**Big Idea**

SOLVE is a problem-solving paradigm students can utilize to understand and solve mathematical and real-world problems.

**Vocabulary**

S-Study the Problem, O-Organize the Facts, L-Line Up a Plan, addition, subtraction, multiplication, division, equals, together, add, plus, and, increase, incline, deposit, sum, total, rises, grow, above, take away, difference, minus, withdraw, write a check, decline, subtract, fewer, decrease, left over, "How much more?" below, times, product, each, of groups, items, per, double, triple, multiplied, quotient, per equal groups, cut into, divvy, split, is, divide, same, balanced, equivalent, V-Verify Your Plan with Action, E-Examine Your Results, percent, rate, unit rate, rational number, compare, order, evaluate, base, algebraic expressions, exponent, variable, equations, quotient, inverse operation, volume, cube, edge, rectangular prism, numerical expression, rounding

**Prior Learning**

Standards for Mathematical Practice as applied to Grade 5 Content Standards (SMP 1, 2, 7 and 8)

**Essential Questions**

- Why is it important to have a problem-solving strategy?
- What do the S and O in SOLVE represent?
- Why is it important to know what the problem is asking?
- How does organizing the facts in a word problem make it easier to solve?
- What does the L in SOLVE represent?
- Why is it important to write your plan in words before completing the math?
- Why is it important to determine the operation in the L Step?
- What do the V and E in SOLVE represent?
- Why is it important to estimate the answer?
- Why is it important to examine the results of your problem?
- Why is it essential to understand the steps of solving a problem and not just give an answer?
- How can SOLVE be used for problems other than contextual or real-world situations?

**Competencies**

Apply SOLVE as a problem-solving paradigm to support integration of the Standards for Mathematical Practice throughout all Grade 6 Content Standards.

S: Underline the question.
This problem is asking me to find_____.

O: Identify the facts.
Eliminate the unnecessary facts.
List the necessary facts.

L: Write in words what your plan of action will be.
Choose an operation or operations.

V: Estimate your answer.
Carry out your plan.

E: Does your answer make sense? (Compare your answer to the question.)
Is your answer reasonable? (Compare your answer to the estimate.)
Is your answer accurate? (Check your work.)
Write your answer in a complete sentence.

SOLVE Modifications for ELL or ESL students: (**Example shown**)

**Jason has 345 model cars and 487 model trucks. How many model vehicles does he have in all?**

S: TPIAMTF (this problem is asking me to find) – the **total vehicles.**
(The students cannot just restate the question if the response starts with "the.")

O: Be as brief as possible and teach the students abbreviations right away ($, #, lb., cm, pkg, etc.,)

L: # of cars + # of trucks = total

**345** + **487** = **832**

V: Estimate (use familiar strategies) then fill in blanks in the "L" step **About 800**

E: No modifications necessary

| Misconceptions |
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| • Students may attempt to solve word problems by computing with given values instead of reading and applying a problem-solving paradigm.<br>• Students may think that SOLVE can only be used with real world problems.<br>• Students may not understand the importance of a problem-solving paradigm that can be used at any grade level and with any concept. |
| **Resources from The Key Elements to Mathematics Success - KEMS Grade 6 for Building the Conceptual Understanding of this Module** |
| LESSON 1 – SOLVE – S AND O<br>Additional Activities: Quiz – T17-T19<br>Foldable: "SOLVE" (5 flap foldable)<br><br>LESSON 2 – SOLVE – L<br>Additional Activities: Quiz – T37-T39<br>Foldable: "SOLVE" (5 flap foldable)<br><br>LESSON 3 - SOLVE – V AND E<br>Additional Activities: Quiz – T58-T59<br>Foldable: "SOLVE" (5 flap foldable) |

| Standards for Mathematical Practice | Examples: |
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| 1. Make sense of problems and persevere in solving them. | In grade 6, students solve problems involving ratios and rates and discuss how they solved them. Students solve real world problems through the application of algebraic and geometric concepts. Students seek the meaning of a problem and look for efficient ways to represent and solve it. They may check their thinking by asking themselves, "What is the most efficient way to solve the problem?", "Does this make sense?", and "Can I solve the problem in a different way?" |
| 2. Reason abstractly and quantitatively. | In grade 6, students represent a wide variety of real-world contexts through the use of real numbers and variables in mathematical expressions, equations, and inequalities. Students contextualize to understand the meaning of the number or variable as related to the problem and decontextualize to manipulate symbolic representations by applying properties of operations. |
| 3. Construct viable arguments and critique the reasoning of others. | In grade 6, students construct arguments using verbal or written explanations accompanied by expressions, equations, inequalities, models, and graphs, tables, and other data displays (i.e., box plots, dot plots, histograms, etc.). They further refine their mathematical communication skills through mathematical discussions in which they critically evaluate their own thinking and the thinking of other students. They pose questions like "How did you get that?", "Why is that true?" "Does that always work?" They explain their thinking to others and respond to others' thinking |
| 4. Model with mathematics. | In grade 6, students model problem situations symbolically, graphically, tabularly, and contextually. Students form expressions, equations, or inequalities from real world contexts and connect symbolic and graphical representations. Students begin to explore covariance and represent two quantities simultaneously. Students use number lines to compare numbers and represent inequalities. They use measures of center and variability and data displays (i.e., box plots and histograms) to draw inferences about and make comparisons between data sets. Students need many opportunities to connect and explain the connections between the different representations. They should be able to use all of these representations as appropriate to a problem context. |
| 5. Use appropriate tools strategically. | In grade 6, students may decide to represent similar data sets using dot plots with the same scale to visually compare the center and variability of the data. Additionally, students might use physical objects or applets to construct nets and calculate the surface area of three-dimensional figures. |
| 6. Attend to precision. | In grade 6, students continue to refine their mathematical communication skills by using clear and precise language in their discussions with others and in their own reasoning. Students use appropriate terminology when referring to rates, ratios, geometric figures, data displays, and components of expressions, equations or inequalities. |
| 7. Look for and make use of structure. | In grade 6, students may recognize patterns that exist in ratio tables recognizing both the additive and multiplicative properties. Students apply properties to generate equivalent expressions (i.e., $6 + 2x = 3\ (2 + x)$ by distributive property) and solve equations (i.e., $2c + 3 = 15$, $2c = 12$ by subtraction property of equality), c=6 by division property of equality). Students compose and decompose two- and three-dimensional figures to solve real world problems involving area and volume. |
| 8. Look for and express regularity in repeated reasoning. | In grade 6, students use repeated reasoning to understand algorithms and make generalizations about patterns. During multiple opportunities to solve and model problems, they may notice that $a/b \div c/d = ad/bc$ and construct other examples and models that confirm their generalization. Students connect place value and their prior work with operations to understand algorithms to fluently divide multi-digit numbers and perform all operations with multi-digit decimals. Students informally begin to make connections between covariance, rates, and representations showing the relationships between quantities. |

| Works Referenced in the Development of the Module | |
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| Common Core State Standards Initiative<br>www.corestandards.org | Ohio Department of Education<br>http://education.ohio.gov/Topics/Learning-in-Ohio/Mathematics |
| Illustrative Mathematics Project<br>https://illustrativemathematics.org/ | North Carolina Math Tools for Teachers<br>https://tools4ncteachers.com/ |
| Mathematics Assessment Project<br>https://www.map.mathshell.org/index.php | Smarter Balanced Assessment Consortium<br>https://smarterbalanced.org/ |
| PARCC<br>http://parcconline.org/ | Utah Education Network<br>https://www.uen.org/core/math/ |
| NOYCE Foundation:<br>https://www.insidemathematics.org/ | |

**Other Strategies for using SOLVE problems**

- Pass Back Activity: This activity works if students are sitting in rows or it can be adapted to sitting in groups. Each row or group is given a SOLVE problem. The first student completes the S Step and then passes the paper back or to the next student. The second student checks the "S" Step and then marks it with their initials and completes the "O" Step. The SOLVE problem is then passed to the next person who checks and initials the "S" and "O" steps and completed the "L" step. This continues until the problem goes back to the first person who reviews all steps. Student groups can then share their responses as a whole group.
- Have students work in groups of 4 or 5 and assign them one of the SOLVE problems to complete as a group. Students can then transfer answers to chart paper and present to the whole group for discussion and feedback.
- Have a copy of one of the SOLVE problems at each table or group (5 groups). Have students complete the S Step and then pass the problem on to the next group when you give a signal. Students will continue this process until they get back their original problem.
- SOLVE Gallery Walk: Post each SOLVE problem on a chart around the room. Have students work in 5 different groups, each group having a different color marker. Student groups can start at one poster and complete the "S" step. After a few minutes, have student groups move to the next poster, read the "S" step (noting any corrections as necessary with their marker), and then complete the "O" step. (**Note:** Each time a group moves to a new station they should read the steps that were completed by the previous group(s) and note any comments/corrections using their color marker. This helps to guide the discussion of any differences at the end of the activity.) After a few minutes, have students move to the next poster, read the "S" and "O" steps, and complete the "L" step. Continue with this procedure until student groups have returned to their original problem. Students can also present their problem to the whole group and guide the discussion about student responses.

**Additional problems to use for SOLVE**

1. David and Carl are working on their math homework. The problem is asking them to evaluate the numerical expression. David says the answer is 18.8, and Carl says the answer is 26. Which answer is correct? Expression: 4(3 + 0.2) + 6 (5.NBT.7)

2. There was a question on the math quiz about rounding decimals. Students were asked to round decimals to the nearest tenth place. What is the number 32.167 rounded to the nearest tenth? Use a model to explain your answer. (5.NBT.4)

3. Angela is baking a cake with her mom. They need $2\frac{1}{4}$ cups of sugar for the cake recipe and $1\frac{1}{2}$ cups of sugar for the frosting. How much sugar will they need to make the cake and frosting? (5.NF.2)

4. There is a garden in front of the school where the Science Club plants different types of vegetables for their unit on plants. There are 24 plants and $\frac{1}{3}$ of the plants are bean plants. How many bean plants are in the garden? (5.NF.6)

5. A math teacher asks students to build a 3-dimensional figure with a base that has a length of six units, a width of four units, and a height of three units. What is the volume of the rectangular prism? (5.MD.5b)