

Mathematical knowledge for teaching (MKT)

- Frame: knowledge used in practice
 - “knowledge *entailed by* the work of teaching”
- What do we mean by “knowledge”?
 - Mathematical knowledge, skill, habits of mind
- What do we mean by the “work of teaching”?
 - The activities in which teachers engage, and the responsibilities they have, to teach mathematics, both inside and outside of the classroom

Mathematical Knowledge In Teaching Mathematical Knowledge In Teaching

Padhraic Smyth



Mathematical Knowledge In Teaching Mathematical Knowledge In Teaching:

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.

Understanding primary school teachers' mathematical knowledge for teaching Yasmin Sitabkhan, Aida Alikova, Nurgul Toktogulova, Adema Zholdosbekova, Wendi Ralaingita, Jonathan Stern, 2025-05-13 We present the results from an exploratory study that aimed to measure teachers' specialized knowledge in early mathematics during a pilot of an educational intervention using the Foundational Mathematical Knowledge for Teaching (FMKT) survey. The survey was administered to 323 teachers in the Kyrgyz Republic in 2021. We delve into survey results at two timepoints: pre and post intervention, to showcase the areas in which the intervention was successful and identify ongoing challenges in teacher knowledge. We found that the FMKT provided detailed, specific information on teacher learning and is an example of one way to center teacher knowledge in an instructional intervention.

Mathematical Understanding for Secondary Teaching M. Kathleen Heid, Patricia S. Wilson, Glendon W. Blume, 2015-12-01 A perennial discussion about teacher development is the optimal content background for teachers. In recent years, that discussion has taken center stage in the work of mathematics education researchers, mathematicians, mathematics professional developers, and mathematics education policymakers. Much of the existing and prior work in this area has been directed toward mathematical knowledge for teaching at the elementary level. The work described in this volume takes a sometimes neglected approach, focusing on the dynamic nature of mathematical understanding rather than on a stable description of mathematical knowledge and on mathematics for secondary teaching rather than mathematics for teaching at the elementary level. The work reported in *Mathematical Understanding for Secondary Teaching: A Framework and Classroom Based Situations* is a practice-based response to the question of what mathematical understandings secondary teachers could productively use in their teaching. For each of more than 50 events, our team of almost 50 mathematics educators, who were experienced mathematics teachers, developed descriptions of the mathematics that teachers could use. Each of those descriptions consisted of the event and the mathematics related to the event, which is what we call a Situation. We developed our Framework for Mathematical Understanding

for Secondary Teaching MUST based on an analysis of our entire set of Situations We call the work practice based because the MUST framework is based on actual events that we witnessed in our observations of secondary mathematics practice Groups of mathematics teachers can use this volume to enhance their own understandings of secondary mathematics School leaders and professional developers in secondary mathematics will find our MUST Framework and Situations useful as they work with teachers in enhancing and deepening their understanding of secondary mathematics Mathematics teacher educators and mathematicians who teach mathematics to prospective and in service secondary teachers will be able to couch their mathematical discussions in the Situations examples that arise from secondary mathematics classrooms They will be able to use this volume as they design courses and programs that enhance mathematics from the perspectives identified in the MUST framework Policymakers and researchers can use our MUST framework as they consider the mathematics background needed by teachers

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

Mathematical Knowledge: Its Growth Through Teaching Alan Bishop, Stieg Mellin-Olsen, Joop van Dormolen, 2013-11-27 In the first BACOMET volume different perspectives on issues concerning teacher education in mathematics were presented B Christiansen A G Howson and M Otte Perspectives on Mathematics Education Reidel Dordrecht 1986 Underlying all of them was the fundamental problem area of the relationships between mathematical knowledge and the teaching and learning processes The subsequent project BACOMET 2 whose outcomes are presented in this book continued this work especially by focusing on the genesis of mathematical knowledge in the classroom The book developed over the period 1985-9 through several meetings much discussion and considerable writing and redrafting Our major concern was to try to analyse what we considered to be the most significant aspects of the relationships in order to enable mathematics educators to be better able to handle the kinds of complex issues facing all mathematics educators as we approach the end of the twentieth century With access to mathematics education widening all

the time with a multi tude of new materials and resources being available each year with complex cultural and social interactions creating a fluctuating context of education with all manner of technology becoming more and more significant and with both informal education through media of different kinds and non formal education courses of training etc growing apace the nature of formal mathematical education is increasingly needing analysis

Mathematical Knowledge in Teaching Dr Tim Rowland, Kenneth Ruthven, 2011-03-30 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

Mathematics Teaching and Learning Rina Kim, Lillie R. Albert, 2015-03-28 The purpose of this research is to identify the categories of South Korean elementary teachers knowledge for teaching mathematics Emerging from the data collected and the subsequent analysis are five categories of South Korean elementary teachers knowledge for teaching mathematics Mathematics Curriculum Knowledge Mathematics Learner Knowledge Fundamental Mathematics Conceptual Knowledge Mathematics Pedagogical Content Knowledge and Mathematics Pedagogical Procedural Knowledge The first three categories of knowledge play a significant role in mathematics instruction as an integrated form within Mathematics Pedagogical Content Knowledge This study also demonstrated that Mathematics Pedagogical Procedural Knowledge might play a pivotal role in constructing Mathematics Pedagogical Content Knowledge These findings are connected to results from relevant studies in terms of the significant role of teachers knowledge in mathematics instruction

The Handbook of Mathematics Teacher Education: Volume 1, 2008-01-01 The Handbook of Mathematics Teacher Education the first of its kind addresses the learning of mathematics teachers at all levels of schooling to teach mathematics and the provision of activity and programmes in which this learning can take place It consists of four volumes VOLUME 1 Knowledge and Beliefs in Mathematics Teaching and Teaching Development addresses the what of mathematics teacher education meaning knowledge for mathematics teaching and teaching development and consideration of associated beliefs As well as synthesizing research and practice over various dimensions of these issues it offers advice on best practice for teacher educators university decision makers and those involved in systemic policy development on teacher education

The Language of Mathematics Patrick M. Jenlink, 2020-02-04 The Language of Mathematics How the Teacher s Knowledge of Mathematics Affects Instruction

introduces the reader to a collection of thoughtful works by authors that represent current thinking about mathematics teacher preparation. The book provides the reader with current and relevant knowledge concerning preparation of mathematics teachers. The complexity of teaching mathematics is undeniable and all too often ignored in the preparation of teachers with substantive mathematical content knowledge and mathematical teaching knowledge. That said, this book has a focus on the substantive knowledge and the relevant pedagogy required for preparing teachers to enter classrooms to teach mathematics in K-12 school settings. Each chapter focuses on the preparation of teachers who will enter classrooms to instruct the next generation of students in mathematics. Chapter One opens the book with a focus on the language and knowledge of mathematics teaching. The authors of Chapters Two-Nine present field-based research that examines the complexities of content and pedagogical knowledge as well as knowledge for teaching. Each chapter offers the reader an examination of mathematics teacher preparation and practice based on formal research that provides the reader with insight into how the research study was conducted as well as providing the findings and conclusions drawn with respect to mathematics teacher preparation and practice. Finally, Chapter 10 presents an epilogue that focuses on the future of mathematics teacher preparation.

Refining the Mathematics Knowledge Base Bindu Elizabeth Pothen, 2011

Understanding the knowledge that teachers must bring to their classrooms is critical to the advancement of the field of teacher education. Understanding how teacher knowledge impacts various aspects of teacher practice is also critical. Understanding the interplay between teacher knowledge and practice and consequently the result that this relationship has on student learning is most important. This dissertation attempts to advance our collective understanding of the complex relationship between teacher knowledge, teacher practice, and student learning in the field of elementary mathematics. Four third-grade teachers were followed as they taught a subset of lessons in a unit on fractions. The study first investigates the types of knowledge that the teachers brought to their classrooms. Then an examination is conducted of the way in which these types of knowledge impacted their teaching practice. Finally, the student learning that resulted over the course of these lessons is discussed. This study supports the widespread belief that teacher knowledge is important to instruction. The descriptions of the case study teachers highlight that their varying levels of knowledge resulted in unique aspects of practice being emphasized in their classrooms. This dissertation documents the differences in teaching practice and the trade-offs that produce differences in student learning. Interesting student learning patterns emerged based on qualitative student interviews. Medium students from classrooms in which teachers focused for more sustained periods on mathematical concepts seemed to demonstrate greater procedural fluency and deeper conceptual understanding than their peers in the other classrooms. Low students in classrooms where fluency was the focus seemed to show slightly greater procedural fluency though less conceptual understanding than their peers in the classrooms that spent more time on concepts. High students showed no appreciable difference across all classrooms. This study adds to the field by introducing a new construct

the conceptual threshold to offer an explanation of these student learning trends

Middle Grade Teachers' Mathematical Knowledge and Its Relationship to Instruction Judith Sowder, Randolph A. Philipp, Barbara E. Armstrong, Bonnie P. Schappelle, 1998-07-16 Investigates how middle grade teachers deeper understanding of the mathematics of number quantity and proportion influences the way they teach and the way students learn

Research Trends in Mathematics Teacher Education Jane-Jane Lo, Keith R. Leatham, Laura R. Van Zoest, 2014-05-28 Research on the preparation and continued development of mathematics teachers is becoming an increasingly important subset of mathematics education research Such research explores the attributes knowledge skills and beliefs of mathematics teachers as well as methods for assessing and developing these critical aspects of teachers and influences on teaching Research Trends in Mathematics Teacher Education focuses on three major themes in current mathematics teacher education research mathematical knowledge for teaching teacher beliefs and identities and tools and techniques to support teacher learning Through careful reports of individual research studies and cross study syntheses of the state of research in these areas the book provides insights into teachers learning processes and how these processes can be harnessed to develop effective teachers Chapters investigate bedrock skills needed for working with primary and secondary learners writing relevant problems planning lessons being attentive to student learning and illustrate how knowledge can be accessed assessed and nurtured over the course of a teaching career Commentaries provide context for current research while identifying areas deserving future study Included among the topics Teachers curricular knowledge Teachers personal and classroom mathematics Teachers learning journeys toward reasoning and sense making Teachers transitions in noticing Teachers uses of a learning trajectory as a tool for mathematics lesson planning A unique and timely set of perspectives on the professional development of mathematics teachers at all stages of their careers Research Trends in Mathematics Teacher Education brings clarity and practical advice to researchers as well as practitioners in this increasingly critical arena

Knowing and Learning Mathematics for Teaching National Research Council, Mathematical Sciences Education Board, Center for Education, Mathematics Teacher Preparation Content Workshop Program Steering Committee, 2001-01-25 There are many questions about the mathematical preparation teachers need Recent recommendations from a variety of sources state that reforming teacher preparation in postsecondary institutions is central in providing quality mathematics education to all students The Mathematics Teacher Preparation Content Workshop examined this problem by considering two central questions What is the mathematical knowledge teachers need to know in order to teach well How can teachers develop the mathematical knowledge they need to teach well The Workshop activities focused on using actual acts of teaching such as examining student work designing tasks or posing questions as a medium for teacher learning The Workshop proceedings Knowing and Learning Mathematics for Teaching is a collection of the papers presented the activities and plenary sessions that took place

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

Exploring Mathematics and Science Teachers' Knowledge

Hamsa Venkat, Marissa Rollnick, John Loughran, Mike Askew, 2014-05-09 Globally mathematics and science education faces three crucial challenges an increasing need for mathematics and science graduates a declining enrolment of school graduates into university studies in these disciplines and the varying quality of school teaching in these areas Alongside these challenges internationally more and more non specialists are teaching mathematics and science at both primary and secondary levels and research evidence has revealed how gaps and limitations in teachers content understandings can lead to classroom practices that present barriers to students learning This book addresses these issues by investigating how teachers content knowledge interacts with their pedagogies across diverse contexts and perspectives This knowledge practice nexus is examined across mathematics and science teaching traversing schooling phases and countries with an emphasis on contexts of disadvantage These features push the boundaries of research into teachers content knowledge The book s combination of mathematics and science enriches each discipline for the reader and contributes to our understandings of student attainment by examining the nature of specialised content knowledge needed for competent teaching within and across the two domains Exploring Mathematics and Science Teachers Knowledge will be key reading for researchers doctoral students and postgraduates with a focus on Mathematics Science and teacher knowledge research

The Construction of New

Mathematical Knowledge in Classroom Interaction Heinz Steinbring, 2005-03-22 Mathematics is generally considered as the only science where knowledge is uni form universal and free from contradictions Mathematics is a social product a net of norms as Wittgenstein writes In contrast to other institutions traffic rules legal systems or table manners which are often internally contradictory and are hardly ever unrestrictedly accepted mathematics is distinguished by coherence and consensus Although mathematics is presumably the discipline which is the most differentiated internally the corpus of mathematical knowledge constitutes a coher ent whole The consistency of mathematics cannot be proved yet so far no contradictions were found that would question the uniformity of mathematics Heintz 2000 p 11 The coherence of mathematical

knowledge is closely related to the kind of professional communication that research mathematicians hold about mathematical knowledge. In an extensive study Bettina Heintz Heintz 2000 proposed that the historical development of formal mathematical proof was in fact a means of establishing a communicable code of conduct which helped mathematicians make themselves understood in relation to the truth of mathematical statements in a coordinated and unequivocal way.

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.

An Exploration of Pre-service Elementary Teachers' Mathematical Knowledge for Teaching Michael Jarry-Shore, 2016 Abstract Mathematical knowledge for teaching or MKT is a critically important knowledge of mathematics unique to teachers and teaching. One aspect of MKT, specialized content knowledge (SCK), involves the ability to interpret nonstandard student solutions, represent relevant mathematical content non symbolically, and explain standard math algorithms. Ball, Thames, Hill, 2010. Additionally, it would appear as though pre-service teachers would benefit from efforts to foster a flexible disposition, as such flexibility appears to augment one's specialized content knowledge. Hill, Dean, Hill, 2010. Keywords: mathematical knowledge for teaching, specialized content knowledge, disposition, pre-service teacher.

The Language of Mathematics Patrick M. Jenlink, 2020-02-04 The Language of Mathematics: How the Teacher's Knowledge of Mathematics Affects Instruction introduces the reader to a collection of thoughtful works by authors that represent current thinking about mathematics teacher preparation. The book provides the reader with current and relevant knowledge concerning preparation of mathematics teachers. The complexity of teaching mathematics is undeniable and all too often ignored in the preparation of teachers with substantive mathematical content knowledge and mathematical teaching knowledge. That said, this book has a focus on the substantive knowledge and the relevant pedagogy required for preparing teachers to enter classrooms to teach mathematics in K-12 school settings. Each chapter focuses on the preparation of teachers who will enter classrooms to instruct the next generation of students in

mathematics Chapter One opens the book with a focus on the language and knowledge of mathematics teaching The authors of Chapters Two Nine present field based research that examines the complexities of content and pedagogical knowledge as well as knowledge for teaching Each chapter offers the reader an examination of mathematics teacher preparation and practice based on formal research that provides the reader with insight into how the research study was conducted as well as providing the findings and conclusions drawn with respect to mathematics teacher preparation and practice Finally Chapter 10 presents an epilogue that focuses on the future of mathematics teacher preparation

Mathematical Knowledge for Teaching Proof Kristin Lesseig, 2011 The purpose of this study was to detail mathematical knowledge that supports the work of teaching proof and to investigate how such knowledge is evidenced in professional development PD To advance the construct of mathematical knowledge for teaching MKT in the context of proof I developed a framework of MKT for proof by documenting classroom proof activity and student and teachers understanding of proof in coordination with Ball and colleagues 2008 domains of teacher knowledge The framework specifies ways in which teachers hold their knowledge of proof across domains of common and specialized content knowledge as well as knowledge of students and teaching This MKT for proof framework supported an empirical study of teachers proof activity within an existing PD project Researching Mathematics Leader Learning RMLL Specifically this dissertation details teachers work on two proof related tasks in RMLL seminars and subsequent PD sessions case study teachers enacted Findings indicate how the two tasks engaged teachers in different though complementary aspects of MKT for proof These findings resulted in the refinement of the MKT for proof framework and demonstrated its utility in linking PD activities to domains of teacher knowledge For example activities in which participants were prompted to compare or evaluate justifications afforded opportunities to develop specialized knowledge of proof representations and argument structures Comparing the use of the same tasks across seminars and PD enactments allowed for a more detailed description of MKT for proof afforded by each task This comparison highlighted how the specific goals and context of these PD sessions led to the foregrounding of different aspects of MKT for proof For example knowledge of proof and students e g considering algebraic representations that might be accessible to students was more evident when tasks were linked to particular grade level concerns PD is a primary means for teachers to both enhance their own understanding of proof and to develop the knowledge and skills needed to engage students in rich proof experiences Knuth 2002 Sowder 2007 This study offers significant insights on how PD might support such learning and provides a valuable analytic tool for further investigation of mathematical knowledge specifically useable in teaching proof

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