachers in recent years—among them Cathy Humphreys, Carlos Cabana, Sandie Gilliam, Estelle Woodbury, and Ruth Parker. They change students' lives on a daily basis and I am privileged to have been able to work with them and learn from them. Cathy is a good friend who has helped me in many ways. I am also deeply grateful to the students of Railside, Greendale, Hilltop, Amber Hill, and Phoenix Park schools; they all gave me their honest and insightful feedback on their mathematics learning experiences and they are the reason that I wrote this book.

I am fortunate to have had some great teachers of my own in my life—including Professors Paul Black and Dylan Wiliam, both of whom encouraged me in important ways at an early point in my academic career and kindly read chapters of this book for me. Professor Leone Burton, one of my strongest supporters, will be greatly missed by many people. Most of all I would like to thank my two daughters, Jaime and Ariane, for putting up with me when I lock myself away to write!

Preface to the New Edition

Introduction

In 2008, when What's Math Got to Do with It? was first published, the United States was in the grip of endless multiple-choice testing and widespread math failure, brain research was in its infancy, and a group of traditional mathematicians was working tirelessly to stop school reforms. Fast-forward to 2015 and the landscape has changed with the emergence of incredible new research on the brain and learning, which is being acknowledged and acted upon. The White House has convened numerous meetings over the past few years where researchers, myself included, have talked about mathematics, mind-set, and equity. The traditional mathematicians have lost their voice, and many more people are receptive to the idea of a future in which all children can learn mathematics to high levels. These changes pave the way for the creation of mathematics classrooms in which students are excited to learn and teachers are armed with the most important knowledge that inspires students to achieve excellence in math.

I love books. I enjoy reading and writing them, but the Internet has helped me to achieve something that is very important to my long-term professional mission. In the summer of 2013, I tried an experiment. A few months earlier I had been introduced to Sebastian Thrun, an amazing man who invented self-driving cars, led Google teams developing Google Maps and Google Glass, and is the CEO of Udacity. The world of free online courses, or MOOCs (massive open online courses), is generally attributed to Sebastian and his colleague Peter Norvig, who is the director of research at Google. Sebastian and Peter decided to put one of Sebastian's Stanford computer science courses online. One hundred sixty thousand people registered for the course, and the MOOC world began. Sebastian went on to create Udacity, an online-course provider, and some months later asked me to help with course design. The time I spent at Udacity was enough to give me the knowledge I needed to design my own course. Putting knowledge about the brain and math learning into the hands of our nation's teachers and parents would change everything and lent itself perfectly to online courses that could share information widely. I designed my courses to make them engaging and interactive, but the levels of interest in the classes surpassed my greatest hopes. To date more than 130,000 people—teachers, parents, and students—have taken my online courses entitled "How to Learn Math," and they are now armed with the critical information that I will share in this book.

I took Udacity's idea that online courses should not be talking heads and adopted their principle that professors should not talk for more than two minutes before engaging the learners in a task. I didn't have much time, with a full-time job teaching at Stanford, researching, and looking after a large team of doctoral students, but I spent every spare moment on weekends and in the evenings creating my experimental course. The course appeared on Stanford's online platform in the summer of 2013 but was not advertised in any way.

The course opened with approximately five thousand registrants, but word of mouth spread quickly, and by the time the course finished at the end of the summer more than forty thousand teachers and parents had enrolled. Many MOOCs have high enrollment, but generally only a small proportion of the people who register end up taking the courses. This was not the case with my course, and an impressive 63 percent of people completed most of the course. Even more rewardingly, at the end of the course 95 percent of teachers and parents said that they would change their teaching/parenting as a result of the ideas they had learned in the class. In the months after my class, news of the ideas spread, hundreds of videos were posted to YouTube, my in-box was flooded, and requests for speaking engagements increased. So many teachers and parents asked for continued access to the new ideas that Cathy Williams and I launched YouCubed. YouCubed initially was a nonprofit company but now is a center at Stanford. In the summer of 2014, I published a new online course getting the same powerful ideas straight to students, and within a few months of the course opening eighty-five thousand students had taken the class or been shown the videos by their teachers.

I do not think that online courses are the most powerful medium for learning—I would always rather interact with groups of learners face-to-face and have them discuss ideas with each other—but online courses allow wide-scale access to important knowledge that urgently needs to be shared and that cannot depend on parents finding their way to high-quality teaching in their local area. I have been frustrated over the years by universities encouraging professors to publish research on learning only in academic journals, which are read by other academics and do not get to the people who need them—teachers and parents. Important knowledge on ways to learn effectively is usually locked away in journals and libraries unless researchers choose to publish their findings in different, more accessible ways and universities do not penalize them for doing so. This is what motivated me to publish the first edition of What's Math Got to Do with It? and to update this edition with the latest research and practical information on ways to help all learners of mathematics.

When I wrote the original edition of What's Math Got to Do with It? the field of mathematics education had a large body of research on ways to teach and learn mathematics well. We knew how to empower math learners, but the research was not getting to teachers or being used in classrooms. If you walk into most math classrooms in the United States, particularly at the high school level, you would think you had been transported into the Victorian age. For the most part teachers are still at the front of the room lecturing on methods, students are still at desks learning to calculate by hand, and the mathematics being taught is three-hundred-year-old mathematics that is not needed in the modern world.1 In elementary classrooms across the United States, students are turned away from mathematics on a daily basis by timed tests and speed competitions, which we know can cause the early onset of math anxiety for many students.2, 3, 4 We have the research knowledge to change this and for classrooms to become places where all students are inspired by mathematics. In the last decade, important new research on the brain and learning has emerged, which is critical for math teachers, math learners, and parents everywhere.

Mind-set and Mathematics

In 2006, a trade book appeared on bookshelves that ultimately would have one of the biggest impacts of any research volume ever published in education. In Mindset: The New Psychology of Success, Stanford Professor Carol Dweck summarized key findings from her research on the nature and impact of mind-sets. The book quickly became a New York Times bestseller and was translated into more than twenty languages. Dweck's decades of research with people of various ages showed that students with a "growth mind-set"—who believe that intelligence and "smartness" can be learned—go on to higher levels of achievement, engagement, and persistence. The implications of this mind-set are profound, especially for students of mathematics.

When I returned to Stanford in 2010, one of the first things I did was arrange to meet Carol Dweck. She

agreed with me that mathematics is the subject most in need of a mind-set makeover and that mathematics teachers are the group who could benefit the most with knowledge of mind-set. Since that meeting we have been working together, writing, researching, and collaborating with teachers.

Mathematics, more than any other subject, has the power to crush students' confidence. The reasons are related both to the teaching methods that prevail in US math classrooms and the fixed ideas about mathematics held by the majority of the US population and passed on to our children from birth. One of the most damaging mathematics myths propagated in classrooms and homes is that math is a gift—that some people are naturally good at math and some are not.5, 6 This idea is strangely cherished in the Western world but virtually absent in Eastern countries such as China and Japan that top the world in mathematics achievement.7

New scientific evidence showing the incredible capacity of the brain to change, rewire, and grow in a really short time8 tells us that all students can learn mathematics to high levels with good teaching experiences. Traditional educators believe that some students do not have the brains to be able to work on complex mathematics, but it is working on complex mathematics that enables brain connections to develop. Students can grasp high-level ideas, but they will not develop the brain connections that allow them to do so if they are given low-level work and negative messages about their own potential.9

As I work with schools and districts encouraging mathematics teaching that promotes growth rather than fixed mind-sets (see www.youcubed.org), a critical requirement is that teachers offer mathematics as a learning subject, not a performance subject. Most students when asked what they think their role is in math classrooms say it is to answer questions correctly. They don't think they are in math classrooms to appreciate the beauty of mathematics, to explore the rich set of connections that make up the subject, or even to learn about the applicability of the subject. They think they are in math classrooms to perform. This was brought home to me recently when a colleague, Rachel Lambert, told me her six-year-old son had come home saying he didn't like math. When she asked him why, he said, "Math is too much answer time and not enough learning time." Students from kindergarten upward realize that math is different from other subjects: learning gives way to answering questions and taking tests—performing.

For students to see mathematics as a subject of learning, they need tasks and questions in math class that allow for learning. Chapter 3 will show some of these tasks and how they are used in classrooms. Teachers need to stop giving the wrong messages to students, whether through grouping, grading, or short, narrow math problems, which themselves imply that math is a question of the right or wrong answer rather than a learning subject. In chapters 4 and 5, I will describe the highly productive ways that teachers can grade, assess, and group students. The students who suffer most from fixed-mind-set thinking are high-performing girls, and chapter 6 will explain more about this phenomenon and ways we can give girls a positive and equitable future. Chapter 7 is focused on the important role parents can play and provides suggestions for activities and advice that can be used in the home.

One of the most interesting findings from research on the brain to emerge over recent years is something that I try to communicate as widely as I can. We now know that when students make a mistake in math, their brain grows, synapses fire, and connections are made.10 This finding tells us that we want students to make mistakes in math class and that students should not view mistakes as learning failures but as learning achievements.11 But students everywhere feel terrible when they make a mistake. They think it means they are not a "math person." We need to change this thinking by telling students that mistakes are productive. When I talk to teachers about this research they often say, "But surely students have to work through their error and see why it is a mistake for brains to grow." This is a reasonable assumption, but students do not even need to know they have made a mistake for brains to grow. What research tells us is that when a mistake is made there are two potential brain sparks: the first one comes when we make a mistake but are not

aware of the mistake; the second comes when we realize we have made a mistake. How can this be? How can our brains grow when we do not even know we have made a mistake? The best knowledge we have on this question tells us that our brains grow when we make mistakes because those are times of struggle, and our brains grow the most when we are challenged and engaging with difficult, conceptual questions.

Carol Dweck and I sometimes present together in workshops for teachers and parents. One of the pieces of advice Carol gives to parents in our workshops is that when children come home from school and say that they got all of their work correct that day, parents should say, “Oh, I am sorry, then you didn’t get the opportunity to learn today.” She is making a good point, and we need to shift teachers’ and students’ thinking about what they should aim for in mathematics lessons. Teachers care deeply about their students, and it is typical to arrange math lessons so that students are getting most of their work correct. This makes students feel good, but it is not the most productive learning environment for them. We need to change math lessons to make them challenging for all students, and we need to change students’ mind-sets so that they know it is productive to struggle and make mistakes and that they should feel comfortable doing so.

While I was sitting in an elementary classroom in Shanghai recently, the principal leaned over to tell me that the teacher was calling on students who had made mistakes to share with the whole class so that they could all learn. The students seemed pleased to be given the opportunity to share their incorrect thinking. Instead of mathematics classroom lessons filled with short questions that students are intended to get right or wrong, they need to be filled with open-ended tasks that include space for learning as well as space for struggle and growth. YouCubed provides examples of the most productive tasks students should work on at home and in school.

Mathematics and the Common Core

The new Common Core mathematics standards (www.core standards.org) have prompted considerable controversy across the United States. Most of the opponents of the Common Core are politically motivated. Some oppose the Common Core because of the tests that are being written to assess the new standards, but opposing the Common Core because of the standardized tests is somewhat misguided since the tests are not part of the Common Core and really are a separate policy decision, which should be considered outside of the curriculum. Others oppose the Common Core curriculum because their children are successful in the traditional model of math teaching, and they want to keep that advantage. The most curious opposition comes from parents who say that the math in the Common Core is too hard for their children. So what do we know about the Common Core, from research? And is its introduction in the United States a good or a bad thing?

The Common Core math curriculum is not the curriculum I would have designed if I had had the chance. It still has far too much content that is not relevant for the modern world and that turns students off mathematics, particularly in the high school years, but it is a step in the right direction—for a number of reasons. The most important improvement is the inclusion of a set of standards called the “mathematical practices.” The practice standards do not set out knowledge to be learned, as the other standards do, but ways of being mathematical. They describe aspects of mathematics such as problem solving, sense making, persevering, and reasoning. It is critically important that students work in these ways; these actions have been part of curricula in other countries for many years. Now that these methods of thinking are part of the US curriculum, students should be spending time in classrooms using mathematics in these ways.

The inclusion of these practices means that the tasks students work on will change. Students will be given more challenging tasks and spoon-fed less. Instead of being told a method and then practicing it, they will need to learn to choose, adapt, and use methods. Students need to learn to problem solve and persist when tasks are longer or more challenging. This is really important work for teachers and students. My main

problem with the Common Core standards is that they require teachers to engage students in thinking about what makes sense and problem solving; but such activities, which involve going deeper into the mathematics, take more time. In the elementary and middle grades, the content has been reduced so that teachers and students can take the time to work in these productive ways, but the high school standards are as packed as ever with obsolete content that works against teachers being able to go into depth and give students the experiences they need. For more information on the potential impact of the Common Core go to http://youcubed.org/parents/2014/why-we-need-common-core-math.

Many people think that countries such as China, who top the world in mathematics achievement, do so by drilling students in content, but this is far from the truth. In Shanghai, the highest scoring region of China, I watched numerous high school lessons, and in no lesson did the teachers work on more than three questions in an hour. What was staggering was the depth to which teachers and students delved into each question, exploring every aspect of the mathematics. In all of the lessons, the students talked more than the teacher as they discussed what they were learning. We recorded one of the lessons, and it can be seen on YouCubed. This is a model of mathematics teaching that we need in the United States.

Currently, more than half of all US students fail mathematics, and mathematics is a harshly inequitable subject.12, 13 When our classrooms change—when students are encouraged to believe that they can be successful in mathematics and are taught using the high-quality teaching methods we know work—the landscape of mathematics teaching and learning in the United States will change forever. This book gives readers—whether teachers, administrators, or parents—the knowledge needed to make the important changes required for our students in the United States and for the future of our society. I hope you enjoy it, whether you are a new reader or one of the many who read the original What’s Math Got to Do with It?, and are looking to be reenergized by the new ideas shared within this updated edition.

Zurijeta

Introduction

Understanding the Urgency

Users Review

From reader reviews:

Rosa Flint:

This What's Math Got to Do with It?: How Teachers and Parents Can Transform Mathematics Learning and Inspire Success book is not ordinary book, you have it then the world is in your hands. The benefit you get by reading this book is actually information inside this guide incredible fresh, you will get info which is getting deeper you read a lot of information you will get. This particular What's Math Got to Do with It?: How Teachers and Parents Can Transform Mathematics Learning and Inspire Success without we know teach the one who examining it become critical in thinking and analyzing. Don't become worry What's Math Got to Do with It?: How Teachers and Parents Can Transform Mathematics Learning and Inspire Success can bring any time you are and not make your case space or bookshelves' come to be full because you can have it inside your lovely laptop even cellphone. This What's Math Got to Do with It?: How Teachers and Parents Can Transform Mathematics Learning and Inspire Success having very good arrangement in word

and also layout, so you will not truly feel uninterested in reading.

Isidro Wells:

The book untitled What's Math Got to Do with It?: How Teachers and Parents Can Transform Mathematics Learning and Inspire Success contain a lot of information on this. The writer explains your girlfriend idea with easy technique. The language is very clear and understandable all the people, so do not really worry, you can easy to read that. The book was written by famous author. The author will bring you in the new age of literary works. It is possible to read this book because you can keep reading your smart phone, or device, so you can read the book throughout anywhere and anytime. If you want to buy the e-book, you can open their official web-site along with order it. Have a nice go through.

Ada Peterson:

This What's Math Got to Do with It?: How Teachers and Parents Can Transform Mathematics Learning and Inspire Success is fresh way for you who has intense curiosity to look for some information since it relief your hunger details. Getting deeper you onto it getting knowledge more you know otherwise you who still having little bit of digest in reading this What's Math Got to Do with It?: How Teachers and Parents Can Transform Mathematics Learning and Inspire Success can be the light food to suit your needs because the information inside this specific book is easy to get through anyone. These books build itself in the form which is reachable by anyone, that's why I mean in the e-book type. People who think that in e-book form make them feel drowsy even dizzy this guide is the answer. So there is no in reading a guide especially this one. You can find actually looking for. It should be here for you actually. So , don't miss the item! Just read this e-book style for your better life and knowledge.

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