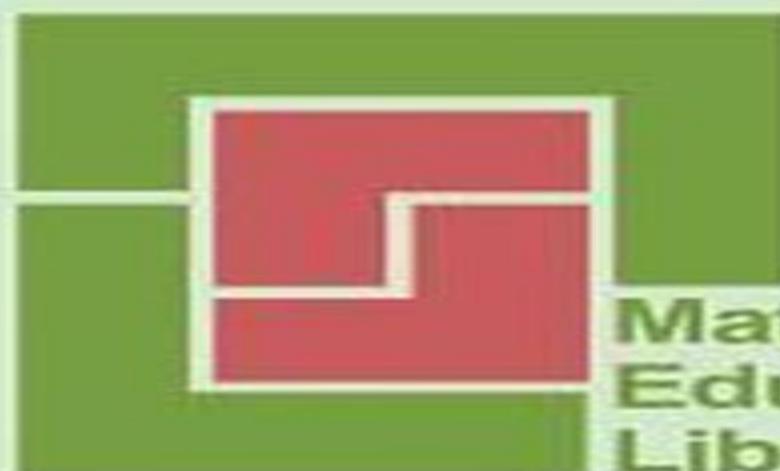


# Mathematical Knowledge: Its Growth Through Teaching

*Edited by*

Alan J. Bishop, Stieg Mellin-Olsen  
and Joop van Dormolen (eds.)



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# Growth Of Mathematical Knowledge

**Paul Ernest**



## **Growth Of Mathematical Knowledge:**

*The Growth of Mathematical Knowledge* Emily Grosholz, Herbert Breger, 2013-04-17 Mathematics has stood as a bridge between the Humanities and the Sciences since the days of classical antiquity For Plato mathematics was evidence of Being in the midst of Becoming garden variety evidence apparent even to small children and the unphilosophical and therefore of the highest educational significance In the great central similes of *The Republic* it is the touchstone of intelligibility for discourse and in the *Timaeus* it provides in an oddly literal sense the framework of nature insuring the intelligibility of the material world For Descartes mathematical ideas had a clarity and distinctness akin to the idea of God as the fifth of the *Meditations* makes especially clear Cartesian mathematical constructions as well as objects envisioned by the soul in the *Principles* the work of the physicist who provides a quantified account of the machines of nature hovers between description and constitution For Kant mathematics reveals the possibility of universal and necessary knowledge that is neither the logical unpacking of concepts nor the record of perceptual experience In the *Critique of Pure Reason* mathematics is one of the transcendental instruments the human mind uses to apprehend nature and by apprehending to construct it under the universal and necessary laws of Newtonian mechanics

**Mathematical Knowledge: Its Growth Through Teaching** Alan J. Bishop, Stieg Mellin-Olsen, Joop van Dormolen, J. van Dormolen, 1991-10-31 The book focuses on the genesis of mathematical knowledge in the classroom As with the first project the concerns are with fundamental analysis of the problem field and various approaches are presented in the book which will stimulate new thinking about research and teacher development

**Unification and Growth of Mathematical Knowledge** Emily R. Grosholz, 1978 **The Origins of Mathematical Knowledge in Childhood** Catherine Sophian, 2017-09-25 This book examines the origins and development of children's mathematical knowledge It contrasts the widely held view that counting is the starting point for mathematical development with an alternative comparison of quantities position According to the comparison of quantities position the concept of number builds upon more basic concepts of equality inequality and less than and greater than relations which derive from comparisons between unenumerated quantities such as lengths The concept of number combines these basic comparative concepts with the concept of a unit of measure which allows one quantity to be described as a multiple of another Sophian examines these alternative accounts of children's developing mathematical knowledge in the light of research on children's counting on their reasoning about continuous quantities such as length and area on the development of the concept of unit on additive and multiplicative reasoning and on knowledge about fractions In the closing chapters Sophian draws out the developmental and the educational implications of the research and theory presented Developmentally the comparison of quantities position undermines the idea that numerical knowledge develops through domain specific learning mechanisms in that it links numerical development both to physical knowledge about objects which is the starting point for the concept of unit and to the acquisition of linguistic number terms Instructionally the comparison of quantities perspective diverges from

the counting first perspective in that it underscores the continuity between whole number arithmetic and fraction learning that stems from the importance of the concept of unit for both Building on this idea Sophian advances three instructional recommendations First instruction about numbers should always be grounded in thinking about quantities and how numbers represent the relations between them second instruction in the early years should always be guided by a long term perspective in which current objectives are shaped by an understanding of their role in the overall course of mathematics learning and third instruction should be directly toward promoting the acquisition of the most general mathematical knowledge possible The Origins of Mathematical Knowledge in Childhood is intended for researchers professionals and graduate students in developmental psychology educational psychology and mathematics education and as a supplementary text for advanced undergraduate courses in cognitive development educational psychology and mathematics education

*Increasing Teachers' Mathematical Knowledge Growth in Practice Model Versus Training Model* Allison Armstrong, 2003

**Constructing Mathematical Knowledge** Paul Ernest, 2012-10-12 First published in 1994 This book and its companion volume Mathematics Education and Philosophy An International Perspective are edited collections Instead of the sharply focused concerns of the research monograph the books offer a panorama of complementary and forward looking perspectives They illustrate the breadth of theoretical and philosophical perspectives that can fruitfully be brought to bear on the mathematics and education The empathise of this book is on epistemological issues encompassing multiple perspectives on the learning of mathematics as well as broader philosophical reflections on the genesis of knowledge It explores

constructivist and social theories of learning and discusses the role of the computer in light of these theories *The Nature of Mathematical Knowledge* Philip Kitcher, 1984 This book argues against the view that mathematical knowledge is a priori contending that mathematics is an empirical science and develops historically just as natural sciences do Kitcher presents a complete systematic and richly detailed account of the nature of mathematical knowledge and its historical development focusing on such neglected issues as how and why mathematical language changes why certain questions assume overriding importance and how standards of proof are modified **Forms of Mathematical Knowledge** Dina Tirosh, 2013-03-14 What

mathematics is entailed in knowing to act in a moment Is tacit rhetorical knowledge significant in mathematics education What is the role of intuitive models in understanding learning and teaching mathematics Are there differences between elementary and advanced mathematical thinking Why can't students prove What are the characteristics of teachers ways of knowing This book focuses on various types of knowledge that are significant for learning and teaching mathematics The first part defines discusses and contrasts psychological philosophical and didactical issues related to various types of knowledge involved in the learning of mathematics The second part describes ideas about forms of mathematical knowledge that are important for teachers to know and ways of implementing such ideas in preservice and in service education The chapters provide a wide overview of current thinking about mathematics learning and teaching which is of interest for researchers in

mathematics education and mathematics educators Topics covered include the role of intuition in mathematics learning and teaching the growth from elementary to advanced mathematical thinking the significance of genres and rhetoric for the learning of mathematics and the characterization of teachers ways of knowing The Nature of Mathematical Knowledge San Diego Philip Kitcher Professor of Philosophy University of California, 1983-04-21 This book argues against the view that mathematical knowledge is a priori contending that mathematics is an empirical science and develops historically just as natural sciences do Kitcher presents a complete systematic and richly detailed account of the nature of mathematical knowledge and its historical development focusing on such neglected issues as how and why mathematical language changes why certain questions assume overriding importance and how standards of proof are modified *Learning Through Teaching Mathematics* Roza Leikin, Rina Zazkis, 2010-04-10 The idea of teachers Learning through Teaching LTT when presented to a naive bystander appears as an oxymoron Are we not supposed to learn before we teach After all under the usual circumstances learning is the task for those who are being taught not of those who teach However this book is about the learning of teachers not the learning of students It is an ancient wisdom that the best way to truly learn something is to teach it to others Nevertheless once a teacher has taught a particular topic or concept and consequently truly learned it what is left for this teacher to learn As evident in this book the experience of teaching presents teachers with an exciting opportunity for learning throughout their entire career This means acquiring a better understanding of what is being taught and moreover learning a variety of new things What these new things may be and how they are learned is addressed in the collection of chapters in this volume LTT is acknowledged by multiple researchers and mathematics educators In the first chapter Leikin and Zazkis review literature that recognizes this phenomenon and stress that only a small number of studies attend systematically to LTT processes The authors in this volume purposefully analyze the teaching of mathematics as a source for teachers own learning *Mathematical Knowledge in Teaching* Tim Rowland, Kenneth Ruthven, 2011-01-06 The quality of primary and secondary school mathematics teaching is generally agreed to depend crucially on the subject related knowledge of the teacher However there is increasing recognition that effective teaching calls for distinctive forms of subject related knowledge and thinking Thus established ways of conceptualizing developing and assessing mathematical knowledge for teaching may be less than adequate These are important issues for policy and practice because of longstanding difficulties in recruiting teachers who are confident and conventionally well qualified in mathematics and because of rising concern that teaching of the subject has not adapted sufficiently The issues to be examined in *Mathematical Knowledge in Teaching* are of considerable significance in addressing global aspirations to raise standards of teaching and learning in mathematics by developing more effective approaches to characterizing assessing and developing mathematical knowledge for teaching **Mathematical Knowledge and the Interplay of Practices** José Ferreirós, 2015-12-22 This book presents a new approach to the epistemology of mathematics by viewing mathematics as a human activity whose knowledge is

intimately linked with practice Charting an exciting new direction in the philosophy of mathematics Jos Ferreir s uses the crucial idea of a continuum to provide an account of the development of mathematical knowledge that reflects the actual experience of doing math and makes sense of the perceived objectivity of mathematical results Describing a historically oriented agent based philosophy of mathematics Ferreir s shows how the mathematical tradition evolved from Euclidean geometry to the real numbers and set theoretic structures He argues for the need to take into account a whole web of mathematical and other practices that are learned and linked by agents and whose interplay acts as a constraint Ferreir s demonstrates how advanced mathematics far from being a priori is based on hypotheses in contrast to elementary math which has strong cognitive and practical roots and therefore enjoys certainty Offering a wealth of philosophical and historical insights *Mathematical Knowledge and the Interplay of Practices* challenges us to rethink some of our most basic assumptions about mathematics its objectivity and its relationship to culture and science

*Developing Mathematical Knowledge for Teaching* Erica Kwiatkowski-Egizio,2015-07-13 The two research questions that frame the research in this book are 1 How do preservice teachers develop mathematical knowledge for teaching during a coordinated math methods course and field experience and 2 What types of portfolio tasks lend themselves to documenting mathematical knowledge in teaching Six female elementary K 8 teacher candidates were the participants in this research The six teacher candidates all completed their field experiences in the same K 8 school St Joseph in Lockport Illinois Three of the teacher candidates had elementary placements grades K 1 and 4 and three of the teacher candidates had middle school placements 5 6 and 7 Each of the teacher candidates completed pre test and post test DTAMS assessments All candidates taught three consecutive mathematics lessons After each lesson was taught a debriefing interview was conducted Each teacher candidate submitted a Math Teaching Portfolio Results illustrated the growth of mathematical knowledge for teaching that occurred for each participant Implications for the field of mathematics education future research and teacher preparation programs are also discussed

*The Learning and Development of Mathematics Teacher Educators* Merrilyn Goos, Kim Beswick,2021-04-07 Research in mathematics teacher education as a distinctive field of inquiry has grown substantially over the past 10 15 years Within this field there is emerging interest in how mathematics teacher educators MTEs themselves learn and develop Until recently there were few published studies on this topic and the processes by which mathematics teacher educators learn and the forms of knowledge they require for effective practice had not been systematically investigated However researchers in mathematics education are now beginning to investigate the development of MTE expertise and associated issues This volume draws on the latest research and thinking in this area is therefore timely to stimulate future development and directions It will survey the emerging field of inquiry in mathematics education combining the work of established scholars with perspectives of newcomers to the field with the aim of influencing development of the field invite cross cultural comparisons in becoming a mathematics teacher educator by highlighting issues in the development of MTEs in different

countries and examine the roles of both mathematics educators and mathematicians in preparing future teachers of mathematics. The primary audience will be university based mathematics teacher educators and MTE researchers and postgraduate research students who are seeking academic careers as MTEs. Additional interest may come from teacher educators in disciplines other than mathematics and education policy makers responsible for accreditation and quality control of initial teacher education programs.

**Mathematical Proficiency for All Students: Toward a Strategic Research and Development Program in Mathematics Education** Deborah Loewenberg, 2003-04-15 A clear need exists for substantial improvement in mathematics proficiency in U S schools. The RAND Mathematics Study Panel was convened to inform the U S Department of Education's Office of Educational Research and Improvement on ways to improve the quality and usability of education research and development. Research on teaching and learning of skills needed for mathematical thinking and problem solving and teaching and learning of algebra from kindergarten through the 12th grade. Mathematics Education for Sustainable Economic Growth and Job Creation David Burghes, Jodie Hunter, 2021-08-23 Mathematics Education for Sustainable Economic Growth and Job Creation considers the need for young employees to be capable and confident with transferable knowledge and skills in mathematics and statistics in order to support economic growth in developing countries in an increasingly digital age. This book draws on differing international perspectives in relation to mathematics education for sustainable economic growth and job creation. The contributors include education researchers and those involved in policymaking for both developing countries and beyond. Within each chapter there is a reflection from the authors on their experiences in educational systems and policy development or research studies which contribute to sustainable economic growth in different countries. As well as considerations of economies and job creation, the scholarship delves further into developing a critically aware citizenship through mathematics education. Extending current thinking about the role of mathematics education and educating students for future needs, this book will be of great interest for academics, researchers and postgraduate students in the field of mathematics education, STEM education and sustainability education. *Journal of Experimental Pedagogy and Training*, 1923

**Mathematical Reviews**, 2003

**Cognitive Foundations for Improving Mathematical Learning** David C. Geary, Daniel B. Berch, Kathleen Mann Koepke, 2019-01-03 The fifth volume in the Mathematical Cognition and Learning series focuses on informal learning environments and other parental influences on numerical cognitive development and formal instructional interventions for improving mathematics learning and performance. The chapters cover the use of numerical play and games for improving foundational number knowledge as well as school math performance, the link between early math abilities and the approximate number system and how families can help improve the early development of math skills. The book goes on to examine learning trajectories in early mathematics, the role of mathematical language in acquiring numeracy skills, evidence based assessments of early math skills, approaches for intensifying early mathematics interventions, the use of analogies in mathematics instruction, schema based

diagrams for teaching ratios and proportions the role of cognitive processes in treating mathematical learning difficulties and addresses issues associated with intervention fadeout Identifies the relative influence of school and family on math learning Discusses the efficacy of numerical play for improvement in math Features learning trajectories in math Examines the role of math language in numeracy skills Includes assessments of math skills Explores the role of cognition in treating math based learning difficulties

*Focusing on Teachers' Mathematical Knowledge* Michael S. Garet, Jessica B. Heppen, Kirk Walters, Julia Parkinson, Toni M. Smith, Mengli Song, Rachel Garrett, Rui Yang, Geoffrey D. Borman, 2016 Recent results from national and international assessments continue to show a need for improvement in math achievement among U S students For example 60 per cent of grade 4 students scored below the proficient level on the 2015 National Assessment of Educational Progress In an era of increasingly rigorous state standards teachers at all grade levels face heightened expectations to deepen their students understanding of math concepts Teachers may benefit from professional development PD that strengthens their own conceptual understanding of math particularly elementary school teachers who are less likely to formally study math in college than secondary teachers are To date there is limited convincing evidence on the effectiveness of intensive content focused PD a gap this study intended to address This study examined the implementation and impact of a 93 hour PD program that focused on deepening teachers general math knowledge but also covered some math knowledge relevant to teaching The core of the PD was Intel Math an intensive 80 hour workshop delivered in summer 2013 that focused on deepening teachers knowledge of grades K 8 math Two additional PD components Mathematics Learning Community and Video Feedback Cycles totaling 13 hours were delivered during the 2013 14 school year to reinforce the math content in Intel Math and help teachers apply the content to improve their instruction Results of the study revealed that despite the PD s positive impact on some teacher outcomes the PD did not have a positive impact on student achievement On average treatment teachers students scored 2 percentile points lower than control teachers students on both spring 2014 student achievement measures see Figure 3 The difference between treatment and control group students was statistically significant for the state math assessment but not the study administered assessment This may be partially explained by the finding that math content knowledge and instructional practice as measured in this study were generally not correlated with student math achievement To access the full report in ERIC *Focusing on Mathematical Knowledge The Impact of Content Intensive Teacher Professional Development* NCEE 2016 4010 see ED569154 To view *Focusing on Mathematical Knowledge The Impact of Content Intensive Teacher Professional Development Executive Summary* NCEE 2016 4009 see ED569155

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