Mathematical Roadmaps

Summary

Students will learn about adding multi-digit numbers.

Main Core Tie

Mathematics Grade 2

Strand: OPERATIONS AND ALGEBRAIC THINKING (2.OA) Standard 2.OA.1

Additional Core Ties

Mathematics Grade 2

Strand: NUMBER AND OPERATIONS IN BASE TEN (2.NBT) Standard 2.NBT.5

Mathematics Grade 2

Strand: NUMBER AND OPERATIONS IN BASE TEN (2.NBT) Standard 2.NBT.7

Mathematics Grade 2

Strand: MEASUREMENT AND DATA (2.MD) Standard 2.MD.10

Materials

Large map of Utah
Overhead map of the school boundaries or local community
Chart paper
String or yarn
Assorted counters

- *Math Map* worksheet
- *Math Journal*
- *Solve It!* worksheet
- *Strategy Math* worksheet

Additional Resources

Books

- *Tyrone the Horrible*
  , by Hans Wilhelm; ISBN 0-590-41472-0
- *Stone Fox*
  , by John Reynolds Gardiner; ISBN 0-06-440132-4

Background for Teachers

When students add multi-digit numbers there are three main types of invented strategies, sequential, combining tens and ones, and compensating. The problem 38 + 26 is used to illustrate these strategies.

Sequential: 38 + 20 = 58 and 58 + 6 = 64

Combining tens and ones: 30 + 20 = 50 and 8 + 6 = 14. The 10 from the 14 makes 60 (10 + 50 = 60), so it's 64.

Compensating: 38 + 26 is like 40 and 24 and that's 64 (40 + 24 = 64).

In addition to *invented* strategies, there are also many *alternative* addition and subtraction algorithms that teachers can use to help solidify a student's understanding of these operations. A sampling of the algorithms include partial-sum algorithms and the equal-additions method of subtraction.

Before completing this activity, students should have extensive practice using single-digit addition and subtraction strategies such as counting on, doubles, doubles + 1, adding 10, and in betweens. A solid

understanding of place value enables students to decompose numbers and experiment with new strategies.

Intended Learning Outcomes

5. Understand and use basic concepts and skills.

Instructional Procedures

Invitation to Learn

Show an overhead map of your school and the surrounding neighborhood. Ask a few students to come and trace the route they take to school. Compare this process to math problem solving. Everyone has the same final destination (school: right answer), but there are many roads you can take to get there.

Instructional Procedures

Write a sample problem on the board or overhead (e.g., 19 + 17). Model one way to solve the problem (Some possible solutions might be 10 + 10 = 20 and 9 + 7 = 16 so 20 + 16 = 36; Draw out two tens, 9 ones, and 7 ones. Combine the ones to make another ten and 6 remaining ones; 29 + 7 = 30, 31, 32, 33, 34, 35, 36; Use a hundreds board to solve it. Add 20 + 16.). Ask a few students to describe another way. Draw their solutions on the *Math Map* worksheet.

Write a sample problem on the board (e.g., 26 + 25). Students can work in small groups to develop a strategy for solving the problem. Provide a variety of counters as well as a large sheet of paper for them to explain their answer. Students should use numbers, pictures, and words. When they are finished, ask students to mount their solution on a large math map. Use yarn to connect their answer to the initial problem.

After modeling the problem and working in groups, give students a similar problem and ask them to develop some of their own strategies for solving the problem. Ask them to record their answers in their *Math Journal* or on their individual *Math Map* worksheet.

Once students have had practice using a variety of strategies/algorithms, ask students to show their work using the *Solve It!* worksheet or the *Strategy Math* worksheet. Be sure to model possible ways to solve the problem using a similar problem.

Extensions

Ask students to draw a map of how they get to school. Write out the steps during writing workshop.

Using a reading map, brainstorm solutions posed during read aloud activities. Some stories that work well using this format are *Tyrone the Horrible* and *Stone Fox*.

When you teach students with learning disabilities, be sure to scaffold problems. Start with smaller numbers so they will not need to use as many steps to solve the problems. Provide counters to enable students to make connections using concrete scenarios.

English Language Learners need additional support with key vocabulary (e.g., add, combine, strategy, solve, answer, etc.). Group work and repetition helps students succeed. Use of the graphic organizer also reinforces understanding.

Family Connections

Ask students to complete a mini math journal with family members. Write three word problems based on household scenarios. Solve the problems using two different strategies.

Encourage students to "teach" their new strategy to family members.

Using a problem-solving map, ask students to brainstorm solutions to problems they may encounter at home or school. Suggestions include dealing with a bully, completing homework and chores, television viewing, etc.

Assessment Plan

Assign groups to present their solutions orally to the class. Highlight effective strategies and help students identify ineffective strategies.
Complete one of the worksheets independently.
Students create a physical model of their solution. Take a digital photo and put it into a slide show or class book.
Students illustrate solutions in the computer lab. Print out and compile a class book or include samples in a portfolio.
Keep an informal record of strategies/algorithms that students use. Encourage them to experiment with other strategies/algorithms.

Bibliography

Research Basis

Behrend, J.L. (2001). Are Rules Interfering with Children's Mathematical Understanding? *Teaching Children Mathematics*, pgs. 36-40.
"Rules learned without understanding interfere with students' abilities to see mathematical relationships. Repetition may help students learn the rules, but it does not guarantee that they will understand the meaning behind the rules or be able to apply the rules appropriately."
Randolph, T. A. & Sherman, H.J. (2001). Alternative Algorithms: Increasing Options, Reducing Errors, *Teaching Children Mathematics*, pgs. 480-484.
The article looks at a variety of alternative algorithms teachers can use to enhance understanding of place value and improve computation. "Students skilled in using a variety of computational techniques have at their command the power and efficiency of mathematics."
Carpenter, T.P., Frank, M.L., Jacobs, V.R., Fennema, E., & Empson, S.B. (1998). A Longitudinal Study of Invention and Understanding in Children's Multidigit Addition and Subtraction, *Journal for Research in Mathematics Education*, pgs. 3-20.
"Students who [use] invented strategies before they learn standard algorithms demonstrate better knowledge of base-ten number concepts and [are] more successful in extending their knowledge to new situations than were students who initially learned standard algorithms."

Authors

Utah LessonPlans