Implementation of *Mathematics in Context*

Mathematics in Context Pilots

Some districts opt to pilot one or more units from *Mathematics in Context* in the year before purchase. If your district makes this choice, it is important to remember that specific units in MiC have prerequisites and may not be suitable for pilots.

Units to choose: it may be suitable to use a Level 1 unit at either grade 6 or grade 7 and Level 2 units at grade 7 or 8. Level 3 units are usually better to pilot only in grade 8 or at the end of the year in grade 7. Pre-algebra students or gifted and talented classes may be the exception to this rule.

It is also suggested that MiC units be used to replace chapters in the text. Do not try to use a few pages from the unit as this will not really let you and your students experience MiC lessons.

Suggested pilot units:

Grade 6	Grade 7	Grade 8
Picturing Numbers	Reallotment	Revisiting Numbers
Models You Can Count On	Figuring All the Angles	Packages and Polygons
Expressions and Formulas	Facts and Factors	Building Formulas
Take a Chance	Triangles and Beyond	Insights into Data

Descriptions of the mathematical content of these units may be found in the Unit Overviews in the front of this book. Time of the year and district standards may influence your decisions on which units to pilot. Pilot in-services and support from former classroom teachers is available during the time of the pilot.

Implementing *Mathematics in Context*

Just as *Mathematics in Context* does not prescribe a single strategy for students to use in solving a problem, the teacher support materials (including this book) do not prescribe a single way of implementing the curriculum. Different teachers, schools, and districts will have different needs and experiences with mathematics curricula, which will influence implementation decisions. While this *Teacher Implementation Guide* is intended to provide general guidance about how to implement this curriculum, the final decision rests with the classroom teacher.

Preparing for Implementation of MiC

Ideally your school or district has been planning for the implementation of MiC several months (or even years) in advance. The academic year and summer before an implementation are important times to work out some of the decisions related to an effective implementation. Although these decisions vary from district to district, here are some of the common decisions to be made.

Before Implementation

In general, the more collaborative experiences teachers have prior to teaching their first unit the better. Teachers need to experience MiC lessons and learn to navigate through the teacher materials. Pedagogical changes may need to be made, and change is not always easy.

Implementation of MiC depends on a results-driven and comprehensive program of professional development. Many factors impact the amount of professional development that is available for teachers. In-service workshops and training are recommended for effective implementation.

Three-Day Overview Workshop: A workshop of this type consists of four half days focused on the four content strands, a half day on assessment, and a half day preparing the first unit of the year's sequence. A key feature of this workshop is engaging teachers in the activities as if they were students. This allows the presenter to model effective pedagogy and discuss the learning lines and management issues.

Unit-Specific Training: This half-day (minimum) workshop is intended to prepare teachers to teach their next unit. It is usually facilitated by someone who is very familiar with the unit under consideration. Teachers are typically led through the unit section by section. Depending on the time available, teachers work only with the student materials and do the problems as if they were students before they get to use the Teacher's Guide. This allows teachers to experience the different ways students will approach the problems. Teachers are also able to think ahead about manipulatives that will be needed and issues related to classroom assessment.

Strand Overview Workshops: The purpose of this training is to provide teachers with an in-depth look at each of the strands. This workshop involves teachers at each of the three grade levels. It is similar to unit training in that teachers work the problems as if they were students. The difference is that the goal is to understand the structure of the strand and to see how the long learning lines develop over time. In this way, teachers see how the units they teach at their level contribute to the learning line. They also see where the mathematics goes beyond their grade level units. Likewise teachers at the higher grade levels see what experiences and understandings they can expect students to have coming into their grade level. Since this type of training will take several hours, it would probably happen over several after-school study sessions or on a professional development day. The most successful training of this type focuses on tracing themes or sub-strands such as the following from the Algebra strand: Patterns and Regularities, Restrictions, Variables, Representations, and Linearity.

Structured and organized professional development activities offer time for collaboration. However, if an experienced facilitator is not available, two or more teachers can facilitate it on their own. The time spent working together is invaluable. National and Local Users Conferences are also scheduled in various geographic areas throughout the summer.

Additional Preparation before School Starts

Assign teaching responsibilities. If you teach in a team of more than one mathematics teacher, decide within the math-science or other teaching team who will teach each unit. If at all possible, have two or more teachers teach the same unit simultaneously so they can prepare together and periodically discuss their experiences with the unit.

Make a schedule. Identify the days on which you plan to begin each unit and mark them on a calendar. (Be sure the calendar includes non-instructional days such as holidays, field trips, and in-service days.) You'll find the suggested number of days for each section of the unit in the **Pacing and Planning** chart of the Section Overview pages of each Teacher's Guide.

Because of the rich mathematical content of the units, it is easy to spend more time on a unit than you originally planned, so check your schedule every week or so to adjust your target dates if necessary. MiC is a spiral curriculum, and mastery develops over time; do not spend too much time on any one unit.

Review the classroom's physical arrangement. Because interaction among students and between students and the teacher is important, make sure that the arrangement of the classroom is conducive to working in small groups or pairs as well as whole-class discussion.

Develop a materials list. Many of the activities in the units require or can be supported with additional materials, which are listed under **Materials Preparation** on page xviii of each Teacher's Guide. Review the materials lists for items you may need to order or gather.

Preparation for Teaching a Unit

You can begin preparing for each unit by familiarizing yourself with the mathematical content of the unit. Read the Overview in the Teacher's Guide, paying particular attention to the following:

- Math in the Unit on page viii
- The Strand Overview on pages x–xiii
- Goals column of the Goals and Assessment charts on pages xvi and xvii

Also read the Teachers Matter pages, the first of which is on pages 1A and 1B. You may want to preview the Summaries and Check Your Work, which are at the end of each section of the Student Book and Teacher's Guide.

The most important preparation for teaching this curriculum is working through all of the problems in order, as if you were a student. Come up with your own solutions and—if at all possible—discuss them with a colleague who is working through the same unit. After you finish the activities on each page or section of the Student Book, review the facing page(s) in the Teacher's Guide. This page contains Solutions and Samples of student work and Hints and Comments for teaching.

By working through the problems yourself, you can appreciate the alternating struggle and enlightenment that awaits your students. You will gain insight into students' reasoning and common misunderstandings. You may also discover an even broader range of solutions and strategies than could be described in the Teacher's Guides.

Preparation for Substitute Teachers

Substitutes should first read the philosophy of *Mathematics in Context* on page 58. You may want to make a copy of these pages and include them with your plans for substitutes. The length of time the substitute will be teaching and the students' familiarity with the curriculum will determine the specific lesson plan.

When substitutes teach a day or two during the first six weeks of the school year, it may be preferable to use activities from *Number Tools* or *Algebra Tools*. Continuing with activities in the middle of a unit may be too challenging since neither the substitute nor the students are familiar with the mathematical reasoning and discussion that are essential in *Mathematics in Context*.

When the substitute will be teaching for more than a few days, continuing with the unit is necessary. Spending one day on an activity from *Number Tools* or *Algebra Tools* may be a good way for the substitute to become familiar with the curriculum. A long-term substitute can prepare by talking with a teacher who is familiar with *Mathematics in Context*. Reading the Math in the Unit on page viii, and the Strand Overview on pages x–xiii of the Teacher's Guide, as well as the Teachers Matter pages of the Teacher's Guide, is also recommended.

Later in the year, students will have developed the habit of reasoning and discussing their problem-solving strategies, so the substitute should continue teaching the unit. If time permits, the substitute should skim the Math in the Unit on page viii, and the Strand Overview on pages x–xiii of the Teacher's Guide and the relevant Teachers Matter. The focus of the class should remain on communication of the students' understanding and problem-solving strategies. When the regular teacher returns, students can share the responsibility of explaining what they have learned.

Preparation for Mid-Year Transfer Students

In most cases, a few days of gradually increasing participation will sufficiently introduce transfer students to the *Mathematics in Context* curriculum. Pairing the transfer student with another student is also helpful. Because transfer students will not be familiar with the number models used in MiC, sections of *Number Tools* or a few activities from preceding units can be used to develop prerequisite skills and understanding.

Introducing Students to *Mathematics in Context*

The first year that students use *Mathematics in Context*, let them know that it may be very different from the textbooks they have used in the past. Your students may not be accustomed to thinking and communicating about mathematics. In addition, they may not be accustomed to evaluating problem-solving strategies suggested by their classmates. When you introduce *Mathematics in Context* to your students, consider sharing the following ideas:

- *Mathematics in Context* is more than computation. It will encourage teachers and students to think about mathematics in different ways. This curriculum will help students develop thinking and reasoning skills that they can use for the rest of their lives. (Tell students that the drawings and materials they will use to solve problems are also are very different from what they are used to, but they will help to make the mathematics clearer.)
- Most of the problems can be solved and explained in more than one way, and many problems have more than one solution. The goal is to discuss different strategies and then decide whether some work better for particular problems. Explain that sometimes you will ask certain students to share their ideas and at other times you will ask the same students to listen to and analyze other students' ideas.
- To give students more opportunities to explain their thinking and understand someone else's thinking, students will sometimes work in pairs or small groups.
- Explain that students may be surprised by the variety of mathematical topics they will learn about. This variety of topics will give each of them a chance to excel—and to be challenged—regardless of how easy or difficult mathematics has been for them in the past.

Conducting a *Mathematics in Context* Class

The Teacher's Guide makes pacing suggestions for moving through the unit. Many teachers start a class period by getting the students into (or back into) the context. Some teachers like to introduce a new section or context by having one person read aloud.

It is important to assess whether students are familiar with the context or not. For example, students in a small town might not know about a big city subway system, and likewise students in the Midwest might never have experienced tides. A little discussion at the beginning of each new context can help students understand the important ideas of the context so that they can engage in the mathematics. Many teachers verify that students understand the context by engaging the whole class in the initial questions about that context.

After the context is established, students can work on the next few problems on their own or in their groups. This gives the teacher an opportunity to work with individual students and to assess the range of strategies that students are using on the problems. After an appropriate amount of time, it is important that the teacher pull the students back into a whole class discussion of critical problems as a way to share strategies and to make sure misconceptions are identified. It is not necessary to discuss every problem in class. The Hints and Comments in the Teacher's Guide will identify the most important problems for whole class discussion.

Successful implementation of *Mathematics in Context* depends on the teacher's ability to create a climate in which students are willing to risk thinking in new ways and communicating about their discoveries. If the teacher values multiple perspectives, students will be more respectful listeners and more willing to volunteer their ideas. Use directions such as "Listen to this student's explanation. How is it different from yours?" to help students develop listening and critical-thinking skills.

The interaction that is related to a particular topic that occurs on a particular day is important, but students will have additional opportunities to explore that topic. All the important mathematical concepts are revisited many times throughout the curriculum. If for some reason the interaction on one day is not as meaningful as you had hoped, make a note about what you can do differently in the future, and move on. If necessary, you can take a few minutes of the next class to summarize the ideas from the previous day.

Students spend a great deal of class time working on problems during which they either reinvent mathematics or apply concepts they have already learned. They may work individually, in pairs, in small groups, or as a whole class, depending on your preference. Your role during these investigations is to encourage interaction among students.

Have students share their discoveries within their small group or periodically with the whole class. Whole-class discussions are helpful when students have difficulty with a specific problem, when you want students to compare and evaluate various problem-solving strategies, and when you want students to summarize what they have learned.

Encouraging Mathematical Thinking

Sometimes, especially during the first few weeks of school, students may be unsure about how to approach a problem. They may try to persuade you to tell them how to solve the problem or complain that a problem is too hard. Although it can be difficult to watch students struggle, it is often a necessary step in helping them develop the mathematical thinking skills that will allow them to use mathematics effectively. Ideally you will convey to your students that you have high expectations for them, that it is O.K. that they don't know how to do the problem right away, and that you are confident that they can find a solution.

If students are having difficulty with a problem, ask open-ended questions and provide hints. For example, you might ask "What do you know about the problem?" or "What are you asked to find?" Based on students' responses, ask probing questions such as "Since this problem is about comparing, can you think of any ways to make comparisons? Do you think any of these ways might apply to this problem? Could drawing a picture help?"

Orchestrating Mathematical Discussions

Well-orchestrated discussions give students a chance to communicate their ideas and expand their understanding because of the variety of ideas they hear. Discussions also allow students to make connections to their prior learning and to their daily lives. Whenever students work on problems individually or in small groups, walk around the room and try to identify those students who have different approaches. Then call on those students and conduct a discussion to uncover this variety.

Sometimes, depending on the concept and the composition of the class, a whole-class discussion is not necessary. Bringing together two or three small groups or pairs of students may provide sufficient interaction.

Certain strategies are highlighted in the Teacher's Guides as particularly effective. If students do not reinvent these strategies after several minutes of discussion, try asking leading questions. If students still don't suggest these strategies, you can describe these strategies. "Here is another way that students solve this problem." Be careful not to present these other suggestions as the most effective. Allow students to evaluate them just as they evaluate the other strategies presented.

Although students should be encouraged to use any strategy they understand to solve a problem, some strategies are more efficient and generalizable than others. It is a challenge for teachers to value all strategies on the one hand and to move students toward more abstract strategies on the other. Teachers can accomplish this through discussion and student-led evaluation of the strategies. In most cases, students will naturally adopt more sophisticated strategies as they understand them. In some cases, students will need extra encouragement to move on to more efficient strategies. However, students should always be able to go back to more informal strategies when they need to.

Too Little or Too Much Discussion

When discussion is sparse, continue to ask probing questions and allow ample time for students to think of responses. Sometimes a teacher's supportive silence is very effective in sparking a discussion.

You do not have to discuss all strategies that are present in a classroom. When discussions run long, acknowledge that students have identified several ways to approach a problem and that there may be even more but that you need to move on to another problem. Consider suggesting to students that they write their additional ideas in their math notebooks or journals.

Some discussions lead naturally to extension activities that can be assigned as homework in mathematics or other subjects. However, if time permits or if students are very animated about a discussion, you may want to take a few more minutes to explore the topic in greater depth or find additional connections to students' daily lives.

Summarizing and Synthesizing the Discussion

When several strategies have been presented and discussed, the teacher should try to summarize the discussion before moving on. This can be done at the end of the class period: "Today we have seen several strategies. Which one do you like best and why?" Similar questions can also be the basis for a writing assignment at the end of the class period or for homework. Teachers might also start class the next day with these questions.

Teacher's Knowledge of Mathematics

Regardless of your prior knowledge of mathematics, the curriculum will almost certainly challenge you to think in new ways and delight you with its accessible content. At least once during the year, you will be surprised by a student's problem-solving strategy. Be honest about your surprise, and don't pretend to know all the answers. At first, you may feel awkward stepping away from the familiar algorithms to look at the problems from your students' perspectives.

If you are less comfortable about your knowledge of mathematics, you may be concerned about the sophistication and variety of concepts in the curriculum. Familiar problem contexts and informal introductions to concepts make challenging concepts accessible to everyone. Working through the problems yourself with the help of the Teacher's Guide and a colleague, if possible, will usually help you understand the mathematics.

If you don't understand a student's description or explanation during class, ask the student to restate it or support it with drawings or models. Remember one of the goals of the curriculum is for students to use mathematics to communicate effectively. You may also want to ask whether a second student can explain the first student's ideas in a different way.

Grouping Strategies

In a typical classroom, students will work in many different grouping arrangements, depending on the situation. At the beginning and end of each class session, the teacher might want to lead whole class discussions. During seat work it is good to have students talking to other students, so pairs or groups of four are recommended. Groups also work well when students are at different reading levels or when the class contains English language learners. It is common for teachers to switch student groupings several times during a class session. For example, using Think–Pair–Share, students initially work alone (think) on a problem, then compare their solution with someone else (pair), and finally discuss (share) the solutions in a whole class setting. This sequence could be repeated to a series of problems.

Teachers who are not accustomed to having students work in groups sometimes worry that they need special training in group work before they can begin. Such training might be helpful, but it is not necessary. The following guidelines cover many of the questions teachers have about groups.

- Four is a good size for a group. Fewer students might limit the conversation and more might make it difficult for all students to participate.
- Mixed ability groups are recommended. However, monitor so that everyone in the group contributes and that the group is not dominated by the higher ability students.
- Change groups during the school year so that students have a chance to work with other students.
- Consider management issues when assigning groups. Talking is a natural result of group work; disruptive behaviors should be controlled.

Homework: Assigning and Reviewing

There are many different ways to assign homework using MiC.

- The Pacing and Planning chart in the beginning of each section of the Teacher's Guide makes specific suggestions for problems that can be done at home.
- For each section there are Additional Practice problems at the end of the Student Book. These can be assigned a few at a time as the material is taught or all together at the end of the section.
- Pages from *Number Tools* or *Algebra Tools* can be used where appropriate to practice a skill or to introduce a skill that a student might have missed.

Whenever homework is assigned, you will need to decide how to review it the next day. With some of problems, you will need to discuss them in class the next day before you can continue with new material, while with others, you can continue unless students have specific questions.

Managing Softbound Units and Student Notebooks

The softbound units of MiC can be protected from excessive wear by having students put them in three-hole binders. These binders can also hold Student Activity Sheets and spiral notebooks for students to record their work. The notebooks can be collected periodically for checking or grading.

Professional Development

Research indicates that effective implementation of *Mathematics in Context* (MiC) relies on a results-driven and comprehensive professional development program. Encyclopædia Britannica will work with you to deliver professional services unparalleled in education, customized and planned to positively impact instruction.

Mathematics in Context workshops and services are designed specifically to support the initial, ongoing, and expanded implementation of *Mathematics in Context*. Each workshop is designed to meet the needs of teachers, mathematics learners, supervisors, administrators, and parents of children using *Mathematics in Context*. The workshops reflect the latest in professional development research and adult-learning theory and are delivered by consultants from the *Mathematics in Context* development team from the University of Wisconsin as well as experienced, certified *Mathematics in Context* specialists.

Local and National Users' Conferences and Leadership Conferences for Mathematics in Context are scheduled each summer. Information on all scheduled MiC events may be found at mathincontext.eb.com.

The comprehensive package of in-service options offered are listed on the following page. Selection of workshops and services is dependent on the needs of your local district or school and the results you wish to achieve.

Professional Development Menu of Services

Product Orientation

Each 1- to 3-hour session is designed to meet the needs of a particular segment of the learning community. Each session will include a complete description of the MiC curriculum and its components, specific action items for each group, and engaging and lively discussions aimed at easing the implementation of the program.

MiC PO1 Teacher Orientation

MiC PO2 Administrator Orientation

MiC PO3 Parent Orientation

MiC PO4 Summer School Orientation

Content Workshops

Each 3- to 6-hour session is designed to foster the development of the MiC educator as a teacher and learner of mathematics. Consultants model instructional strategies as teachers experience lessons from the curriculum. Pedagogy, mathematical content, connections within and among strands, assessment, class management, and planning are integral to each training session.

MiC CW1 New User Grade Level Unit Training

MiC CW2 New User Teacher Leader Training

MiC CW3 Experienced User Grade Level Training

MiC CW4 Experienced User Teacher Leader Training

MiC CW5 Cross-Grade Strand Development

Specialized Workshops

Typically 3 to 6 hours in length, these workshops are tailored to the needs of districts and designed to align to state and local standards. Special arrangements for these workshops should be made through the Professional Development Office.

MiC SW1 Meeting the Needs of Special Education Students

MiC SW2 Classroom Coaching

MiC SW3 On-site Demonstration Lessons and Co-teaching

MiC SW4 Assessment in MiC

MiC SW5 Keynote Address

Consultation and Planning Services

(Value based on time and personnel requirement)

A consultant from our Professional Development Planning Team will work with the district to plan, design, and implement professional development. Written correlations and lesson planning and document design fall within the scope of these services.

MiC CP1 Initial Planning

MiC CP2 Comprehensive Consultation and Planning

MiC CP3 Local Correlation and Design

Special Projects

Districts may have needs that are not covered in our Menu of Services. Special Projects may be approved if they are cost efficient and within the scope of our specialists.





Working with Families

Families may have questions and concerns about *Mathematics in Context*. It is suggested that a Parent's Night be held before school begins to address the concerns and to convince families that student learning is supported by research.

Questions and suggested responses follow.

Why is my child struggling more than before?

The transition to MiC can challenge what it means to do well in mathematics. Students who produced accurate, fast answers to computation problems in a traditional classroom might experience difficulty when they are expected to justify, explain, and reason mathematically. Likewise, students who struggled with arithmetic might begin to shine when multiple strategies are available to solve problems, and conceptual understanding is valued.

Teachers can help parents and students understand that mathematics isn't necessarily about speed and memorization—that being able to grapple with a problem, trying various approaches, and finally reaching an accurate answer are also important. Teachers can reduce everyone's frustrations by communicating with students and their parents the idea that spending concentrated time on a problem is a part of the learning process.

Why doesn't the book offer an explanation of how to do the homework? I don't know how to help my child.

Suggest that family members encourage their children to talk about mathematics outside of school. The Letter to the Family, which is a blackline master in the Teacher's Guide, identifies mathematical situations in daily life. Asking general questions about a student's work is a technique that family members can use even when they may not fully understand the mathematics in a problem. For example, they might ask, *Can you explain how you solved this problem? Are there other ways to solve this problem? Are there other solutions? Why did you choose this way or this solution?*

To help a student with homework, family members can use a similar strategy. They can ask questions such as *What do you know about this problem? What do you know that might be related to this problem? Can you understand the problem better if you make a drawing or model? What have you done so far to solve the problem?* Explain that sometimes just getting students to articulate what they know or have done is enough to help them move forward.

The answers to Check Your Work problems are provided in the back of the Student Books. This is a place for parents to see solutions and help their child find a solution. Suggest to families that they review each section with their child and have the child explain how they reached the solution.

Why won't the teacher answer students' questions?

Parents often have a limited notion of what constitutes "teaching." Their own experiences as students lead them to think that teaching is telling. So if a teacher does not tell students how to do something, misunderstandings can arise. Teachers should share with parents and students why they are sometimes unwilling to answer questions. Teachers will often try to have questions answered by other group members in order to foster discussion and to encourage group ownership of the results.

Where is the math?

Along with a narrow definition of teaching, parents often have a narrow definition of what constitutes mathematics. They might not recognize the math they will encounter in the units. Explain that the curriculum actually has rich mathematics in a realistic context. Although *Mathematics in Context* doesn't have recognizable computation problems, every unit is full of problems that require students to use computation, estimation, and a variety of other mathematics. Invite families to experience the math firsthand by working through a page or two from the first section of a unit. They can do the work at an Open House or at home with their children.

A few families might need more information about the mathematics in the curriculum. Consider giving them a copy of the Goals and Assessment charts on pages xvi and xvii of a Teacher's Guide and mentioning that these are one-ninth of the year's goals. Draw their attention to the first section of the chart, Conceptual and Procedural Knowledge. Tell them that most programs include only these kinds of goals, but as they can see from the other two parts of the chart, *Mathematics in Context* also emphasizes a deeper understanding of mathematics.

Why is there so much reading and writing?

In MiC students are often expected to respond to questions with written explanations to demonstrate their understanding of the mathematics. Teachers can share with parents the strategies they use to accommodate the range of reading and writing skills found in a typical class. Engaging in a mathematics curriculum that is reading and writing intensive is likely to improve a student's reading comprehension and writing clarity along with their mathematical understanding. Many state assessments require this degree of reading, writing, justifying, and explaining.

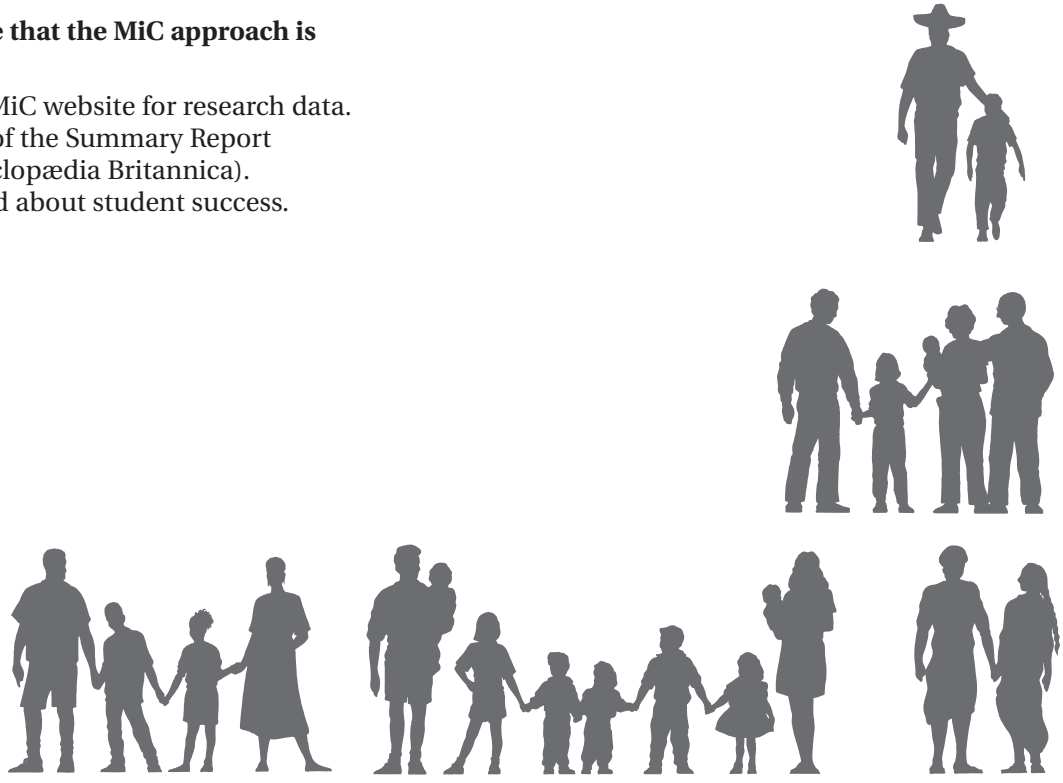
Is there any evidence that the MiC approach is effective?

Refer parents to the MiC website for research data. Or give them a copy of the Summary Report (available from Encyclopædia Britannica). Let them see and read about student success.

Is my child learning basic skills?

Parents need to see that skill development is embedded in investigations rather than in long sets of out-of-context practice problems. MiC engages students in mathematically rich contexts where students *encounter and use* number operations even as they are learning topics in data analysis, algebra, and geometry. To help with parent concerns about basic skills, make sure that some of the homework focuses on skill building and involve parents in the refinement of those skills.

Parents are also looking for reassurance about the use of calculators. Communicate that calculators and computers are used as tools in appropriate situations, as are mental math, estimation, and paper-and-pencil algorithms. Knowing which tool is appropriate for a given task is something for both parents and students to learn. This is a good topic for back-to-school night. Parents can be given a variety of specific examples of tasks that would call for different methods of computation. When parents know the expectations of their child's teacher, they can reinforce them at home.



Reaching All Students

One of the guiding principles of MiC is that mathematics is a subject—and a way of thinking—that all students can learn. This principle is evidenced in the use of models, in the contexts that make sense to students, and in the valuing and encouragement of multiple solution strategies. However, not all students come to MiC with the same ability to learn mathematics. Some students will need more support for their learning.

In the Reaching All Learners box on the Teacher's Guide page, MiC offers suggestions to make the mathematics accessible and appropriate for students with different learning styles, abilities, and disabilities. The goal of these adaptations is to provide access to the math concepts and skills in the lesson in order to meet the needs of diverse learners and thereby increase their chances of success. Although these suggestions cover the most common accommodations, teachers will sometimes need to redesign and adjust the materials to meet the needs of specific learners.

The following suggestions for reaching all learners are based upon the National Science Foundation supported project *Addressing Accessibility in Middle School Mathematics* at the Educational Development Corporation.

Guiding Assumptions

- All students can learn mathematics if given proper support.
- All students fall on a continuum of learner differences. Students with disabilities are part of that continuum, rather than a separate category.
- Adapting curriculum and instruction is appropriate for all learners, not just students with disabilities.
- Making adaptations is a collaborative process that involves general and special educators.
- Teachers are responsible for the success of all their students.

Accessibility Strategies

The *Addressing Accessibility* project identifies three categories of strategies for making mathematics accessible to all students: General Instructional, Curriculum Adaptation, and Classroom Environment. A few examples of strategies in each category are given below.

General Instructional Strategies:

- Provide both visual and auditory directions
- Set up a notebook organizational system
- Read aloud
- Offer manipulatives

Curriculum Adaptation Strategies:

- Adjust the level of difficulty by the use of friendlier numbers, simple language, or reduce the complexity of the task
- Change the context to make it more familiar
- Provide templates for tables, graphs, writing, and other tasks

Classroom Environment Strategies:

- Post homework assignments in a consistent location
- Display wall charts with key vocabulary and information
- Have graph paper, templates available

It is clear that many of these suggestions benefit all students, while others apply to some students with very specific needs.

Accommodations

Teachers often need to make adaptations to the MiC curriculum materials to address the specific needs of students. The chart below shows categories of student needs followed by a sampling of specific tasks and student needs within those categories and a possible accessibility strategy to address that particular need.

Category of Need	Specific Task	Student Need	Possible Accessibility Strategy
Conceptual	Make generalizations	Finds it difficult to make generalizations and to write rules	Provide rules for the student to test
Language	Follow verbal directions	Has difficulty with auditory processing of verbal information	Provide written as well as oral directions
Visual-Spatial Processing	Read handouts and book pages	Finds crowded pages distracting	Reorganize material into a single-sided handout
Organization	Collect and record data	Records data in a disorganized manner that is difficult to analyze	Use table templates for data collection
Memory	Solve multi-step problems	Does not have needed information in working memory to solve a problem	Break problem into smaller chunks
Attention	Participate in class discussions	Distracts the group	Break into small groups and have them report back to large groups
Psycho-Social	Move through a frustration point	Gets frustrated easily	Check to make sure students have the necessary prerequisites

Assessment for Special Learners

The leveled assessments provided with MiC make it easy to differentiate assessment and to write educational plans for students. Formative assessment items indicated by the Assessment Pyramid on the teacher pages let you check student progress through the lessons. Success on Level 1 summative assessment problems may be a goal for only some students. Do allow these students to try all items, but be cognizant of the fact that only some students may be successful on the Level 3 items.

The Test and Practice Generator allows teachers to provide more space for answers, change the font size for visually impaired learners, decrease the number of items on a test, decrease the number of items in a multiple-choice answer, change the scales on graphs, use friendlier numbers for problems: many choices and many ways to accommodate the needs of special learners.

Cautions

There are a few cautions to consider.

- Do not intervene too soon. Expect students to succeed. Unless there is an obvious need for intervention (for example, enlarging a worksheet for a student with a visual impairment), give students a chance to work the problems on their own as written. Student satisfaction follows some struggle with a problem, but do not let the frustration level get too high.
- Do not lose the integrity of the mathematics. Teachers need to know the goals of the lesson and the entire unit. Some concepts are required for all students; do not eliminate these vital topics for any students. Professional development and planning with other teachers can help in identifying the critical mathematics.
- Do not reduce the mathematics to skill sets. In an effort to help students who struggle, it is common for teachers to intervene and reduce the problem to a set of procedures to be followed with the result that they take away all the thinking. Understanding the concept is important to learning and retention of concepts.
- Do not eliminate the investigative nature of the mathematics. Remember that a goal of MiC is that students be able to mathematize their world. This requires investigation, conjecture, discussion, and justification. Try not to scaffold the problems so deeply that no investigation is required.

Working with Advanced Students

Special learners include those who are very talented in mathematics. The Reaching all Learners boxes in the Teacher's Guide will often make suggestions for ways to extend the lesson through additional challenging questions, problems, or investigations. Innovative ideas for challenging these students are also suggested in the Hints and Comments section of the Teacher's Guides. Teachers may find that students want to move ahead and go directly to formalization. This is clearly suitable for some students; do not insist that they do every problem or use only informal strategies. Make use of the Level 3 assessments that are embedded within the lessons. Use the special projects and enhancement activities. *Number Tools* and *Algebra Tools* also offer some challenging problems; ask students to try to design similar problems or to prove their generalizations.

The curriculum design allows students to progress at their own level of understanding. Progressive formalization, moving from informal to preformal to formal, occurs at different rates for different students; the curriculum design supports all student learning.

The Role of the School Administrator

Support from administrators is a key element in the success of MiC implementations. The following suggestions are some information that MiC developers have learned from teachers and districts who have implemented MiC successfully in the past.

Schedule a Parent's Night

MiC represents a significant change for most parents. They will need an opportunity to learn about MiC and what they can expect their child to experience in a MiC classroom. An evening parent's meeting devoted to MiC is a good way to accomplish this.

- Be positive about the new curriculum. Encourage teachers to also be positive.
- Involve the teachers in activities for parents.
- Engage the parents in doing some math so that they can see how MiC is engaging for students. Choose an activity or lesson that insures parental success.
- Invite someone from outside your district who is knowledgeable about MiC to respond to questions the parents might have.
- Have copies of research on student learning using MiC. (Summary Report of Student Achievement in MiC)

Schedule Planning Time

Teachers new to MiC will need time to meet with other teachers to discuss new units, to plan lessons, and to work out solutions to difficulties that arise. This ongoing communication is facilitated by scheduling common planning periods or monthly meetings devoted to MiC. Whenever possible, administrators should attend these meetings It is important that administrators keep informed on progress and teacher concerns.

Protect Teachers

Implementing a new curriculum like *Mathematics in Context* places demands on teachers. They often need to learn new mathematics, new instructional strategies, and new methods of assessment.

Administrators who recognize these demands will work to protect their teachers from additional demands from outside pressures, such as concerned parents and school board members. The key is to make sure teachers do not need to justify their instructional model or the curriculum that they are using.

Alfie Kohn put it best when he wrote about the pressures resulting from external tests. His words could also apply to curriculum implementation:

> "Finally, whatever your position on the food chain of American education, one of your primary obligations is to be a buffer—to absorb as much pressure as possible from those above you without passing it on to those below. If you are a **superintendent** and must face school board members who want to see higher test scores, the most constructive thing you can do is to protect principals from these ill-conceived demands—to the best of your ability and without losing your job in the process. If you are a **building administrator**, on the receiving end of test-related missives from the central office, your challenge is to shield teachers from this pressure—and, indeed, to help them pursue meaningful learning in their classrooms. If you are a **teacher** unlucky enough to work for an administrator who hasn't read this paragraph, your job is to minimize the impact on students. Try to educate those above you whenever it seems possible to do so, but cushion those below you every day. Otherwise you become a part of the problem."
>
> (Kohn, A. January, 2001, "Fighting the Tests," *Phi Delta Kappan*, p. 351)

Field Parent Concerns

Not all parent concerns will be addressed by a Parent's Night; some of them will only surface as the year progresses. It is important to monitor these concerns in order to provide the appropriate response. Some administrators find it helpful to keep a log of calls received from concerned parents.

Typically concerns can be classified in the following five levels of increasing seriousness:

1. **Concerns of parents who support the program.** A parent wanting to know how they can help their child with homework is an example of this level of concern. A failure to respond to these concerns can lead to the loss of these parents' support.
2. **Concerns resulting from misinformation or no information.** A parent who is worried about the lack of drill and practice in MiC might not understand the spiraling of the curriculum and the embedding of computation within problem solving situations.
3. **Concerns about program implementation.** It takes time for teachers to adjust to the new pedagogy of MiC. They will make mistakes in the first year of implementation. Continued attention on professional development will address these concerns.
4. **Concerns based on lack of trust.** Some parents are uncomfortable with any change, and they lack trust in both MiC and the teachers' ability to use it effectively to educate their child. Administrators can address these concerns with evidence of the district commitment to the implementation.
5. **Concerns based on traditional beliefs about schooling.** Some parents' beliefs about schooling and mathematics will be in conflict with the goals and approach of MiC. Concerns at this level are the hardest to address, because nothing will change their minds. The best response is to seek a compromise for their child.

Support Implementation

Since MiC expects changes in both the mathematics content that is taught and in the way that content is taught, one can expect considerable variation in how the materials are implemented in classrooms by teachers. Fidelity to the content and pedagogy of MiC is a serious issue.

1. To implement MiC well, teachers need training and support. The training needs to be both prior to and during implementation. The support needs to include both administrative assistance and the opportunity for teachers to meet and share on a regular basis (see above on Scheduling Planning Time). Lack of adequate support and in particular isolation of teachers as they teach MiC, lead to poor implementation.
2. The mathematical background and content knowledge of teachers vary. Provide activities and professional development workshops that focus on content for the teacher.
3. Recognize the differences in classroom techniques. MiC focuses on teaching for understanding. This often involves posing contextual problems and having students investigate ways of representing and solving the problems. Do not expect teachers to adhere to a model of teaching that does not support the instructional goals of MiC.
4. Assessments must inform instruction. MiC expects teachers to judge the strategies and quality of answers students provide to complex tasks. Require teachers to use assessments provided with the curriculum. Provide scoring workshops and have teachers share their strategies for evaluating student learning.
5. Understand that talking is a part of the curriculum; interaction between students is to be expected. Straight rows and quiet classes may not indicate success!

Expectations about Student Performance

Student performance as a consequence of implementing MiC depends on answers to three questions.

1. Have the students had an opportunity to learn the content and processes emphasized in MiC?
2. Were the students adequately prepared to study the content of MiC?
3. Is the district's method of assessing student performance aligned with the new curriculum?

Student learning is the central guiding principle for the design of the MiC curriculum. Students master concepts over time; research shows that student scores on assessments will also rise over time. Administrators who recognize these issues will not look for instant results and will instead reserve judgment until the end of the second or third year of implementation.

The MiC Classroom

Building administrators are often responsible for doing periodic observations of teachers' lessons during the school year. What should an administrator look for in a *Mathematics in Context* classroom?

Use of MiC materials:

- The teacher is using MiC units.
- The teacher monitors groups and uses informal assessments.
- There is evidence that the teacher has worked through the problems and understands the mathematical tasks.

Student engagement and communication:

- Students are engaged in complex, higher level problem solving.
- Students collaborate on strategies and solutions.
- Students listen to other students' strategies.
- Students constantly assess their own and others' strategies.
- Students write and explain orally their solutions.

Teacher as facilitator:

- The presentation of the lesson emphasizes conceptual understanding.
- The teacher encourages multiple paths to a solution.
- Discourse between students and teacher includes connections and generalizations (when appropriate).
- The teacher encourages active participation of all students.
- The teacher provides ongoing, purposeful feedback to students to help them make sense of the mathematics and the solutions.
- The teacher asks questions on articulation of thinking, understanding mathematics, or the reasonableness of solutions.
- Mathematical talk time is shared by students and the teacher.
- The teacher exhibits high expectations for all students.
- Students work independently and without constant input from the teacher.