The Montana Mathematics Enthusiast

Series Editors
Bharath Sriraman, University of Montana

The Montana Mathematics Enthusiast-Monograph Series in Mathematics Educaton is an eclectic internationally established book series which focuses on the sociology of mathematics, mathematics education research, innovation, interdisciplinary and societal issues related to mathematics education. The monographs are published by Information Age Publishing and the Department of Mathematical Sciences- The University of Montana. The nine monographs that have been published since 2007 have covered a wide spectrum of issues with the hope of stimulating dialogue in the community of researchers, practitioners and students. The monograph series is interested in research based views as well as historical, philosophical, political, sociological, crosscultural and systems perspectives of mathematics education, teaching and learning. The monograph series is known in 110+ countries and its readers include students of mathematics, future and practicing teachers, mathematicians, cognitive psychologists, critical theorists, mathematics/science educators, historians and philosophers of mathematics and science as well as those who pursue mathematics recreationally. The monographs create a forum for argumentative and critical positions on mathematics education, and especially welcome themes which challenge commonly held assumptions about the nature and purpose of mathematics and mathematics education. Those interested in proposing a topic for a monograph or guest editing a monograph are invited to send in a detailed proposal to the Editor, Bharath Sriraman [sriramanb@mso.umt.edu]

Books in this series:

- Selected Writings from the Journal of the Saskatchewan Mathematics Teachers' Society
- Selected writings from the Journal of the British Columbia Association of Mathematics Teachers
- Critique as Uncertainty
- Selected writings from the Journal of the Mathematics Council of the Alberta Teachers' Association
- The Development of Teaching Expertise from an International Perspective
- Crossroads in the History of Mathematics and Mathematics Education
- Interdisciplinarity for the 21st Century
- The Role of Mathematics Discourse in Producing Leaders of Discourse
- Relatively and Philosophically E’rnest
- Interdisciplinarity, Creativity, and Learning
- Critical Issues in Mathematics Education
- Interdisciplinary Educational Research In Mathematics and Its Connections to The Arts and Sciences
- Creativity, Giftedness, and Talent Development in Mathematics
- Mathematics Education and the Legacy of Zoltan Paul Dienes
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- Beliefs and Mathematics

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The teaching and learning of mathematics in Saskatchewan—one of three Canadian provinces sharing a border with Montana—has a long and storied history. An integral part of the past 50 years (1961-2011) of history has been vinculum: Journal of the Saskatchewan Mathematics Teachers’ Society (in its many different renditions). This monograph, which presents ten memorable articles from each of the past five decades (i.e., 50 articles from the past 50 years of the journal), provides an opportunity to share this rich history with a wide range of individuals interested in the teaching and learning of mathematics and mathematics education. Each decade begins with an introduction, providing a historical context, and concludes with a decade-specific commentary by a prominent member of the Saskatchewan mathematics education community. As a result, this monograph provides a historical account as well as a contemporary view of many of the trends and issues (e.g., curriculum, technology) in the teaching and learning of mathematics. This book is meant to serve as a resource for a variety of individuals, including teachers of mathematics, mathematics teacher educators, mathematics education researchers, historians, and undergraduate and graduate students and, further, as a celebratory retrospective on the work of the Saskatchewan Mathematics Teachers’ Society.

The teaching and learning of mathematics in British Columbia has a long and storied history. An integral part of the past 50 years (1962-2012) of this history has been Vector: Journal of the British Columbia Association of Mathematics Teachers. This volume, which presents ten memorable articles from each of the past five decades, is 50 articles from the past 50 years of the journal, provides an opportunity to share this rich history with a wide range of individuals interested in the teaching and learning of mathematics and mathematics education. Each decade begins with an introduction, providing a historical context, and concludes with a commentary from a prominent member of the British Columbia mathematics education community. As a result, this monograph provides a historical account as well as a contemporary view of many of the trends and issues in the teaching and learning of mathematics. This volume is meant to serve as a resource for a variety of individuals including: teachers of mathematics, mathematics teacher educators, mathematics education researchers, historians, and undergraduate and graduate students. Most importantly, this volume is a celebratory retrospective on the work of the British Columbia Association of Mathematics Teachers.

The title of the book is Critique as Uncertainty. Thus Ole Skovsmose sees uncertainty as an important feature of any critical approach. He does not assume the existence of any blue prints for social and political improvements, nor that certain theoretical structures can provide solid foundations for a critical activities. For him critique is an open and uncertain activity. This also applies to critical mathematics education.

Critique as Uncertainty includes papers Ole Skovsmose already has published as well as some newly written chapters. The book addresses issues about: landscapes of investigations, students’ foregrounds, mathematics education and democracy, mathematics and power. Finally it expresses concerns of a critical mathematics education.


Selected writings from the Journal of the Mathematics Council of the Alberta Teachers' Association Celebrating 50 years (1962-2012) of delta-K

Egan J Chernoff, University of Saskatchewan; Gladys Sterenberg, Mount Royal University


The teaching and learning of mathematics in Alberta - one of three Canadian provinces sharing a border with Montana - has a long and storied history. An integral part of the past 50 years (1962-2012) of this history has been delta-K: Journal of the Mathematics Council of the Alberta Teachers' Association. This volume, which presents ten memorable articles from each of the past five decades, that is, 50 articles from the past 50 years of the journal, provides an opportunity to share this rich history with a wide range of individuals interested in the teaching and learning of mathematics and mathematics education. Each decade begins with an introduction, providing a historical context, and concludes with a commentary from a prominent member of the Alberta mathematics education community. As a result, this monograph provides a historical account as well as a contemporary view of many of the trends and issues in the teaching and learning of mathematics. This volume is meant to serve as a resource for a variety of individuals, including teachers of mathematics, mathematics teacher educators, mathematics education researchers, historians, and undergraduate and graduate students. Most importantly, this volume is a celebratory retrospective on the work of the Mathematics Council of the Alberta Teachers' Association.

The Development of Teaching Expertise from an International Perspective

Su Liang, California State University - San Bernardino


This book provides an insightful view of effective teaching practices in China from an international perspective by examining the grades 7-12 mathematics teacher preparation in the Shandong province of China. It is an excellent reference book for teacher educators, researchers, reformers, and teaching practitioners. A qualitative research approach, involving in-depth interviews with purposive sampling of ten grades 7-12 award-winning mathematics teachers, was chosen to conduct the study. The participants are from the Shandong province and have been awarded recognition for his/her achievements in teaching grades 7-12 mathematics by the different levels: school, district, city, province, or nation; and his/her students have achieved high average scores in college entrance exams or in high school entrance exams among the classes at the same grade level.

Data analysis revealed the following findings: first, grades 7-12 mathematics teachers from the Shandong province of China were prepared to teach through pre-service training, in-service training, and informal learning. The pre-service training can be characterized as emphasizing formal mathematics training at advanced level. The in-service training is integrated with teacher collaboration and teaching research, and has the characteristics of diversity, continuity, and orientation toward teaching practice. The in-service training also stimulates teachers to conduct self-directed learning. Second, the award-winning grades 7-12 mathematics teachers are identified by the following characteristics: they are passionate about mathematics and share their passion through teaching; they actively take part in teaching research through application of teaching research in the classroom, collaboration with peers, and systematic lesson preparation; they apply technology into teaching; and they take an active role in teaching research in order to expand their professional opportunities.
Based on the findings of this study, the following conclusions were reached: pre-service training and in-service training are both necessary processes for mathematics teachers to build up their knowledge base for effective teaching. Pre-service training is just a starting point for the teaching profession. In-service training, integrated with teacher collaboration and teaching research should be a continuous activity that is a part of a teacher’s everyday life.


The interaction of the history of mathematics and mathematics education has long been construed as an esoteric area of inquiry. Much of the research done in this realm has been under the auspices of the history and pedagogy of mathematics group. However there is little systematization or consolidation of the existing literature aimed at undergraduate mathematics education, particularly in the teaching and learning of the history of mathematics and other undergraduate topics. In this monograph, the chapters cover topics such as the development of Calculus through the actuarial sciences and map making, logarithms, the people and practices behind real world mathematics, and fruitful ways in which the history of mathematics informs mathematics education. The book is meant to serve as a source of enrichment for undergraduate mathematics majors and for mathematics education courses aimed at teachers.

**CONTENTS:** TOPICS IN HISTORY AND DIDACTICS OF CALCULUS AND ANALYSIS. A note on the institutionalization of mathematical knowledge or “What was and is the Fundamental Theorem of Calculus, really”? Eva Jablonka and Anna Kisinska (Sweden). Transitioning students to calculus: Using history as a guide, Nicolas Haverhals & Matt Roscoe (USA). The tension between intuitive infinitesimals and formal mathematical analysis, Mikhail Katz (Israel) & David Tall (UK). The didactical nature of some lesser known historical examples in mathematics, Kaja Bråting (Sweden) Nicholas Kallem & Bharath Sriraman (USA). The Brachistochrone Problem: Mathematics for a Broad Audience via a Large Context Problem, Jeff Babb & James Currie (Canada). Chopping Logs: A Look at the History and Uses of Logarithms, Rafael Villarreal-Calderon (USA). The history of mathematics as a pedagogical tool: Teaching the integral of the secant via Mercator’s projection, Nicolas Haverhals & Matt Roscoe (USA).


Interdisciplinarity has become increasingly important for emergent professions of the 21st century yet there is a dearth of systematic studies aimed at implementing it in the school and university curricula. The Mathematics and its Connections to the Arts and Sciences (MACAS ) group places Mathematics as a vehicle through which deep and meaningful connections can be forged with the Arts and the Sciences and as a means of promoting interdisciplinary and transdisciplinary thinking traits amongst students. The Third International Symposium held by the MACAS group in Moncton, Canada in 2009 included numerous initiatives and ideas for interdisciplinarity that are implementable in both the school and university setting. The chapters in this book cover interdisciplinary links with mathematics found in the domains of culture, art, aesthetics, music, cognition, history, philosophy, engineering, technology and science with contributors from Canada, U.S, Denmark, Germany, Mexico, Iran and Poland amongst others.


**The Role of Mathematics Discourse in Producing Leaders of Discourse**

Libby Knott, Washington State University


The intent of this monograph is to showcase successful implementation of mathematical discourse in the classroom. Some questions that might be addressed are:

* How does a teacher begin to learn about using discourse purposefully to improve mathematics teaching and learning?
* How is discourse interwoven into professional development content courses to provide teachers with the tools necessary to begin using discourse in their own classrooms?
* What does a discourse-rich classroom look like and how is it different from other classrooms, from both the teacher’s and the students’ perspectives?
* How can teachers of pre-service teachers integrate discourse into their content and methods courses?
* How can we use discourse research to inform work with teachers, both pre- and in-service, for example, to help them know how to respond to elicited knowledge from students in their classrooms?
* What are the discourse challenges in on-line mathematics courses offered for professional development? Can on-line classrooms also be discourse-rich? What would that look like?
* In what ways does mathematical discourse differ from discourse in general?


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**Relatively and Philosophically Ernest**

Festschrift in honor of Paul Ernest’s 65th Birthday

Bharath Sriraman, University of Montana; Simon Goodchild, University of Agder, Norway


Paul Ernest’s name is synonymous with social constructivism as a philosophy of mathematics. His contributions to mathematics education have occurred at a very fundamental level and to a extent shaped theory development in this field. His research addresses fundamental questions about the nature of mathematics and how it relates to teaching, learning and society. For the last three decades Paul has been a prolific scholar who has published in a wide array of topics such as the relationship between the philosophy of mathematics and mathematics education, and more generally the philosophy of mathematics education, ethics and values in mathematics education, and the philosophy of research methodology.

The title of this Festschrift is meant to be a pun to convey the sometimes relativistic dimension to mathematical certainty that Paul argued for in developing his philosophy, and also a play on words for the fact that absolute “earnestness” may perhaps be a Platonic construct, and not possible in the realm of language and human discourse! Paul Ernest’s scholarly evolution and life can best be summarized in the words of Walt Whitman “Do I contradict myself? Very well then I contradict myself I am large, I contain multitudes”. Indeed his presence has been large and multitudinous and this Festschrift celebrates his 65th Birthday with numerous contributions coming from the mathematics, philosophy and mathematics education communities around the world.

Interdisciplinarity, Creativity, and Learning
Mathematics with Literature, Paradoxes, History, Technology, and Modeling
Bharath Sriraman, University of Montana; Viktor Freiman, University of Moncton; Nicole Lirette-Pitre, University of Moncton

Interdisciplinarity is increasingly viewed as a necessary ingredient in the training of future oriented 21st century disciplines that rely on both analytic and synthetic abilities across disciplines. Nearly every curricular document or vision statement of schools and universities include a call for promoting creativity in students. Yet the construct of creativity and giftedness across disciplines remains elusive in the sense that the prototypical examples of such work come from eminent scientists, artists and mathematicians, and little if any work has been conducted with non-eminent individuals. This monograph is an attempt to fill this gap by putting forth the view that interdisciplinarity and creativity are related constructs, and that the cultivation of domain general creativity is possible. Mathematics has historically been anchored to numerous disciplines like theology, natural philosophy, culture and art, allowing for a flexibility of thought that is difficult to cultivate in other disciplines. In this monograph, the numerous chapters from Australia, U.S.A., Canada, Cyprus, Denmark and Japan provide a compelling illustration of the intricate connection of mathematics with literature, paradoxes, history, technology and modeling, thus serving as a conduit for interdisciplinarity, creativity and learning to occur.


Critical Issues in Mathematics Education
Paul Ernest, University of Exeter, UK; Brian Greer, Portland State University; Bharath Sriraman, University of Montana

The word "critical" in the title of this collection has three meanings, all of which are relevant. 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 analyze the merits and faults of". The authors contributing to this book pose challenging questions, from multiple perspectives, about the roles of mathematics in society and the implications for education. Traditional reasons for teaching mathematics include: preparing a new generation of mathematics researchers and a cadre of technically competent users of mathematics; training students to think logically; and because mathematics is as much part of cultural heritage as literature or music. These reasons remain valid, though open to critique, but a deeper analysis is required that recognizes the roles of mathematics in framing many aspects of contemporary society, that will connect mathematics education to the lived experiences of students, their communities, and society in general, and that acknowledges the global ethical responsibilities of mathematicians and mathematics educators.

The chapters address fundamental issues such as the relevance of school mathematics in people's lives; creating a sense of agency for the field of mathematics education, and redefining the relationship between mathematics as discipline, mathematics as school subject and mathematics as part of people's lives.

CONTENTS: Section 1: Mathematics education: For what and why? Brian Greer • What is mathematics education for? Bill Atweh • Ethical responsibility and the "What" and "Why" of mathematics education in a global context Uwe Gellert & Eva Jablonka • The demathematising effect of technology: Calling for critical competence Mellon Graven & Hansa Venkat • Mathematical literacy: Issues of engagement from the South African experience of curriculum implementation Cecilia Aguadlo-Valderrama • The purpose of school mathematics: Perspectives of Colombian mathematics teachers Roza Leikin • Teaching mathematics with and for creativity: An intercultural perspective Fiona Walls • Whose mathematics education? Mathematical discourses as cultural matricide? Alexandre Pais • The tension between what mathematics education should be for and what it is actually for Monica Mesquita • Mathematics education: For whom? Section 2: Globalization and cultural diversity Paul Ernest • Mathematics education ideologies and globalization Bill Atweh • What is this thing called social justice and what does it have to do with us in the context of globalization Bal Chandra Luitel & Peter Charles Taylor • Defrosting and re-frosting the ideology of pure mathematics: An infusion of Eastern-Western perspectives on conceptualizing a socially just mathematics education Gelsa Knijnik • Mathematics education and the Brazilian landless movement Dennis Almeida & George Gheverghese Joseph • Kerala mathematics and its possible transmission to Europe Paul Ernest • The philosophy of mathematics, values, and Kerala mathematics Section 3: Mathematics, education, and society Paul Ernest • Classroom Research: Impact and Long Term Effect versus Justice, Liberation and Empowerment? Simon Goodchild • Values and the social responsibility of mathematics Paola Valero • What has power got to do with mathematics education? Ole Skovsmose • Mathematics in action Ole Skovsmose & Keiko Yasukawa • Formatting power of mathematics Paul Budnik • What is mathematics about? Philip Davis • Applied mathematics as social contract De Freitas • Mathematics and curriculum integration: Challenging the hierarchy of school knowledge Section 4: Social justice in, and through, mathematics education Bharath Sriraman & Olof Steinthorsdottir • Social justice and mathematics education: Issues, dilemmas, excellence and equity Kurt Stembhagen • Social justice and mathematics: Rethinking the nature and purposes of school mathematics Eric (Rico) Gutstein • Possibilities and challenges in teaching mathematics for social justice Peter Applebaum & Erica Davila • Math education and social justice: Gatekeepers, politics, and teacher agency Jeff Evans • On methodologies of research into gender and other equity questions Carol V. Livingston • The privilege of pedagogical capital: A framework for understanding scholastic success in mathematics Kwame E. Glevey • Pupils of African heritage, mathematics education, and social justice Renuka Vithal • Researching, and learning mathematics at the margin.

Interdisciplinary Educational Research In Mathematics and Its Connections to The Arts and Sciences

Bharath Sriraman, University of Montana; Claus Michelsen, University of Southern Denmark; Astrid Beckmann, University of Education- Schwäbisch Gmünd, Germany; Viktor Freiman, University of Moncton


The book is based on the recently held Symposium on mathematics and its connections to the arts and sciences, namely the second Mathematics and its Connections to the Arts and Sciences (MACAS2) Symposium in Odense, Denmark (May 29-31, 2007). The chapters are an eclectic collection of interdisciplinary research initiatives undertaken by mathematicians and educators with implications for practitioners concerned with teaching and learning processes. The papers cover a wide genre of research domains within mathematics education (cognition, modelling, problem solving, teacher education, ethnomathematics, mathematical/statistical literacy, curricular and technological initiatives and research related to science education). The major interdisciplinary themes of the papers in this book are:

1. How can modeling activities be used to foster interdisciplinary projects in the school and university setting?

2. How can the intricate connections between mathematics and physics be used to design and research interdisciplinary activities in schools and the university?

3. How can research within the ethnomathematics domain of mathematics education be linked to critical mathematics education and interdisciplinary projects involving mathematics, art and culture?
4. How can the push for mathematical and statistical literacy be connected to other subjects in the school curricula and emphasized via interdisciplinary activities?

5. What are concrete examples of classroom experiments with empirical data that demonstrate new and unusual connections/relations between mathematics, arts and the sciences with implications for pedagogy?

6. What is the role of technology and new ICT interfaces in linking communities of learners in interdisciplinary activities involving problem solving? The book is an important contribution to the literature on educational initiatives in interdisciplinary education increasing vital for emerging professions of the 21st century.

Creativity, Giftedness, and Talent Development in Mathematics
Bharath Sriraman, University of Montana


Our innovative spirit and creativity lies beneath the comforts and security of today’s technologically evolved society. Scientists, inventors, investors, artists and leaders play a vital role in the advancement and transmission of knowledge. Mathematics, in particular, plays a central role in numerous professions and has historically served as the gatekeeper to numerous other areas of study, particularly the hard sciences, engineering and business. Mathematics is also a major component in standardized tests in the U.S., and in university entrance exams in numerous parts of world.

Creativity and imagination is often evident when young children begin to develop numeric and spatial concepts, and explore mathematical tasks that capture their interest. Creativity is also an essential ingredient in the work of professional mathematicians. Yet, the bulk of mathematical thinking encouraged in the institutionalized setting of schools is focused on rote learning, memorization, and the mastery of numerous skills to solve specific problems prescribed by the curricula or aimed at standardized testing. Given the lack of research based perspectives on talent development in mathematics education, this monograph is specifically focused on contributions towards the constructs of creativity and giftedness in mathematics. This monograph presents new perspectives for talent development in the mathematics classroom and gives insights into the psychology of creativity and giftedness. The book is aimed at classroom teachers, coordinators of gifted programs, math contest coaches, graduate students and researchers interested in creativity, giftedness, and talent development in mathematics.

The name of Zoltan P. Dienes (1916-) stands with those of Jean Piaget and Jerome Bruner as a legendary figure whose theories of learning have left a lasting impression on the field of mathematics education. Dienes' name is synonymous with the Multi-base blocks (also known as Dienes blocks) which he invented for the teaching of place value. He also is the inventor of Algebraic materials and logic blocks, which sowed the seeds of contemporary uses of manipulative materials in mathematics instruction. Dienes' place is unique in the field of mathematics education because of his theories on how mathematical structures can be taught from the early grades onwards using multiple embodiments through manipulatives, games, stories and dance.

Dienes' notion of embodied knowledge presaged other cognitive scientists who eventually came to recognize the importance of embodied knowledge and situated cognition - where knowledge and abilities are organized around experience as much as they are organized around abstractions. Dienes was an early pioneer in what was later to be called sociocultural perspectives and democratization of learning.

This monograph compiled and edited by Bharath Sriraman honors the seminal contributions of Dienes to mathematics education and includes several recent unpublished articles written by Dienes himself. These articles exemplify his principles of guided discovery learning and reveal the non-trivial mathematical structures that can be made accessible to any student. The monograph also includes a rare interview with Dienes in which he reflects on his life, his work, the role of context, language and technology in mathematics teaching and learning today. The book finds an important place in any mathematics education library and is vital reading for mathematics education researchers, cognitive scientists, prospective teachers, graduate students and teachers of mathematics.


International Perspectives on Social Justice in Mathematics Education

Bharath Sriraman, University of Montana


International Perspectives and Research on Social Justice in Mathematics Education is the highly acclaimed inaugural monograph of The Montana Mathematics Enthusiast now available through IAP. The book covers prescient social, political and ethical issues for the domain of education in general and mathematics education in particular from the perspectives of critical theory, feminist theory and social justice research. The major themes in the book are (1) relevant mathematics, teaching and learning practices for minority and marginalized students in Australia, Brazil, South Africa, Israel, Palestine, and the United States, (2) closing the achievement gap in the U.K, U.S and Iceland across classes, ethnicities and gender, and (3) the political dimensions of mathematics. The fourteen chapters are written by leading researchers in the international community interested and active in research issues of equity and social justice.