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Book Review

Mathematical Mindsets

Review of: Jo Boaler (2016). *Mathematical mindsets*. San Francisco, CA: Jossey-Bass.

Many of us who teach mathematics have noticed that when we mention our subject to others, they frequently go silent or describe their bad experiences with mathematics. *Mathematical Mindsets* addresses this problem where it often arises - in schools. Jo Boaler, Professor of Education at Stanford, has written this book for teachers, parents, and others who are concerned about the fact that despite all the time and effort devoted to mathematics in schools the result is many students who do not understand much mathematics and who dislike it.

I had long assumed that if teachers really understood the mathematics they are supposed to teach (such understanding is in short supply today) attitudes and achievement in mathematics would naturally improve. Boaler's book shows how much more there is to the problem.

Mathematicians view their field as a quest for insight and understanding, but the mathematics curriculum is centered on mastery of results, mostly algorithms and theorems, that never interested the students to begin with. Boaler wants to refocus the mathematics curriculum on questions and investigations. I applaud Boaler in this.

Of course, simply focusing on questions instead of answers does not make a successful mathematics program, and Boaler has a lot to say about that. In order to create a classroom climate that supports and fosters student inquiry, she proposes detailed steps to organize classrooms around group learning and discussion among students. In support of that group learning, she stresses the importance of teaching students to listen carefully to their classmates and respect their contributions. This is to help all students be valued and feel capable in math classes.

Boaler goes even further, insisting that students be made to take responsibility for each other's learning. Boaler wants students to benefit both from being helped by peers and from the fact that the act of teaching can actually clarify the understanding of the person acting as teacher.

Boaler sees the change in mindset and the classroom practices she describes as tools to alleviate problems of equity and disenfranchisement that are so common in schools today, especially impacting students from non-dominant cultural groups. She cites norms and practices in schools today that hinder learning mathematics, and she makes some very strong suggestions for changing them. The focus on group learning is one of those suggestions.

She points out that in many American schools, especially in the lower grades, kids are assigned excessive homework, most of which has little educational value and is a boring waste of time. She

cites research to back up this claim. I was appalled to see my own grandson given that kind of homework beginning in kindergarten; even on weekends he was assigned arithmetic drill that in some cases consisted of thirty or more addition "problems," and long lists of words to learn to spell, some of which, like "could," are not phonetic. It was frustrating and discouraging for all concerned. Boaler eloquently describes her feelings of outrage and frustration when her daughter faced just that situation, and I sympathize with her completely.

Boaler also points out that many testing and grading practices in schools today are counterproductive. Alfie Kohn (2018), in *Punished by Rewards*, described in depth how extrinsic rewards, such as grades, can actually be destructive of intrinsic motivation and diminish interest in the material to be learned. The same is true of tests. The legitimate uses of tests, both formatively and for placement or certification, can be overshadowed by the distraction from learning and the pressure they create. The pressure occurs at many levels, as tests are often misused to assess teachers and schools in ways that are invalid and misleading. The Los Angeles Unified School District (LAUSD) actually evaluated teachers and tried to fire some of them based on their classes' test scores. At one point, LAUSD implemented a "value added" method (i.e., using changes in test scores from year to year) to measure teaching effectiveness. But the scores themselves are not calibrated for such use as variables. Thus, while a 50 is better than a 40, there is no way to tell if a gain from 40 to 50 represents a greater or smaller increase in mathematical skill than a gain from 50 to 60. These comments apply as well to the flawed but common attempts to use changes in average student scores as a basis for measuring "adequate yearly progress" for schools, subsets of students, or teachers.

Boaler's criticism of school norms and practices related to testing harkens back, implicitly, to Benson Snyder's *The Hidden Curriculum* (1970). Snyder asserted that in addition to the subjects nominally taught in schools, there is a hidden curriculum that teaches attitudes centered on conformity to and acceptance of authority.

Boaler's book is nominally about mathematical mindsets, but its focus is the very nature of education and schooling. The points about homework, testing, and classroom organization are independent of the subject under consideration.

As mentioned previously, simply focusing on questions rather than on mastery of algorithms and a fixed body of knowledge does not, by itself, create a successful school mathematics program. Neither does careful classroom organization. How does one select questions and specific topics for focus of inquiries? *Mathematical Mindsets* spends little time on this, stating the need to use "rich" problems that are easy to understand and get into ("low threshold") and open ended in nature ("high ceiling"). Boaler gives examples of such problems and mentions sources of them, primarily online. However, the book slights the question of how to choose the problems appropriately, which is a critical issue for teachers. Finding, selecting and presenting those problems lies at the very heart of good mathematics teaching, yet many teachers today do not have the mathematical background to make those selections wisely.

Boaler's subsequent work with colleagues has begun to generate tools to support teachers in this challenging work through a series of books: *Mathematical Mindsets: Visualizing and Investigating Big Ideas*(Boaler, Munson, & Williams, 2018). The books offer activities for classroom use. Still open is the question of how U.S. teachers will take up and use such resources.

This brings us back to the difficulty of ensuring deep mathematical and pedagogical preparation of teachers. Liping Ma, in *Knowing and Teaching Elementary Mathematics*, pointed out in 1999 that teachers of elementary mathematics in the United States could not explain or make up a problem which modeled $1\frac{3}{4} \div \frac{1}{2}$. There is every reason to think that the same is true among today's teachers as well, 20 years later. *Mathematical Mindsets* does not face squarely the challenge of how to give all teachers the mathematical and pedagogical expertise that Boaler and her colleagues brought to bear in the schools in which they worked. This is my greatest reservation about *Mathematical Mindsets*.

I wonder, too, why Boaler did not mention the work of other mathematics educators who have addressed some of the same issues as she does, some of them very successfully. *Get It Together*, a charming book devoted to small group work for elementary mathematics classes, was published right across the Bay from Stanford at the Lawrence Hall of Science (Erikson, 1989). Also, there is no mention of the work of Uri Treisman, whose use of group work was dramatically successful with the issues of equity that concern Boaler. With regard to discovery learning, I was surprised to see no mention of George Polya, who for decades taught at Stanford, or of Stan Yoshinobu who has championed inquiry-based learning at Cal Poly San Luis Obispo. Also absent are connections to forerunners like W. W. Sawyer, whose work on discovery learning included both paperbacks for adults and *Math Workshop for Children*, a K-6 textbook series of the 1960s that Sawyer co-authored with Robert Wirtz, Morton Botel, and Max Beberman. I would also have expected some mention of Robert Davis, Roger Howe, Dick Askey, Al Cuoco, Robert Moses, or some of the other mathematics educators who have done so much to deal with the problems Boaler writes about.

These criticisms fade somewhat when one takes *Mathematical Mindsets* as being about issues of education as a whole, of which mathematics is just one part. The broader message is a well-considered and powerful cry for a more humane, inclusive, and student-centered approach to all of education. That message is of great urgency and importance today.

Contributed by: Bob Stein.

References

Boaler, J., Munson, J., & Williams, C. (2018). *Mathematical mindsets: Visualizing and investigating big ideas.* San Francisco, CA: Jossey-Bass. (Note: separate books for each grade, grades 3, 4, 5, 6, and 7)

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