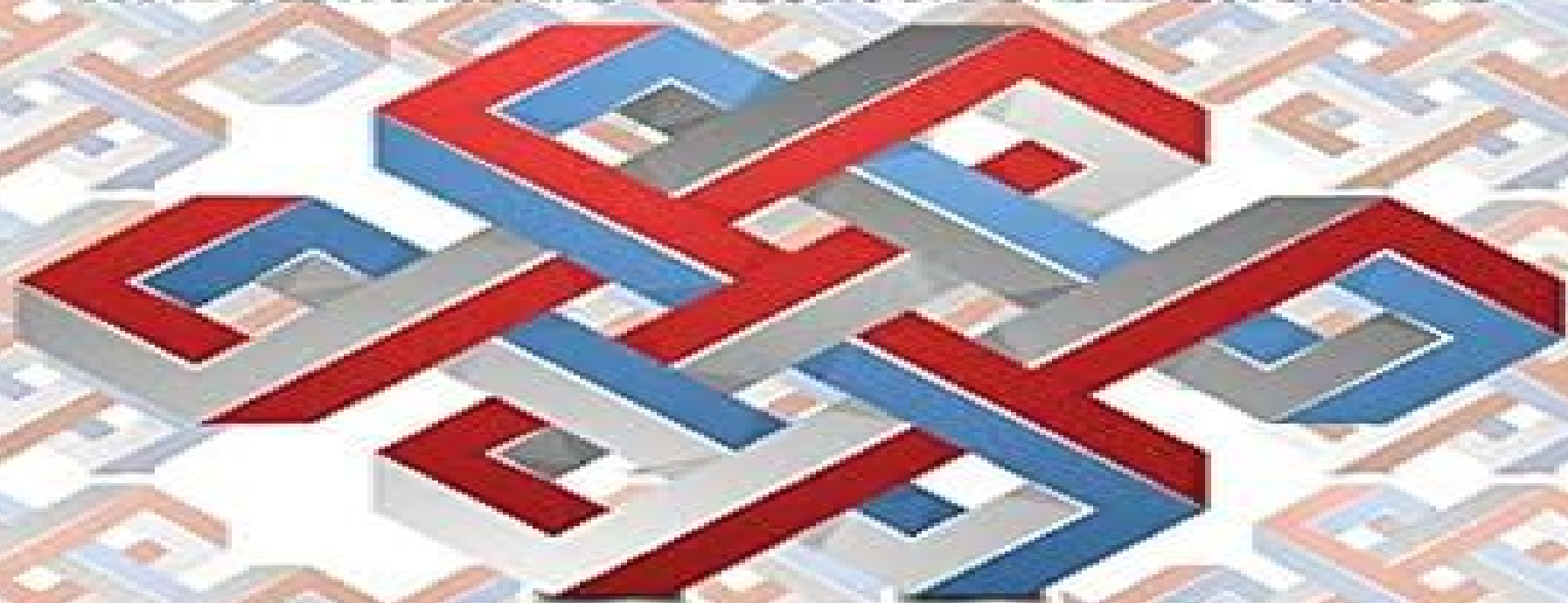


Mathematical Understanding for Secondary Teaching

A FRAMEWORK AND CLASSROOM-BASED SITUATIONS



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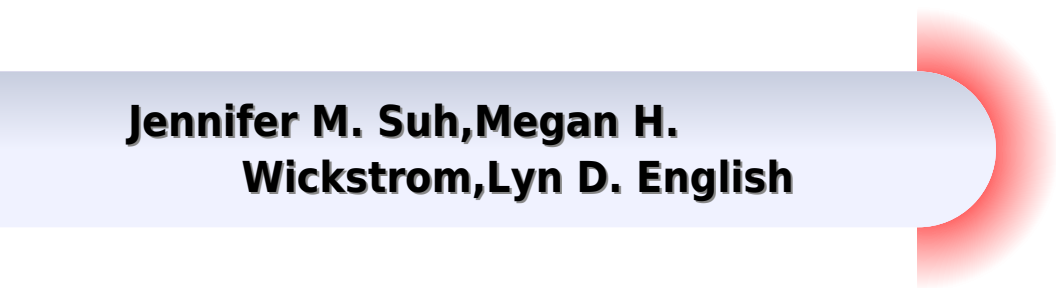
M. Kathleen Heid
Patricia S. Wilson
with Glendon W. Blume



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Mathematical Understanding Secondary Teaching Classroom Based

**Jennifer M. Suh, Megan H.
Wickstrom, Lyn D. English**



Mathematical Understanding Secondary Teaching Classroom Based:

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 consisting of the event and the mathematics related to the event 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.

Understanding Analysis and its Connections to Secondary Mathematics Teaching Nicholas H. Wasserman, Timothy Fukawa-Connelly, Keith Weber, Juan Pablo Mejía Ramos, Stephen Abbott, 2022-01-03 Getting certified to teach high school mathematics typically requires completing a course in real analysis. Yet most teachers point out real analysis content bears little resemblance to secondary mathematics and report it does not influence their teaching in any significant way. This textbook is our attempt to change the narrative. It is our belief that analysis can be a meaningful part of a teacher's mathematical education and preparation for teaching. This book is a companion text. It is intended to be a supplemental resource used in conjunction with a more traditional real analysis book. The textbook is based on our efforts to identify ways that studying real analysis can provide

future teachers with genuine opportunities to think about teaching secondary mathematics. It focuses on how mathematical ideas are connected to the practice of teaching secondary mathematics and not just the content of secondary mathematics itself. Discussions around pedagogy are premised on the belief that the way mathematicians do mathematics can be useful for how we think about teaching mathematics. The book uses particular situations in teaching to make explicit ways that the content of real analysis might be important for teaching secondary mathematics and how mathematical practices prevalent in the study of real analysis can be incorporated as practices for teaching. This textbook will be of particular interest to mathematics instructors and mathematics teacher educators thinking about how the mathematics of real analysis might be applicable to secondary teaching as well as to any prospective or current teacher who has wondered about what the purpose of taking such courses could be.

Facilitator's Guidebook for Use of Mathematics Situations in Professional Learning

Rose Mary Zbiek, Glendon W. Blume, M. Kathleen Heid, 2018-01-01

The depth and breadth of a mathematics teacher's understanding of mathematics matter most as the teacher engages in the daily work of teaching. One of the major challenges to teachers is to be ready to draw on the relevant mathematical ideas from different areas of the school curriculum and from their postsecondary mathematics experiences that can be helpful in explaining ideas to students making instructional decisions, creating examples and engaging in other aspects of their daily work. Being mathematically ready and confident requires teachers to engage in ongoing professional learning that helps them to connect mathematics to events like those they live on a daily basis. The purpose of this volume is to provide teachers, teacher educators and other facilitators of professional learning opportunities with examples of authentic events and tools for discussing those events in professional learning settings. The work shared in *Facilitator's Guidebook for Use of Mathematics Situations in Professional Learning* resulted from a collaborative effort of school mathematics supervisors and university mathematics educators. The collaborators joined their varied experiences as teachers, coaches, supervisors, teacher educators and researchers to suggest ways to scaffold activities, encourage discussion and instigate reflection with teacher participants of differing mathematics backgrounds and with varying teaching assignments. Each guide has ideas for engaging and furthering mathematical thought across a range of facilitator and participant mathematics backgrounds and draws on the collaborators' uses of the Situations with in-service and prospective teachers. The events and mathematical ideas connected to each event come from *Situations in Mathematical Understanding for Secondary Teaching: A Framework and Classroom Based Situations*. A Situation is a description of a classroom-related event and the mathematics related to it. For each of six Situations, school and university collaborators developed a facilitator's guide that presents ideas and options for engaging teachers with the event and the mathematical ideas. The Guidebook also contains suggestions for how teachers and others might develop new Situations based on events from their own classrooms as a form of professional learning. Both teacher educators and school-based facilitators can use this volume to structure sessions and inspire ideas for professional learning activities that are rooted in

the daily work of mathematics teachers and students *Tools for Teaching Conceptual Understanding, Secondary* Julie Stern, Krista Ferraro, Juliet Mohnkern, 2017-02-02 Students become experts and innovators through Concept Based teaching Innovators don't invent without understanding how the world works With this foundation they apply conceptual understanding to solve problems We want students to not only retain ideas but relate them to other things they encounter using each new situation to add nuance and sophistication to their thinking Discover how to help learners uncover conceptual relationships and transfer them to new situations Teachers will learn Strategies for introducing conceptual learning to students Four lesson frameworks to help students uncover conceptual relationships How to assess conceptual understanding and How to differentiate concept based instruction *Exploring Mathematical Modeling with Young Learners* Jennifer M. Suh, Megan H. Wickstrom, Lyn D. English, 2021-06-01 This book conceptualizes the nature of mathematical modeling in the early grades from both teaching and learning perspectives Mathematical modeling provides a unique opportunity to engage elementary students in the creative process of mathematizing their world A diverse community of internationally known researchers and practitioners share studies that advance the field with respect to the following themes The Nature of Mathematical Modeling in the Early Grades Content Knowledge and Pedagogy for Mathematical Modeling Student Experiences as Modelers Teacher Education and Professional Development in Modeling Experts in the field provide commentaries that extend and connect ideas presented across chapters This book is an invaluable resource in illustrating what all young children can achieve with mathematical modeling and how we can support teachers and families in this important work **Problem Posing and Problem Solving in Mathematics Education** Tin Lam Toh, Manuel Santos-Trigo, Puay Huat Chua, Nor Azura Abdullah, Dan Zhang, 2024-01-01 This book presents both theoretical and empirical contributions from a global perspective on problem solving and posing PS PP and their application in relation to the teaching and learning of mathematics in schools The chapters are derived from selected presentations in the PS PP Topical Study Group in ICME14 Although mathematical problem posing is a much younger field of inquiry in mathematics education this topic has grown rapidly The mathematics curriculum frameworks in many parts of the world have incorporated problem posing as an instructional focus building on problem solving as its foundation The juxtaposition of problem solving and problem posing in mathematics presented in this book addresses the needs of the mathematics education research and practice communities at the present day In particular this book aims to address the three key points to present an overview of research and development regarding students mathematical problem solving and posing to discuss new trends and developments in research and practice on these topics and to provide insight into the future trends of mathematical problem solving and posing **Implementing Problem-Based Instruction in Secondary Mathematics Classrooms** Sarah Ferguson, Denise L. Polojac-Chenoweth, 2024 Problem based instruction PBI facilitates learning by making connections between mathematical concepts and real world applications rather than through rote learning of skills This practical

resource provides an overview of the PBI instructional strategy that includes best practices guidance for implementation and a companion website with over 50 downloadable resources for secondary classrooms

Tools for Teaching Conceptual Understanding, Elementary Julie Stern, Nathalie Lauriault, Krista Ferraro, 2017-09-16 Harness natural curiosity for conceptual understanding Nurture young learners innate curiosity about the world and bring intellectual rigor throughout the developmental stages of childhood Concept based teaching helps students uncover conceptual relationships and transfer them to new problems Readers of this must have road map for implementing concept based teaching in elementary classrooms will learn Why conceptual learning is a natural fit for children Strategies for introducing conceptual learning Instructional strategies to help students uncover and transfer concepts How to write lessons assess understanding and differentiate in a concept based classroom How concept based teaching aligns with best practices and initiatives

Connecting Abstract Algebra to Secondary Mathematics, for Secondary Mathematics Teachers Nicholas H. Wasserman, 2018-12-12 Secondary mathematics teachers are frequently required to take a large number of mathematics courses including advanced mathematics courses such as abstract algebra as part of their initial teacher preparation program and or their continuing professional development The content areas of advanced and secondary mathematics are closely connected Yet despite this connection many secondary teachers insist that such advanced mathematics is unrelated to their future professional work in the classroom This edited volume elaborates on some of the connections between abstract algebra and secondary mathematics including why and in what ways they may be important for secondary teachers Notably the volume disseminates research findings about how secondary teachers engage with and make sense of abstract algebra ideas both in general and in relation to their own teaching as well as offers itself as a place to share practical ideas and resources for secondary mathematics teacher preparation and professional development Contributors to the book are scholars who have both experience in the mathematical preparation of secondary teachers especially in relation to abstract algebra as well as those who have engaged in related educational research The volume addresses some of the persistent issues in secondary mathematics teacher education in connection to advanced mathematics courses as well as situates and conceptualizes different ways in which abstract algebra might be influential for teachers of algebra *Connecting Abstract Algebra to Secondary Mathematics for Secondary Mathematics Teachers* is a productive resource for mathematics teacher educators who teach capstone courses or content focused methods courses as well as for abstract algebra instructors interested in making connections to secondary mathematics

The Mathematics Teacher Education Partnership W. Gary Martin, Brian R. Lawler, Alyson E. Lischka, Wendy M. Smith, 2020-01-01 This book provides an overview of a body of work conducted over the past seven years related to the preparation of secondary mathematics teachers by the Mathematics Teacher Education Partnership MTE Partnership a national consortium of more than 90 universities and 100 school systems The MTE Partnership is organized as a Networked Improvement Community NIC which combines the disciplined inquiry of

improvement science with the power of networking to accelerate improvement by engaging a broad set of participants The MTE Partnership is addressing key challenges in secondary mathematics teacher preparation including Supporting the development of content knowledge relevant to teaching secondary mathematics Providing effective clinical experiences to teacher candidates Recruiting secondary mathematics teacher candidates ensuring program completion and their subsequent retention in the field as early career teachers Supporting overall transformation of secondary mathematics teacher preparation in alignment with these challenges Ensuring a focus on equity and social justice in secondary mathematics teacher recruitment preparation and induction This book outlines existing knowledge related to each of these key challenges as well as the work of Research Action Clusters RACs formed to address the challenges Each RAC includes participants from multiple institutions who work collaboratively to iteratively develop test and refine processes and products that can help programs more effectively prepare secondary mathematics teacher candidates The book describes promising approaches to improving aspects of secondary mathematics teacher preparation developed by the RACs including specific products that have been developed which will inform the work of others involved in secondary mathematics teacher preparation In addition reflections on the use of the NIC model provides insights for others considering this research design Particular references to the Standards for Preparing Teachers of Mathematics Association of Mathematics Teacher Educators 2017 are included throughout the book

Concept-Based Mathematics Jennifer T.H. Wathall, 2016-01-14 Give math students the connections between what they learn and how they do math and suddenly math makes sense If your secondary school students are fearful of or frustrated by math it s time for a new approach When you teach concepts rather than rote processes you show students math s essential elegance as well as its practicality and help them discover their own natural mathematical abilities This book is a road map to retooling how you teach math in a deep clear and meaningful way through a conceptual lens helping students achieve higher order thinking skills Jennifer Wathall shows you how to plan units engage students assess understanding incorporate technology and even guides you through an ideal concept based classroom Practical tools include Examples from arithmetic to calculus Inquiry tasks unit planners templates and activities Sample assessments with examples of student work Vignettes from international educators A dedicated companion website with additional resources including a study guide templates exemplars discussion questions and other professional development activities Everyone has the power to understand math By extending Erickson and Lanning s work on Concept Based Curriculum and Instruction specifically to math this book helps students achieve the deep understanding and skills called for by global standards and be prepared for the 21st century workplace Jennifer Wathall s book is one of the most forward thinking mathematics resources on the market While highlighting the essential tenets of Concept Based Curriculum design her accessible explanations and clear examples show how to move students to deeper conceptual understandings This book ignites the mathematical mind Lois A Lanning Author of Designing Concept based Curriculum for English Language Arts K

12 Wathall is a master at covering all the bases here this book is bursting with engaging assessment examples discussion questions research and resources that apply specifically to mathematical topics Any math teacher or coach would be hard pressed to read it and not come away with scores of ideas assessments and lessons that she could use instantly in the classroom As an IB Workshop Leader and instructional coach I want this book handy on a nearby shelf for regular referral it s a boon to any educator who wants to bring math to life for students Alexis Wiggins Instructional Coach IB Workshop Leader and Consultant

The AMTE Handbook of Mathematics Teacher Education Babette M. Benken, 2024-02-01 This new volume of The Association of Mathematics Teacher Educators AMTE Professional Book Series is a critical and timely resource that paves the way and guides the future of mathematics teacher education The collection of work in this AMTE Handbook of Mathematics Teacher Education reflects on research and what we know about how best to prepare and support both mathematics teachers and mathematics teacher educators and presents what is happening in the field Examples included in the 22 chapters highlight how we are preparing teachers across multiple contexts e g within district in content courses for the major and grade ranges K 20 and all chapters highlight relevant connections to the AMTE Standards for Preparing Teachers of Mathematics Most importantly this volume explores what we do not yet fully understand and where we are going In essence it considers how we can move the field forward The 95 contributing authors range from graduate students to those who have served as leaders in the field in multiple ways for many years Authors include K 12 teachers school administrators district leaders graduate students higher education faculty and professional development facilitators

Teaching Mathematical Reasoning in Secondary School Classrooms Karin Brodie, 2009-10-08 For too many students mathematics consists of facts in a vacuum to be memorized because the instructor says so and to be forgotten when the course of study is completed In this all too common scenario young learners often miss the chance to develop skills specifically reasoning skills that can serve them for a lifetime The elegant pages of Teaching Mathematical Reasoning in Secondary School Classrooms propose a more positive solution by presenting a reasoning and discussion based approach to teaching mathematics emphasizing the connections between ideas or why math works The teachers whose work forms the basis of the book create a powerful record of methods interactions and decisions including dealing with challenges and impasses involving this elusive topic And because this approach shifts the locus of authority from the instructor to mathematics itself students gain a system of knowledge that they can apply not only to discrete tasks relating to numbers but also to the larger world of people and the humanities A sampling of the topics covered Whole class discussion methods for teaching mathematics reasoning Learning mathematical reasoning through tasks Teaching mathematics using the five strands Classroom strategies for promoting mathematical reasoning Maximizing student contributions in the classroom Overcoming student resistance to mathematical conversations Teaching Mathematical Reasoning in Secondary School Classrooms makes a wealth of cutting edge strategies available to mathematics teachers and teacher educators This book is

an invaluable resource for researchers in mathematics and curriculum reform and of great interest to teacher educators and teachers

Teaching Secondary School Mathematics Merrillyn Goos, Colleen Vale, Gloria Stillman, Katie Makar, Sandra Herbert, Vince Geiger, 2020-07-16 Since its first publication Teaching Secondary School Mathematics has established itself as one of the most respected and popular texts for both pre service and in service teachers This new edition has been fully revised and updated to reflect the major changes brought about by the introduction of the Australian Curriculum Mathematics as well as discussing significant research findings the evolution of digital teaching and learning technologies and the implications of changes in education policies and practices The mathematical proficiencies that now underpin the Australian curriculum understanding fluency problem solving and reasoning are covered in depth in Part 1 and a new section is devoted to the concept of numeracy The chapter on digital tools and resources has been significantly expanded to reflect the growing use of these technologies in the classroom while the importance of assessment is recognised with new material on assessment for learning and as learning along with a consideration of policy development in this area Important research findings on common student misconceptions and new and effective approaches for teaching key mathematical skills are covered in detail As per the first edition readers will find a practical guide to pedagogical approaches and the planning and enactment of lessons together with enhanced chapters on teaching effectively for diversity managing issues of inequality and developing effective relationships with parents and the community This book is the essential pedagogical tool for every emerging teacher of secondary school mathematics The text offers an excellent resource for all of those involved in the preparation of secondary mathematics teachers with links to research literature exemplars of classroom practices and instructional activities that encourage readers to actively examine and critique practices within their own educational settings Professor Glenda Anthony Institute of Education Massey University A rich and engaging textbook that covers all of the important aspects of learning to become an effective secondary mathematics teacher The second edition of this text is further enhanced with updated references to the Australian Curriculum NAPLAN STEM current Indigenous social justice and gender inequity issues and the place of Australian mathematics curricula on the world stage Dr Christine Ormond Senior Lecturer Edith Cowan University

Concept-Based Curriculum and Instruction for the Thinking Classroom H. Lynn Erickson, Lois A. Lanning, Rachel French, 2017-02-02 Develop students critical thinking abstract reasoning and creative learning skills with concept based teaching Take learning beyond the facts with a teaching approach that develops conceptual thinking and problem solving skills A Concept Based curriculum recaptures students innate curiosity about the world and provides the thrilling feeling of using one's mind well Concept Based teachers will learn how to Meet the demands of rigorous academic standards Use the Structure of Knowledge and Process when designing disciplinary units Engage students in inquiry through inductive teaching Identify conceptual lenses and craft quality generalizations

Designing Tasks in Secondary Education Ian Thompson, 2014-09-19 Engaging students in learning about their subject is a central

concern for all teachers and teacher educators How teachers view and use the pedagogic potential of different tasks to engage pupils with knowledge in different subjects is central to this endeavour *Designing Tasks in Secondary Education* explores models for effective task design helping you translate the curriculum into the tasks and activities that you ask your students to do in order to facilitate developmental or higher level understanding of curriculum content Written by experts in the field of education from a range of subjects and including a foreword written by renowned author Professor Walter Doyle this book spans an international context and offers a refreshing alternative of how to plan and design tasks that will not only intellectually stimulate but improve teaching quality Key topics explored include Designing tasks which engage learners with knowledge Policy perspectives on task design Designing cognitively demanding classroom tasks Task design issues in the secondary subjects *Designing Tasks in Secondary Education* offers essential insight into task design and its importance for enhancing subject understanding and student engagement It will challenge and support all education professionals concerned with issues of curriculum design subject knowledge classroom organisation agency in the learning process and teaching quality

Answers to Your Biggest Questions About Teaching Secondary Math Frederick L. Dillon, Ayanna D. Perry, Andrea Cheng, Jennifer Outzs, 2022-03-02 Designed for just in time learning and support this practical resource gives you brief actionable answers to your most pressing questions about teaching secondary math

Educating Prospective Secondary Mathematics Teachers Marilyn E. Strutchens, Rongjin Huang, Despina Potari, Leticia Losano, 2018-06-01 This book highlights innovative approaches to preparing secondary mathematics teachers Based on empirical findings gathered in several countries on five continents it provides a wealth of best practices for preparing secondary mathematics teachers and discusses issues related to their professional and personal growth such as identity content knowledge and pedagogical content knowledge which also includes knowledge of integrating technology into teaching and learning mathematics Divided into four parts the book focuses on field experiences technologies tools and resources teacher knowledge and teacher professional identities Some of the main threads running through the book are the importance of university and school partners working together to ensure preservice secondary mathematics teacher success in developing pedagogical strategies that lead toward students mathematical engagement and achievement the critical need for preservice secondary mathematics teachers to develop strong content knowledge and pedagogical content knowledge and the importance of providing opportunities during pre service education for developing prospective teachers professional identities

International Perspectives on the Teaching and Learning of Geometry in Secondary Schools Patricio Herbst, Ui Hock Cheah, Philippe R. Richard, Keith Jones, 2018-04-27 This book presents current perspectives on theoretical and empirical issues related to the teaching and learning of geometry at secondary schools It contains chapters contributing to three main areas A first set of chapters examines mathematical epistemological and curricular perspectives A second set of chapters presents studies on geometry instruction and teacher knowledge and a third set of chapters offers studies on geometry

thinking and learning Specific research topics addressed also include teaching practice learning trajectories learning difficulties technological resources instructional design assessments textbook analyses and teacher education in geometry Geometry remains an essential and critical topic in school mathematics As they learn geometry students develop essential mathematical thinking and visualization skills and learn a language that helps them relate to and interact with the physical world Geometry has traditionally been included as a subject of study in secondary mathematics curricula but it has also featured as a resource in out of school problem solving and has been connected to various human activities such as sports games and artwork Furthermore geometry often plays a role in teacher preparation undergraduate mathematics and at the workplace New technologies including dynamic geometry software computer assisted design software and geometric positioning systems have provided more resources for teachers to design environments and tasks in which students can learn and use geometry In this context research on the teaching and learning of geometry will continue to be a key element on the research agendas of mathematics educators as researchers continue to look for ways to enhance student learning and to understand student thinking and teachers decision making

Unveiling the Magic of Words: A Review of "**Mathematical Understanding Secondary Teaching Classroom Based**"

In a world defined by information and interconnectivity, the enchanting power of words has acquired unparalleled significance. Their capability to kindle emotions, provoke contemplation, and ignite transformative change is really awe-inspiring. Enter the realm of "**Mathematical Understanding Secondary Teaching Classroom Based**," a mesmerizing literary masterpiece penned by a distinguished author, guiding readers on a profound journey to unravel the secrets and potential hidden within every word. In this critique, we shall delve in to the book is central themes, examine its distinctive writing style, and assess its profound effect on the souls of its readers.

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