General description/overview

Solving Ratio, Proportion, & Percent Problems Using Schema-Based Instruction is a Core program for teaching important math concepts and skills to middle school students.

Product information

- An evidence-based practice, schema-based instruction (SBI), can be used to develop student understanding of ratios and proportional relationships.

- The instructional components of SBI include:
  1. Problem solving and metacognitive strategies that provide students with guidance and structure for approaching unfamiliar problems and for monitoring and reflecting on the problem solving process,
  2. Identifying the underlying mathematical structure of problems,
  3. Representing problems using diagrams that highlight the quantitative relations described in the problem, and
  4. Developing procedural flexibility through comparing and contrasting multiple solution methods and explaining when, how, and why to use a broad range of methods for a given class of problems.

- Aligned with Common Core State Standards

Program Features

1. Lessons are scripted and include anticipated student responses. However, we do not expect teachers to read the scripts verbatim. Instead, teachers should be familiar with the content to be able to use own explanations and elaborations to implement the SBI program.

2. This program does not cover the topics “slope” and “similar figures.” If they are included in your state standards, we suggest that you use other resources to support your instruction.

3. Included in the program are optional challenge problems – note the purpose of challenge problems is to stimulate deep thinking and hone students’ mathematical problem-solving skills and logical reasoning skills. They are not meant for all students especially low-achieving students who need to master the basic content.

4. The program focuses on 3 content-related features – (a) determining the type of problem, (b) estimation, and (c) multiple strategies. In terms of the problem type, generally students are introduced to the most basic ‘form’ of the problem, with variations and more complex problems used subsequently.

  (a) A key part of our curriculum is getting students to recognize problem types and to use the visual-schematic diagrams to help in solving them. Using these diagrams to solve problems is only a subtle change in how teachers already solve these types of problems, but we think that this subtle change makes a big difference in student outcomes. Research suggests that “visual-schematic representations should be used to support the first phase of the word problem solving process (i.e., problem comprehension) and that arithmetical representations are only appropriate in the problem solution phase” (Boonen, van der Schoot, van Wesel, de Vries, & Jolles, 2013, p. 60).

  (b) A few somewhat tricky things about generating estimates. First, there is no one set strategy for coming up with an estimate – it really depends on the quantities in the problem. Second, sometimes it might seem like an estimate is not necessary, because the numbers in the problem don’t appear to be too hard. But nevertheless we feel that generating and using an estimate is still very important to do. Third, each student may come up with a different estimate, and this is fine.

  aWe purposefully used nice numbers in the word problem contexts to focus student attention on problem solving skills rather than computation skills, but these nice numbers are at odds with generating an estimate.

  (c) There are three strategies that are taught in the SBI program: cross multiplication, unit rate, and equivalent fractions. We want students to know all three. We want students to be able to use the
“best” one for a given problem. What does “best” mean? Usually it means the strategy that is the easiest for a particular problem. But we also know that what might be easy for one student may not be easy for another student. So, it is possible that students can have different opinions on which strategy is best for a given problem – this is fine. But we do hope that students do not “mindlessly” use cross multiplication for every problem.

Note. Although we introduce cross-multiplication as the first strategy in the program (early development of the curriculum was informed by what strategies were familiar to students and cross multiplication was the one that was taught in most schools), it is fine to delay this strategy until students have learned the other strategies.

5. Problem solving and DISC: The SBI program makes extensive use of a specific problem solving process that we call DISC (Discover, Identify, Solve, Check). Our rationale for the DISC is that it is an anchor for students to reflect on the problem-solving processes. Questions are used to scaffold a solution process and encourage students to regulate their strategy knowledge during the problem-solving processes: (a) problem comprehension (e.g., How do you know it is a Ratio, Proportion, or Percent problem? How is this problem similar or different from the previously solved problem?), (b) problem representation (e.g., What diagram best fits this problem type to represent information in the problem?), (c) planning (e.g., How can you solve this problem? What are the different ways to solve it? Which strategies are better and why?), and (d) problem solution (e.g., What is an estimated answer to this problem? Is the answer reasonable given the question asked?).

A key component of the problem solving approach is to have students use carefully constructed diagrams that bridge the relationship between the word problem and the underlying quantitative relations in that problem. Each of the three diagrams in the SBI program underscores different types of ratio or proportional relationships found in word problems. The use of visual representations – or diagrams in this case – is a key recommendation in today’s research on problem solving.

6. Homework: Homework problems were developed to complement and reinforce critical concepts and skills taught in the SBI program. Optional challenge problems are included in each lesson. Select problems to assign for homework based on meeting the needs of your students. A caveat – it is critical to appropriately balance the time spent in class reviewing and checking homework problems (no more than 15-20% of the total instructional time) with the time spent on core instruction of critical content.

The distributive practice in the homework is critical because it reinforces the interactive work conducted in class on different problem types. By having teachers help students work carefully through new concepts in class, students are in a much better position to be successful on similar kinds of problems found in the homework. It is expected that students should be able to solve these problems independently.

Materials

All materials listed below are included in a Teacher Kit. The Student Books and Teacher’s Guide may also be purchased separately. Formats consist of downloadable PDFs for self-printing and PowerPoint presentations for use during instruction according to a Distribution License Agreement.

Teacher’s Guide
Includes:
- 21 detailed lessons
- Six weeks of instruction based on daily 45-50 minute sessions.
- Worked answers to Practice Problems.

Student Books
Workbook
- Blank copies of all problems included in the Teacher Guide.
- Reference guide for solving each problem type.
- Discover, Identify, Solve and Check (DISC) checklist
Program Description
Solving Ratio, Proportion, & Percent Problems Using Schema-Based Instruction

Student Homework Book
- Homework problems corresponding to each lesson.
- Reference guide for solving each problem type.
- Discover, Identify, Solve and Check (DISC) checklist

Teacher Homework Answer Key
- Worked answers with explanations for all problems in the Student Homework Book.

Instructional PowerPoints
- PowerPoint presentations to use during classroom instruction.

Jeopardy Game to accompany Lesson 19.
Discover, Identify, Solve and Check (DISC) Checklists to print poster size.

Pricing
Formats consist of downloadable PDFs for self-printing in accordance with a Distribution License Agreement along with printing guidelines. See https://dibels.uoregon.edu/market for specific ordering information.

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<td>May be ordered in addition to the Teacher Kit for a teaching assistant, or as a replacement.</td>
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Research

Our Research to Your Classroom

Based on the findings of several randomized control studies, benefits of SBI include: (a) student gains (including students with mathematics difficulties) in proportional problem solving. Such gains (although indirect) are also associated with improved attitudes toward mathematics; (b) SBI instructional resources help teachers apply the evidence-based practice to effectively teach proportional reasoning.

References:


**Testimonials**

“I found many of the strategies very useful in my teaching, and found myself using the vocabulary with my other classes when I taught ratios, proportions, and percents at a later time. I found the diagrams to be very helpful in explaining ideas to students. I also felt that the DISC problem solving procedure was good, but often times, the estimation part was difficult if the problem was easy or quite obvious. I sometimes left it out in the beginning, but explained to students that it is still important to look back and check the reasonableness of their answers (Is your answer in the ballpark?) The script was helpful, especially in the beginning when I was unsure how to present the material. However, I felt that once I was into the lessons a little further, I condensed what was in the script and cut out some of the examples due to time and not needing to do quite so many.”

“This was a fun curriculum to use. It took a few lessons before I caught on to what to do, but then it became better. I will be using this curriculum next year.”

“I loved how the Schema-Based intervention helped my students understand sales tax. The SBI “jump starts” the process … kids often times read word problems impulsively, go straight to the numbers and this helped them discriminate and work systematically. I thought my students who participated in the intervention understood better conceptually than those students who did not and effectively retained the information.”