MONOGRAPH 6 IN
THE MONTANA MATHEMATICS ENTHUSIAST
MONOGRAPH SERIES IN MATHEMATICS EDUCATION

CRITICAL ISSUES *in* MATHEMATICS EDUCATION

edited by
Paul Ernest
Brian Greer
Bharath Sriraman

Critical Issues in Mathematics Education

INTERNATIONAL CONTRIBUTING EDITORS AND EDITORIAL ADVISORY BOARD

Critical Issues in Mathematics Education

edited by

Paul Ernest
University of Exeter

Brian Greer
Portland State University

Bharath Sriraman
The University of Montana

INFORMATION AGE PUBLISHING, INC.
Charlotte, NC • www.infoagepub.com

Library of Congress Cataloging-in-Publication Data

Printed in the United States of America

CONTENTS

Introduction: Agency in Mathematics Education ..... **ix**
Paul Ernest, Brian Greer, and Bharath Sriraman

SECTION 1

MATHEMATICS EDUCATION: FOR WHAT AND WHY?

1 What Is Mathematics Education For? 3
Brian Greer

2 Ethical Responsibility and the "What" and "Why" of Mathematics Education in a Global Context 7
Bill Atweh

3 The Dematematising Effect of Technology: Calling for Critical Competence 19
Uwe Gellert and Eva Jablonka

4 Mathematical Literacy: Issues for Engagement from the South African Experience of Curriculum Implementation 25
Mellony Graven and Hamsa Venkat

5 The Purpose of School Mathematics: Perspectives of Colombian Mathematics Teachers 33
Cecilia Agudelo-Valderrama

6 Teaching Mathematics with and for Creativity: An Intercultural Perspective 39
Roza Leikin

7 Whose Mathematics Education?: Mathematical Discourses as Cultural Matricide? 45
Fiona Walls

8 The Tension between What Mathematics Education Should Be for and What It Is Actually For 53
Alexandre Pais

9 Mathematics Education: For Whom? 61
Mônica Mesquita

SECTION 2

GLOBALIZATION AND CULTURAL DIVERSITY

10 Mathematics Education Ideologies and Globalization 67
Paul Ernest

11 What Is This Thing Called Social Justice and What Does It Have to Do With Us in the Context of Globalisation? 111
Bill Atweh

12 Defrosting and Re-Frosting the Ideology of Pure Mathematics: An Infusion of Eastern–Western Perspectives on Conceptualising a Socially Just Mathematics Education 125
Bal Chandra Luitel and Peter Charles Taylor

13 Mathematics Education and the Brazilian Landless Movement: Three Different Mathematics in the Context of the Struggle for Social Justice 153
Gelsa Knijnik

14 Kerala Mathematics and Its Possible Transmission to Europe 171
Dennis Francis Almeida and George Gheverghese Joseph

15 The Philosophy of Mathematics, Values, and Keralese Mathematics 189
Paul Ernest

SECTION 3

MATHEMATICS, EDUCATION, AND SOCIETY

16 Values and the Social Responsibility of Mathematics 207
Paul Ernest

17 Classroom Research: Impact and Long Term Effect *versus* Justice, Liberation and Empowerment? 217
Simon Goodchild

18 What Has Power Got to Do with Mathematics Education? 237
Paola Valero

19 Formatting Power of "Mathematics in a Package": A Challenge for Social Theorising? 255
Ole Skovsmose and Keiko Yasukawa

20 What Is Mathematics About? 283
Paul Budnik

21 Applied Mathematics As Social Contract 293
Philip J. Davis

22 Mathematics and Curriculum Integration: Challenging the Hierarchy of School Knowledge 305
Elizabeth de Freitas

SECTION 4

SOCIAL JUSTICE IN, AND THROUGH, MATHEMATICS EDUCATION

23 Social Justice and Mathematics Education: Issues, Dilemmas, Excellence and Equity 319
Bharath Sriraman and Olof Steinthorsdottir

24 Social Justice and Mathematics: Rethinking the Nature and Purposes of School Mathematics 337
Kurt Stemhagen

25 Possibilities and Challenges in Teaching Mathematics for Social Justice 351
Eric Gutstein

26 Math Education and Social Justice: Gatekeepers, Politics and Teacher Agency 375
Peter Appelbaum and Erica Davila

27 Methodologies of Research into Gender and Other Social Differences within a Multi-Faceted Conception of Social Justice .. 395
Jeff Evans and Anna Tsatsaroni

28 The Privilege of Pedagogical Capital: A Framework for Understanding Scholastic Success in Mathematics 423
Carol V. Livingston

29 Pupils of African Heritage, Mathematics Education, and Social Justice 457
Kwame E. Glevey

30 Researching, and Learning Mathematics at the Margin: From "Shelter" to School 475
Renuka Vithal

INTRODUCTION

AGENCY IN MATHEMATICS EDUCATION

Paul Ernest, Brian Greer, and Bharath Sriraman

The word "critical" in the title of this collection has several meanings. One meaning, as applied to a situation or problem, is "at a point of crisis." A second meaning is "expressing adverse or disapproving comments or judgments." A third is related to the verb "to critique," meaning "to analyse the merits and faults of." All are contemporarily relevant to mathematics education.

Few would question that the world is in a critical state; the connection with mathematics and mathematics education has been most forcefully delineated by Ubiratan D'Ambrosio (2007):

> It is widely recognized that all the issues affecting society nowadays are universal, and it is common to blame, not without cause, the technological, industrial, military, economic and political complexes as responsible for the growing crises threatening humanity. Survival with dignity is the most universal problem facing mankind.
>
> Mathematics, mathematicians and mathematics educators are deeply involved with all the issues affecting society nowadays. But we learn, through History, that the technological, industrial, military, economic and political

Critical Issues in Mathematics Education, pages ix–xvi

> complexes have developed thanks to mathematical instruments. And also that mathematics has been relying on these complexes for the material bases for its continuing progress. It is also widely recognized that mathematics is the most universal mode of thought.
>
> Are these two universals conflicting or are they complementary? It is sure that mathematicians and math educators, are concerned with the advancement of the most universal mode of thought, that is, mathematics. But it is also sure that, as human beings, they are equally concerned with the most universal problem facing mankind, that is, survival with dignity.

At the time of writing, the United States is a few weeks into a financial crisis with world-wide ramifications. It is a reasonable question to ask whether this crisis is not only due, mainly, to a failure to apply elementary mathematical principles to financial government but also, partly, to a lack of fiscal sense among many citizens that can be seen as an indictment of their education, including their mathematical education.

Critical judgments on mathematics education are nothing new, but, alongside the maturation of the field of mathematics education itself, they are now concerned with more than internal issues about the nature of teaching and what it is that students take from their mathematics education in terms of technical competence and higher-order thinking. As interest in, and attention to, the historical, cultural, social, and political contexts in which mathematics education is situated have developed, external issues about the circumstances in which children are living, and about the relationships between mathematics education and society have become prominent. The distinction between internal and external is neatly made by Skovsmose's (2006) question as to whether the leak in the ceiling of a classroom does not constitute a learning obstacle, just as much as some point about, say, the epistemology of rational numbers.

The development of mathematics education as a field has been marked by a broadening from an initial concentration in mathematics itself and psychology to a much broader interaction with human sciences, such as sociology, anthropology, ethnomathematics, gender issues, critical race theory, social history of mathematics, philosophy of mathematics, sociolinguistics, semiotics, and so on. Together with this enrichment of theoretical frameworks has come methodological diversity and liberation.

Critical mathematics educators across the world voice concern about the perceived lack of connection between school mathematics and students' lives, leading to lack of interest and alienation. They challenge the notion of mathematics and mathematics education as being morally and politically neutral. They question the role of mathematics as a gatekeeper, limiting economic and social advancement. They point to the increasingly nationalistic, and indeed militaristic, tone of much governmental rhetoric (Guts-

tein, in press). All of these major concerns, and many more, are discussed by the contributors to this collection.

The emerging group of practitioners, researchers, and scholars that is evolving critical mathematics education is, above all, characterized by its recognition of the necessity of critiquing the institutions, pedagogical and research practices, and political embeddedness of mathematics education. Such a position is aligned with many other developments, including a new philosophy of mathematics (Ernest, 1991; Tymoczko, 1986) that takes as central the notion of fallibility.

In this brief introduction, we do not attempt to summarize the diversity, depth, and richness of the chapters that follow, but rather, with illustrative examples, we try to convey a sense of the common threads of criticality, in all of the above senses, that they share.

SOURCES AND ORGANIZATION OF THIS BOOK

The book is organized in four sections, namely:

1. Mathematics education: For what and why?
2. Globalization and diversity
3. Mathematics, education, and society
4. Social justice in, and through, mathematics education

The papers in the first section were prepared for Discussion Group 3 at the 11th ICME, organized by Brian Greer and Claude Gaulin. These papers were deliberately kept short, in order to maximize the chances of participants reading them in advance, and related to the specific questions for discussion, namely:

- What are the most productive ways of characterizing "mathematical literacy"?
- Should school mathematics education be dominated by the discipline of mathematics, rather than reflecting the diversity of mathematical practices?
- Can a balance be achieved between a homogeneous, monolithic, globalized curriculum and the diversity of people and forms of knowledge construction and use?
- How should mathematics education prepare people for technology?

The papers in the remaining sections are republished from the electronic *Philosophy of Mathematics Education Journal* created and maintained by Paul Ernest (http://people.exeter.ac.uk/PErnest/).

Like the papers in the Philosophy of Mathematics Education Journal, the chapters in this book are freely available on the Internet, which is the policy adopted by Bharath Sriraman for the journal The Montana Mathematics Enthusiast (www.math.umt.edu/TMME). Entirely voluntary work of this nature, making material available in this way instead of published in overly expensive books, may be considered a form of academic activism. (And see the first monograph in the series to which this book belongs (Sriraman, 2007) on social justice in mathematics education).

MATHEMATICS EDUCATION: FOR WHAT AND WHY?

The International Congress on Mathematical Education is a major quadrennial conference that brings together mathematicians and mathematics educators, between which groups exist considerable tensions. As a generalization, it is probably not unfair to say that mathematicians would tend to answer the question "What is mathematics education for?" by reference to traditional motivations such as the need to produce another generation of scholars to continue developing the discipline of mathematics; the supply of a cadre of scientists and others such as engineers who need strong mathematical competence; as a training in logical thinking and problem solving; as exposure to what is as much a part of cultural heritage as literature or music.

Critical mathematics educators, on the other hand, would go beyond these reasons and argue that mathematics education should provide people with tools to analyse, and act upon, issues important in their lives, in their communities, and to society in general. Further, it is desirable that mathematics education should give people some understanding of the complex, often hidden, roles that mathematics plays in society, "formatting" many aspects of our lives.

The discussion group was planned to confront these different perspectives and open up the issues, and the collection of papers that resulted, and is reproduced here, was assembled accordingly. In addressing the themes of the remaining three sections, they also serve as an introduction to those sections.

GLOBALIZATION AND DIVERSITY

Mathematics and mathematics education are carried on against the background of geopolitical events—globalization, growth of the knowledge economy and the attendant commodification of knowledge and corporification of schools, post-colonialism, struggles over finite resources . . . not to mention wars.

Academic mathematics as a discipline is an international endeavor, with well-developed institutions, publications, and networks of communication and collaboration. To a degree, the same can be said of mathematics education (Bishop, 1992), increasingly so. Atweh (Section 1, this volume) suggests that globalization may not be intrinsically good or evil, but is certainly not value-free or beyond ethical considerations, and presents both challenges and dangers. An obvious danger is that globalization, in effect, becomes Westernization (Sen, 2004, cited by Ernest, Section 2, this volume). Thus, some "Western" scholars share a concern voiced by Clements (1995, p. 3) that: "Over the past 20 years I have often had cause to reflect that it is Western educators who were responsible not only for getting their own mathematics teacher education equation wrong, but also for passing on their errors to education systems around the world." Bishop (1990) referred to "Western" mathematics as "the secret weapon of cultural imperialism."

Counter-narratives are being developed. For example, the history of the development of mathematics as written by "the winners" has been challenged by documenting, often uncovering, the contributions of non-European cultures (Joseph, 1992; Powell & Frankenstein, 1997). If mathematics education were just the transmission of the academic canon to a new generation, then world-wide homogeneity of mathematics education would be even greater than it is (Usiskin, 1999). Examples of resistance to homogeneity include post-Apartheid South Africa, where serious efforts have been made to devise mathematics education aims to contribute to improvement of the social and political conditions of the people. Brazil is another country in which mathematics educators have been heavily involved in ethnomathematics (D'Ambrosio, 2006) and in applications of mathematics as activists for social justice (Knijnik, this volume).

MATHEMATICS, EDUCATION, AND SOCIETY

A major theme of the turn from the internal problems of learning and teaching mathematics to consideration of the external historical, cultural, social, and political contexts in which mathematics education takes place is consideration of how analysis of the roles of mathematics in society should guide the education of the children who will become citizens of that society. Thus, in Discussion Group 3 at ICME11, the final question "How should mathematics education prepare people for technology?" was not aimed at standard discussions about how the use of computers can help mathematics teaching/learning but rather to raise issues about the use of technology in contemporary society through the complementary processes of mathematization (application of mathematical models in the control of situations) and dematematization (embedding of mathematics within physical and

symbolic artifacts such that it is hidden in the use of those artifacts) (Gellert and Jablonka, 2007, this volume).

SOCIAL JUSTICE IN, AND THROUGH, MATHEMATICS EDUCATION

A common theme of the quest for social justice within mathematics education has taken the form of analyzing inequities based on gender, class, and ethnic differences (though rarely their interactions). Thus mathematics often acts as a gatekeeper to educational and economic advancement, as the civil rights activist, Robert Moses, has emphasized in characterizing quality mathematics education as a civil right (Moses & Cobb, 2001) (and see Appelbaum & Davila, this volume).

Such questions could be considered as internal. A more recent development has been concentration of external issues—in other words, social justice *through* mathematics education, providing people with tools for critiquing their own situations and acting on them. In Freire's terms (adapted for the title of his book by Gutstein (2006)) that means not just "reading" the world but also "writing" it.

Numbers can tell a story very starkly and simply. A fine book for children (and adults) called "If the world were a village" (Smith and Armstrong, 2002) provides proportional statistics that would apply if the world were a village of 100 people. Only 24 always have enough to eat, while 60 are always hungry (26 being severely undernourished), and 16 go to bed hungry at least some of the time.

FINAL COMMENT: ON BEING SELF-CRITICAL

Teachers, scholars, and researchers who consider themselves critical do not forget to turn their critical gaze, on their individual and collective beliefs, attitudes, and actions and to remain open to critique by others. We are aware that as academics located in wealthy Western countries we are privileged both materially and in the freedom and autonomy that academic work still grants us (if only just!). Nevertheless, we hope that by addressing these issues we are helping to raise awareness among mathematics educators and teachers in a way that contributes a little bit to improvements in the teaching and learning of mathematics. We passionately believe in the importance of the enterprise of mathematics education worldwide, without

overestimating the impact that we three editors and the score or so contributors can make.

REFERENCES

Bishop, A. J. (1990). Western mathematics: the secret weapon of cultural imperialism. *Race and Class, 32*(2), 51–65.

Bishop, A. J. (1992). International perspectives on research in mathematics education. In D. Grouws (Ed.), *Handbook of research on mathematics teaching and learning,* (pp. 710–723). New York: Macmillan.

Clements, K. (1995). Restructuring mathematics teacher education: Overcoming the barriers of elitism and separatism. In R. Hunting, G. FitzSimons, P. Clarkson, & A. Bishop (Eds.), *Regional collaboration in mathematics education,* (pp. 1–10). Melbourne: Monash University.

D'Ambrosio, U. (2003). The role of mathematics in building up a democratic society. In Madison, B. L., & Steen, L. A. (Eds.), *Quantitative literacy: Why numeracy matters for schools and colleges. Proceedings of National Forum on Quantitative Literacy, National Academy of Sciences, Washington, DC, December, 2001.* Princeton, NJ: National Council on Education and the Disciplines. (http://www.maa.org/ql/qltoc.html)

D'Ambrosio, U. (2006). *Ethnomathematics: Link between tradition and modernity.* Rotterdam, The Netherlands: Sense Publishers.

Ernest, P. (1991) *The Philosophy of Mathematics Education*, London: Falmer Press.

Gellert, U., & Jablonka. E. (Eds.) (2007). *Mathematisation and demathematisation: Social, philosophical and educational ramifications.* Rotterdam: Sense Publishers.

Gutstein, E. (2006). *Reading and writing the world with mathematics: A pedagogy for social justice.* New York: Routledge.

Gutstein, E. (in press). The politics of mathematics education in the US: Dominant and counter agendas. In B. Greer, S. Mukhopadhyay, S. Nelson-Barber, & A. B. Powell (Eds.), (in press). *Culturally responsive mathematics education.* New York: Routledge.

Joseph, G. G. (1992). *The crest of the peacock: Non-European roots of mathematics.* London: Penguin.

Moses, R. P., & Cobb, C. E. (2001). *Radical equations: Civil rights from Mississippi to the Algebra Project.* Boston: Beacon Press.

Powell, A. B., & Frankenstein, M. (1997). *Ethnomathematics: Challenging Eurocentrism in mathematics education.* Albany, NY: SUNY Press.

Sen, A. (2004) How to judge globalism, In F. J. Lechner and J. Boli, *The Globalization Reader* (Second edition), pp. 17–21. Oxford: Blackwell.

Skovsmose, O. (2006). *Travelling through education: Uncertainty, mathematics, responsibility.* Rotterdam: Sense Publishers.

Smith, D. J, & Armstrong, S. (2002). *If the world was a village.* Tonawanda, NY: Kids Can Press.

Sriraman, B. (Ed.) (2007). *International perspectives on social justice in mathematics education. The Montana Mathematics Enthusiast Monograph 1.* Missoula, MT: University of Montana Press.

Tymoczko, T. (Ed.) (1986). *New directions in the philosophy of mathematics.* Boston: Birkhauser.

Usiskin, Z. (1999). Is there a worldwide mathematics curriculum? In Z. Usiskin (Ed.), *Developments in mathematics education around the world, Volume 4* (pp. 213–227). Reston, VA: National Council of Teachers of Mathematics.