REAL WORLD ADDITION AND SUBTRACTION

described by Courtney Flessner and Ryan Flessner

The Indiana Academic Standards place a high priority on contextualizing the mathematics students study. This series of videos examines how educators can assist students in seeing addition and subtraction in the world around them. Rather than reviewing specific strategies or tools students use in solving these problems, these videos address ways educators can construct problems for students to solve. In addition, a variety of contexts for Grades K-8 is discussed so the problems students complete are real-world but also realistic and relevant to their lives.

KINDERGARTEN

Solve real-world problems that involve addition and subtraction within 10 (e.g., by using objects or drawings to represent the problem). (K.CA.2)

Unpacking the Standard

In kindergarten it's important to begin connecting math to real-world situations for children. In doing so, they begin to realize that math is a part of everyday life and is a useful lens through which to view the world around them. Students must have the opportunity to concretely represent their thinking at all times, using a variety of manipulatives and drawings to do so.

Considerations for Lessons and Assessments

Opportunities to solve real-world problems can be offered to students in both large and small group situations, one-on-one, and during non "math" times. Sitting children on the floor in a circle, reading a problem out loud, and having them act it out with a manipulative, creates a situation where they can look around to see how everyone is organizing their thinking. In this type of scenario, the teacher can facilitate a meaningful conversation about what students are noticing. Providing opportunities for children to solve real-world problems can also authentically occur during free play, snack time, or recess. When children are ready, teachers can model how one can take what they've done with manipulatives and transfer that thinking to paper with drawings. Assessment is done on an ongoing basis through observation, conversation, and conferring.

GRADE 1

Solve real-world problems involving addition and subtraction within 20 in situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all parts of the addition or subtraction problem (e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem). (1.CA.2)

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Solve real-world problems that call for addition of three whole numbers whose sum is within 20 (e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem). (1.CA.4)

Unpacking the Standards

Building off the work they did in kindergarten, first graders work on a variety of problem types that connect to real-world situations with "unknowns in all parts of the addition or subtraction problem." Students should also represent the problem using an equation. For example, the story problem, "Our playground has 6 slides. 2 are blue, the rest are red. How many slides are red" can be represented by the equation $6 = 2 + ⬚$. Students should use concrete representations to solve problems as they move toward representing their work on paper. Story problems should also include opportunities for students to consider situations that involve 3 addends.

Considerations for Lessons and Assessments

Rather than working with just one problem type at a time (such as $2 + 4 = ⬚$, students should be given problems with different structures on a regular basis ($2 + ⬚ = 6$ and $⬚ + 4 = 6$). This ensures students don't just "follow the rules," but are truly making sense of problems and persevering in solving them (Process Standard 1). Lessons and assessments in first grade should require students to comprehend the problems, choose appropriate mathematics for each situation, employ multiple strategies, and create viable arguments to justify answers (Process Standard 3).

GRADE 2

Solve real-world problems involving addition and subtraction within 100 in situations of adding to,taking from, putting together,taking apart, and comparing, with unknowns in all parts of the addition or subtraction problem (e.g., by using drawings and equations with a symbol for the unknown number to represent the problem). Use estimation to decide whether answers are reasonable in addition problems. (2.CA.2)

Unpacking the Standard

As they engage with real-world mathematics, second graders should be provided with examples that contain "unknowns in all parts of the addition or subtraction problem." This means that problems using a traditional structure ($28 + 25 = ⬚$; Dominique has 28 markers. Tyler has 25 markers. How many do they have altogether?) provide just one way of thinking about addition or subtraction. As the variable moves within the problem, complexity increases ($35 + ⬚ = 72$; Dominique has 35 markers. Tyler has some markers, too. If there are 72 markers altogether, how many markers does Tyler have?)

Considerations for Lessons and Assessment

This video supports teachers in understanding that rather than working with just one problem type at a time (such as $28 + 25 = ⬚$), students should be given problems with different structures on a regular basis ($28 + 25 = ⬚$ and $35 + ⬚ = 72$ on the same day, for example). This ensures students avoid the rut of "following the rules." Lessons and assessments in second grade should require students to comprehend the problems, choose appropriate mathematics for the situations, and create viable arguments to justify answers (an important aspect of Process Standard 3 at each grade level).

GRADE 3

Solve real-world problems involving addition and subtraction of whole numbers within 1000 (e.g., by using drawings and equations with a symbol for the unknown number to represent the problem). (3.AT.1)

Unpacking the Standard

Building on their experiences within 100 in second grade, third graders should be given opportunities to add and subtract numbers within 1,000. The hope is that teachers will begin with numbers within 100 (to identify strengths brought from second grade) before gradually increasing the numbers to meet the third grade expectations.

Considerations for Lessons and Assessment

As in second grade, daily lessons—as well as formative and summative assessments—at the third-grade level should provide a variety of problem structures. This allows for unknowns to appear in different places as students move from one problem to the next (58 + 25 = ▢; 300 + ▢ = 520; ▢ + 150 = 665). In this video, teachers will see that by the end of the addition and/or subtraction unit, third graders should compute answers to problems with numbers within 1,000 fluently (demonstrating flexibility, efficiency, and accuracy).

GRADE 4

Solve real-world problems involving addition and subtraction of multi-digit whole numbers (e.g., by using drawings and equations with a symbol for the unknown number to represent the problem). (4.AT.1)

Unpacking the Standard

Multi-digit whole numbers move past 100 (second grade) and 1,000 (third grade) into numbers in the ten thousands, hundred thousands, millions, and beyond. It is important for educators to remember that these numbers are the end-of-year expectation, not a starting point for addition and/or subtraction units. Fourth graders should first engage with numbers within 1,000, identify strategies that can be translated to larger numbers, and then move to numbers beyond 1,000.

Considerations for Lessons and Assessment

This video explains the importance of fourth grade teachers continuing to address the second grade standard of presenting unknowns in different parts of the problem (4,582 + 3,276 = ▢; 75,125 + ▢ = 93,775; ▢ + 7,500,000 = 9,300,000). As in previous grades, lessons and assessments in fourth grade should allow students to demonstrate their mathematical understandings with a variety of problem structures and situations as the number sizes increase.

GRADE 5

Solve real-world problems involving addition, subtraction, multiplication, and division with decimals to hundredths, including problems that involve money in decimal notation (e.g. by using equations, models or drawings and strategies based on place value or properties of operations to represent the problem). (5.AT.5)

Unpacking the Standard

After mastering addition and subtraction of multi-digit whole numbers in fourth grade, fifth graders begin to work with decimals. Most students have significantly less experience with decimals (as compared to exposure to whole numbers); therefore, fifth-grade teachers should take great care to ensure students have strong number sense with decimals up to the hundredths prior to asking them to solve real-world problems containing these numbers.

Considerations for Lessons and Assessment

As in prior grades, unknowns should appear in different parts of the problems offered to fifth graders (2.3 + 1.6 = ▢; 5.25 + ▢ = 8.75; ▢ + 3.80 = 6.85). This video explains that lessons and assessments in fifth grade should include familiar contexts (e.g., money and other forms of measurement, statistics from sporting events) and strategies or tools with which students are comfortable (e.g., place value blocks, number lines, partial sums/differences). This comfort can be leveraged as students translate this knowledge to numbers containing decimals.

GRADE 6

Solve real-world problems with positive fractions and decimals by using one or two operations. (6.C.3)

Unpacking the Standard

In Grade 6 students begin to utilize what they know about fractions and decimals to solve real-world problems. In addition, multi-step problems that require the use of two operations are introduced.

It is important to note that this strand focuses on addition and subtraction. For ideas related to multiplication and division, please see the "Real-world Multiplication and Division" series.

Considerations for Lessons and Assessments

Sixth graders need multiple opportunities to apply the mathematical knowledge they are learning in the classroom to situations they will encounter in the world outside of school. Lessons at this grade level should provide students with opportunities to make multiple connections to their lives and to their communities. It is important to remember that the standard U.S. algorithms are new to sixth graders; therefore, lessons and assessments should encourage students to make connections across a variety of strategies when solving these problems.

GRADES 7-8

Solve real-world problems with rational numbers by using one or two operations. (7.C.8)

Solve real-world problems with rational numbers by using multiple operations. (8.C.1)

Unpacking the Standards

In fifth and sixth grades, students worked with fractions and decimals. Seventh and eighth graders apply conceptual understandings of multiple strategies learned in prior grades as they extend their knowledge to real-world problems that include other rational numbers and multiple operations.

It is important to note that this strand focuses on addition and subtraction. For ideas related to multiplication and division, please see the "Real-world Multiplication and Division" series.

Considerations for Lessons and Assessments

Lessons in seventh and eighth grade should continue to strengthen students' understandings of fractions and decimals while expanding students' experiences to other rational numbers (e.g., positive and negative integers) in real-world situations . Assessments should ensure that students use more efficient strategies while explaining their mathematical choices conceptually as they explore the world around them.

ADDITIONAL RESOURCES

Carpenter, T. P., Fennema, E., Franke, M. L., Levi, L., & Empson, S. B. (2014). *Children's mathematics: Cognitively guided instruction* (2nd ed.). Portsmouth, NH: Heinemann.

Empson, S. B., & Levi, L. (2011). *Extending children's mathematics: Fractions and decimals.* Portsmouth, NH: Heinemann.

Partnership for Inquiry Learning (n.d.). http://partnershipforinquirylearning.org.