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# Questions Addressed in Each Section

## **Mathematics For All**

- What is equity and how is it evident in mathematics classrooms?
- What are the impacts of ability grouping and tracking on student learning?
- What can schools do to facilitate students' opportunity to learn mathematics?
- How can different learning styles be addressed with consistent expectations?

## **Teaching Mathematics**

- What instructional methods support mathematical reasoning and problem solving?
- How is mathematical thinking addressed in the mathematics classroom?
- What role does teacher questioning play in learning mathematics?
- How can teachers motivate students to enjoy and want to learn mathematics?
- What instructional strategies make mathematics teaching more learner-centred?
- How does linking instruction and classroom assessment impact student learning?
- How does teacher content knowledge impact instruction?
- How does teacher pedagogical knowledge impact instruction?
- How do teacher attitudes about mathematics learning impact student achievement?
- What are the characteristics of effective professional development for mathematics?

## **Assessment in Mathematics**

- What roles can assessment play in mathematics teaching and learning?
- How can the use of varied assessments provide important evidence of learning?
- How can mathematical thinking be assessed in the classroom?
- What do assessments tell us about teaching and learning mathematics?

## **Mathematics Curriculum**

- What is the importance of standards-based curricula in mathematics?
- How do we determine what students should know and be able to do in mathematics?
- What is curriculum coherence and articulation?

- What is the importance of reading and writing in the mathematics curriculum?
- What are the most important considerations in selecting textbooks and other materials?
- In what ways can integrating curriculum enhance learning in mathematics?
- How does integrated instruction in mathematics affect teaching and learning?
- How does classroom curriculum connect to the outside world?

### **Instructional Technology in Mathematics**

- How can using instructional technology affect mathematics reasoning and problem solving?
- What effect do calculators have on student learning?
- How can technology make mathematics teaching more learner-centred?
- How can students best use information and data from the Internet?
- How has technology changed the mathematics that is important for students to learn?

### **Learning Mathematics**

- How can we communicate with the public about the importance of learning mathematics?
- What do we know about how students learn mathematics?
- What does learning theory show teachers about how students learn mathematics?
- What is the role of basic skills in mathematics instruction?
- What is the role of algorithms in mathematics instruction?
- What factors contribute most strongly to students' success in learning mathematics?
- How do students' attitudes affect their performance and future opportunities?
- How can teachers help students reflect on and communicate their own learning?
- What role does active hands-on learning play in mathematics instruction?
- How does using contextual or applied activities improve student learning in mathematics?
- What can parents do to support student learning in mathematics?
- What are characteristics of effective homework in mathematics?
- What is the impact of teacher learning on student learning?

# Preface

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The world around us is changing rapidly. There have been changes in how people live, work and learn. Likewise, the culture and practice of mathematics continue to evolve. These changes signal the need for reform in mathematics education. As students increasingly are educated to become lifelong learners, they must develop skills to manage and use knowledge to solve problems in the personal, social and economic realms, not just in textbooks. Today's students will need to build their capabilities for career changes, more so than at any time in the past. Many twenty-first century careers are knowledge-based, not skill-based. Knowing how to access, evaluate and use information is a major component of mathematics literacy.

New knowledge, tools, and ways of doing or communicating mathematics continue to emerge and evolve. Students today need mathematics skills, concepts and understandings different from those needed by their parents and grandparents. The level of mathematics needed for intelligent citizenship has increased dramatically, along with increased needs for mathematical thinking and problem solving.

Mathematics is critical to the education of all students, not just for a select few. Mathematically powerful students is the goal, and we need to provide the basic skills and understandings students will need to function effectively into the twenty-first century. Enhanced career opportunities do and will exist for those who understand and can do mathematics. Mathematics education should prepare students who can use mathematics appropriately in their careers and their lives.

The purpose of this volume is to support standards-based reform of mathematics education. For each question addressed, background is provided from the perspectives of research and best practices, followed by implications for improving classroom instruction.

Teachers need the findings from research and best practices to inform their daily decisions. It is ineffective for teachers to base decisions on anecdotal information or individual cases. Part of the decision-making process requires teacher expertise (knowledge and experience) in determining whether the practices being considered for adoption will work in their own classrooms. Using data to drive instructional decisions improves the efficiency of reform efforts by focusing change in the desired direction — toward improved student achievement.

The authors of this volume strongly support standards-based systemic reform. They recognise that state and national mathematics standards describe not only important curricular content, but also ways to reform all parts of the educational system to support improved teaching and student

achievement. Systemic reform purposefully revises and aligns all components of a system. The mathematics education system is complex, including components such as assessment, curriculum, equity, student outcome standards, teaching, professional development of teachers, stakeholder involvement, leadership and policy. While the last three topics are generally beyond the scope of this volume, they are important in the context of standards-based systemic reform.

Every person concerned with teaching and learning mathematics, whether teacher, administrator, student, parent or community member, will find useful information in this document. As we move forward in reform of mathematics education, we must apply lessons learned from research and best practices. These will guide us toward the improvement of our students' achievement — a goal we cannot afford to ignore.