Literature Review: A Hierarchy of Math Skills

Erika Hufford

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Literature Review: A Hierarchy of Math Skills

Erika Hufford

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Abstract

This literature review explores the progression and development of math skills in students up to the third grade level. There is much research available about the required skills, teaching strategies for these skills, and what skills are vital building blocks for later math development. This paper is a review of the available research with a focus on ten vital skills that are necessary for students to have by the end of grade three. These skills are among the most important building blocks and, also, ones that are considered the weakest in terms of the level of understanding most students obtain through typical instruction. The research suggests that these skills should be a primary focus for third grade teachers and that intervention might be necessary if students lack these skills.
Literature Review: A Hierarchy of Math Skills

There are a number of math skills that are vital for students to have by the end of grade three. These skills can be deduced from looking at the standards and expectations of students at this grade level, available curriculum, and research into skills that are often lacking. After looking at this, ten skills came to the forefront as necessary for students to practice and master: understanding numbers, place value, base-ten, addition, subtraction, word problems, multiplication, division, time, and shapes. Everyday Math curriculum and Virginia’s Department of Education both emphasize the necessity of these skills by the end of third grade.

About Numbers

Understanding of numbers

One of the first skills that must be mastered in math is a general understanding of numbers and how they work and are ordered. Most people naturally acquire some awareness of numbering. According to Clements & Samara (2014), “both animals and people can represent number across senses without language.” However, this ability does not mean that an understanding of numbers comes naturally. Mastering an understanding of numbers is crucial for any math mastery later on. “Most children without specific disabilities have these competencies which appear to form one of the innate, foundational abilities for all later numerical knowledge” (Clements & Samara, 2014). Because of the foundation that an understanding of number has in math it is crucial skill to master.
Place Value

Going along with mastering an understanding of numbers comes understanding higher numbers and their features. One of these primary features is place value. “Understanding of place value requires that one understand both the English system of number words and the system of written multidigit marks” (Fuson, 1990). This makes it necessary to give extra attention to the instruction and practice of place value. This skill is extremely important in moving up in math but can be a hard concept to grasp. According to Fuson (1990), “the evidence indicates that U.S. children do not learn place-value concepts or multidigit addition and subtraction adequately and even many children who calculate correctly show little understanding of the procedures they are using.” The evidence reviewed by Fuson presented here shows that it is necessary to enforce place value to students and help them to solidify their understanding of this.

Base-ten

To dive further into place value comes the understanding of base-ten. “The lack of verbal support in the English language for named-value or base-ten concepts of ten makes it particularly important that support for constructing such ten-structured conceptions be provided in other ways to English-speaking children” (Fuson & Briars, 1990). Base-ten is often taught with the concrete manipulative of base-ten blocks that allow students to gain a solid understanding of base-ten. The requirements for understanding place value are similar to those for understanding base-ten. According to Fuson & Briars (1990), “in order to understand these systems of English words and written number marks for large multidigit numbers, children must construct named-value and positional base-ten
conceptual structures for the words and the marks and relate these conceptual structures to each other and to the words and the marks.” Place value and base-ten can often times go hand-in-hand during instruction but it is vital to make sure that students have a concrete understanding of both concepts.

Computations

Addition

As math skills begin to develop for students, math computations begin to come into play. The first and most basic form of math computation is addition. There are numerous strategies and suggestions available for educators about how to teach addition to students. This first form of math computations is one that is used in everyday life and is necessary for students to master. Many students do struggle with learning addition and, so, it is important to take the time to give students various strategies for solving these types of problems. Parrish’s section on teaching math through number talks with intermediate grade students has a lot dedicated to addition and the development of addition strategies (2010). This is a vital skill for students to be able to do with automaticity and is a building block for other forms of math computations.

Subtraction

The next form of math computation that is typically introduced to students and just as important for them to master is subtraction. Parrish also includes a number of strategies for teaching and developing students skills in subtraction (2010). Similar to
addition, subtraction is used in everyday life and by the time that students come to come to the end of third grade there should be a level of automaticity for students in subtraction. There are many strategies that educators can use with students as a way to reinforce and strengthen students’ skills in subtraction and it is important to take the time to help students obtain mastery in this area.

**Multiplication**

After addition and subtraction comes the introduction of multiplication. Multiplication is a skill that many students will struggle with if they have not yet mastered addition and subtraction. After discussing teaching and practice strategies for addition and subtraction, Parrish also dives into multiplication strategies (2010). Although multiplication is not as regularly used as addition and subtraction, having a concrete understanding of how it works and readily having strategies available to solve multiplication problems is still necessary. Without these skills it becomes nearly impossible to continue to grow in an understanding of math and numbers.

**Division**

The final form of standard math computations is division. Similarly to multiplication, division is not used nearly as regularly as addition and subtraction. However, it is still just as important to have a strong understanding of how division works, when it is used, and what strategies can be used to solve these types of problems. Looking at the curriculum and standards that students are held to at the third grade level, it becomes clear why understanding this type of math computation is necessary. Division
is probably the hardest type of math computation for students to learn but it is still important for students to be familiar with these skills and provide extra guidance for students who struggle with understanding here.

More Math

Word Problems

As students gain and become more confident in their understanding of math computations, this knowledge then transfers to solving word problems. According to Swanson (2015), “word problems are an important part of mathematics programs in elementary schools. This is because word problems help students apply formal mathematical knowledge and skills to real world situations.” Students must not only understand how to solve computations but how to interpret their uses in society. “Numerical abilities and word problem solving skills are essential in daily routines and even more so with the increasing role of technology in contemporary society” (González-Castro, 2016). Being able to interpret word problems and apply the correct math strategies for solving them is a necessary skill for students to learn and develop. By third grade, students should at least have a beginning understanding of this and it is important to guide students in this practice.

Time

Time is one of the skills not as explicitly talked about in the standards but is incorporated into math curriculum and is vital for students to learn. According to
Andrade (1981), “recently I read that teaching the skill of telling time is unessential because, after all, ‘Is any adult unable to perform this task?’ I can’t agree with that reasoning because too many of my nine- and ten-year-old students are embarrassed by their inability to tell time.” This story exemplifies the deficit that occurs when proper instruction on telling time does not occur. As digital clocks become more prevalent, it is easy to move instruction away from explicitly teaching analog clocks. However, this is still a critical skill for students to learn because of its everyday use in the real world.

**Shapes**

Various skills in being familiar with and understanding shapes are necessary for students to know. “Shape is a fundamental concept in cognitive development. For example, infants use mainly shape to learn the names of objects. Shape is also a fundamental idea in geometry, but in other areas of mathematics, too. Unfortunately, geometry is one of the U.S. Students’ weakest topics in mathematics” (Clements & Samara, 2014). Familiarity with shapes is something that should be introduced early in schooling and further developed through the primary grades. By third grade, students should be able to recognize and analyze shapes. This can be something students struggle with and, so, it is important that there is direct instruction for students to develop these skills.

**Conclusion**

After reviewing and evaluating available curriculum and research, these are ten of the most critical skills for students to become comfortable with by grade three. It is
important that students have an understanding of numbers, place value, base-ten, addition, subtraction, multiplication, division, word problems, time, and shapes. The importance of the development of these skills and the tendency for students to fall behind in math skills makes it critical for educators to help their students succeed in these areas.
References


DOI: 10.1177/0022219413498771
A. Instructional Goal (with Learned Capability specified)
Students will be able to demonstrate fluency in addition

B. Pennsylvania Academic Standard(s)
CC.2.1.3.B.1 – Apply place value understanding and properties of operations to perform multi-digit arithmetic

C. Essential Content (only what is necessary to perform the instructional goal)
Addition facts using numbers up to 1000

D. Instructional Objective (Summative Assessment Strategy, same as Part F)

<table>
<thead>
<tr>
<th>context</th>
<th>Given a small group intervention focusing on addition</th>
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<tbody>
<tr>
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<tr>
<td>performance: action</td>
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<tr>
<td>quality</td>
<td>Students will participate in all intervention activities and correctly complete (at least 85%) final math fact test</td>
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</table>

E. Instructional Sequence

1. Pre-instructional Phase (preparing learners: attention, motivation, expectancy)

To prepare students for the activities, ask first what they know about addition – rules, strategies, things that might be tricky, etc. *(Point out things like tens facts, the importance of paying attention to place value, rules about adding odds and evens, adding 5s, and any other areas that you notice students might be struggling with)*

Introduce to the students that they will be participating in some different activities to work on their addition skills.

2. Instructional Phase (engaging learners with essential content)

Introduce and explain each activity. *(You may introduce each activity separately or introduce them all at once. If introducing separately, repeat the pre-instructional phase at the beginning of each new activity to activate prior knowledge)*

**Activity 1 (Find-a-Fact):** Students will be given the “Find-a-Fact” worksheet and work with a partner. Have students work in pairs and take turn coloring out (with a dry erase
marker) two numbers that make an addition fact (two addend numbers) and then will have to solve for the sum. Once there are no more possible addition facts or time is up, have students erase the worksheet and put materials away.

**Activity 2 (Addition War):** Students will play this in pair using a card set. Both students will countdown from 3 and lay down one card. The first student to say the sum of both of the numbers laid down gets to collect both cards. Keep playing until one student has all of the cards. (*This is a game of partially of luck and, also, of speed. Students might need to be re-grouped if you notice one student is consistently slower or faster than their partner*)

**Activity 3 (Say it, Make it, Write it):** Students will be given a laminated worksheet with 3 boxes. First the teacher will give an addition problem by saying it out loud and have students repeat it (SAY IT) while also writing it in the first box. Next, students will create a visual representation of the problem by either using base-ten blocks or (if they are comfortable) drawing base ten blocks in the second box (MAKE IT). Finally, students will make a number sentence to represent their computation (WRITE IT). After each problem, check and then have students erase and prepare for the next problem.

3. **Post-instructional Phase (strengthening learning through continued practice)**

   Have students participate in the activities. (*For a small group you can do one activity a day and change up activities on different days. For whole group or larger group, you could have students rotate through the activities*)

   Close the intervention by recapping what was done and asking students to reflect – what did they learn? Do they feel like it helped? Are they more confident in their addition skills?

F. **Summative Assessment (Consistent with Instructional Objective, Part D)**

   [provide any additional details related to implementing the instructional objective]

G. **Resources**

1. **Materials**
   a. **Activity 1:** “Find-a-Fact” laminated sheet, dry erase markers and erasers
   b. **Activity 2:** Card set (1 per pair)
   c. **Activity 3:** Laminated worksheets, dry erase markers and erasers
   d. **Other:** Final worksheet

2. **Advance Preparations**
   a. **Activity 1:** Laminating worksheets
   b. **Activity 2:** Printing and laminating (optional) card sets
   c. **Activity 3:** Laminating worksheets
d. Other: Preparing pre- and post-test of addition facts that you would like to test students on

3. References
A. **Instructional Goal (with Learned Capability specified)**
Students will be able to demonstrate fluency in division

B. **Pennsylvania Academic Standard(s)**
CC.2.2.3.A.3 – Demonstrate multiplication and division fluency

C. **Essential Content (only what is necessary to perform the instructional goal)**
Division facts with up to 3-digit dividends

D. **Instructional Objective (Summative Assessment Strategy, same as Part F)**

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E. **Instructional Sequence**

1. **Pre-instructional Phase (preparing learners: attention, motivation, expectancy)**

   To prepare students for the activities, ask first what they know about division – rules, strategies, things that might be tricky, etc.

   Introduce to the students that they will be participating in some different activities to work on their division skills.

2. **Instructional Phase (engaging learners with essential content)**

   Introduce and explain each activity. *(You may introduce each activity separately or introduce them all at once. If introducing separately, repeat the pre-instructional phase at the beginning of each new activity to activate prior knowledge)*

   **Activity 1 (Find-a-Fact):** Students will be given the “Find-a-Fact” worksheet and work with a partner. Have students pair up and take turn coloring out (with a dry erase marker) two numbers that make a division fact (a dividend number, a divisor number) and then students will solve for the quotient number. When someone can no longer find any possible division facts, see if the other partner is able to see one that the other didn’t.
Once there are no more possible division facts or time is up, have students erase the worksheet and put materials away.

**Activity 2 (Egg Carton Groups):** Give each student an egg carton and have the students take out the beads/beans from the egg carton. Students will be given division problems and use the egg carton to solve the problems with grouping. Students will be given the dividend to know how many beads/beans they need total and the divisor would be the number of egg carton spots used. They will solve for the quotient by finding the number of beads/beans that can go into each spot. This can be done individually or with the group. If individually, print out a set of division problems for each student a head of time and have them use grouping to solve each problem and write the answers. In whole group, give problems one-at-a-time (problems should be said out loud and also written on either a white board and held up or on the board where everyone can see). Have students solve the problem with the egg cartons, write their answer on their white board and then hold up the answer.

**Activity 3 (Sequence Song):** Put the sequence of long division to a tune and have students work through problems out loud with the tune. Use the rhyme of “*Divide. Multiply. And subtract. Now bring it on down and bring it on back.*” Give a division problem and have students write the problem in long division format. Next, have students solve the problem by showing their work on the white board and saying the steps out loud to the tune. Have one student do a problem at a time and then other students can do the tune along with the student solving the problem.

3. **Post-instructional Phase (strengthening learning through continued practice)**

   Have students participate in the activities. *(For a small group you can do one activity a day and change up activities on different days. For whole group or larger group, you could have students rotate through the activities)*

   Close the intervention by recapping what was done and asking students to reflect – what did they learn? Do they feel like it helped? Are they more confident in their division skills?

F. **Summative Assessment (Consistent with Instructional Objective, Part D)**

   *[provide any additional details related to implementing the instructional objective]*

G. **Resources**

1. **Materials**
   a. **Activity 1:** “Find-a-Fact” laminated sheet, dry erase markers and erasers
   b. **Activity 2:** Egg cartons, beads/beans, problem sheet (individual), white boards, dry erase markers and erasers (group)
   c. **Activity 3:** White boards, dry erase markers and erasers
   d. **Other:** Final worksheet
2. **Advance Preparations**
   a. **Activity 1:** Laminate worksheets
   b. **Activity 2:** Prepare egg cartons, make/print out worksheets (individual)
   c. **Other:** Preparing pre- and post-test of division facts that you would like to test students on

3. **References**
A. Instructional Goal (with Learned Capability specified)
Students will be able to demonstrate fluency in multiplication

B. Pennsylvania Academic Standard(s)
CC.2.2.3.A.3 – Demonstrate multiplication and division fluency

C. Essential Content (only what is necessary to perform the instructional goal)
Multiplication fluency using 1-digit and 2-digit factors

D. Instructional Objective (Summative Assessment Strategy, same as Part F)

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</tbody>
</table>

E. Instructional Sequence

1. Pre-instructional Phase (preparing learners: attention, motivation, expectancy)

To prepare students for the activities, ask first what they know about multiplication – rules, strategies, things that might be tricky, etc. (Point out things like the importance of paying attention to place value, rules about multiplying with 2, 5, 10, and any other areas that you notice students might be struggling with)

Introduce to the students that they will be participating in some different activities to work on their multiplication skills.

2. Instructional Phase (engaging learners with essential content)

Introduce and explain each activity. (You may introduce each activity separately or introduce them all at once. If introducing separately, repeat the pre-instructional phase at the beginning of each new activity to activate prior knowledge)

Activity 1 (Find-a-Fact): Students will be given the “Find-a-Fact” worksheet and work with a partner. Have students pair up and take turn coloring out (with a dry erase marker) two numbers that make a multiplication fact (two factor numbers) and then have students
solve for the product. If the student gets the wrong product, they must erase their factors. Once there are no more possible multiplication facts or time is up, have students erase the worksheet and put materials away.

**Activity 2 (BINGO):** Students will be given a BINGO sheet with possible product from the factors 1-6. Students will pair up – one person will be the roller and the other will be in charge of the BINGO sheet. The roller will roll two dice and tell the sheet person what the two numbers are. The sheet person will have to tell the roller what the product of those two numbers are then see if that is one of the open spots on their BINGO sheet. If the sheet person gets it wrong, s/he switches with the dice roller. Students will continue until both partners complete the given pattern (a straight line, perimeter, blackout, etc.) on their BINGO sheet.

**Activity 3 (Egg Carton Groups):** Give each student an egg carton and have the students take out the beads/beans from the egg carton. Students will be given multiplication problems and use the egg carton to solve the problems with grouping. One factor would be the number of egg carton spots used, the other is the number of beads/beans that go into each spot. This can be done individually or with the group. If individually, print out a set of multiplication problems for each student a head of time and have them use grouping to solve each problem and write the answers. In whole group, give problems one-at-a-time (problems should be said out loud and also written on either a white board and held up or on the board where everyone can see). Have students solve the problem with the egg cartons, write their answer on their white board and then hold up the answer.

3. **Post-instructional Phase (strengthening learning through continued practice)**

   Have students participate in the activities. *(For a small group you can do one activity a day and change up activities on different days. For whole group or larger group, you could have students rotate through the activities)*

   Close the intervention by recapping what was done and asking students to reflect – what did they learn? Do they feel like it helped? Are they more confident in their multiplication skills?

F. **Summative Assessment (Consistent with Instructional Objective, Part D)**

   [provide any additional details related to implementing the instructional objective]

G. **Resources**

1. **Materials**
   a. **Activity 1:** “Find-a-Fact” laminated sheet, dry erase markers and erasers
   b. **Activity 2:** BINGO sheets and markers, dice
   c. **Activity 3:** Egg cartons, beads/beans, problem sheet (individual), white boards, dry erase markers and erasers (group)
   d. **Other:** Final worksheet
2. **Advance Preparations**
   
   a. **Activity 1:** Laminating worksheets
   b. **Activity 2:** Print out BINGO sheets
   c. **Activity 3:** Create egg cartons, create/print out problem sheets (individual)
   d. **Other:** Preparing pre- and post-test of multiplication facts that you would like to test students on

3. **References**
   
A. Instructional Goal (with Learned Capability specified)
Students will be able to demonstrate an understanding of number sense

B. Pennsylvania Academic Standard(s)
CC.2.1.1.B.1 – Extend the counting sequence to read and write numerals to represent objects

C. Essential Content (only what is necessary to perform the instructional goal)
Understanding that 1 = one = a single thing, 2 = two = a pair of things, 3 = three = a group of three things, etc.

D. Instructional Objective (Summative Assessment Strategy, same as Part F)

<table>
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<tr>
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<tbody>
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<td>performance: capability</td>
<td>Students will be able to demonstrate an understanding of number sense</td>
</tr>
<tr>
<td>performance: action</td>
<td>By completing the intervention and completing a final number check</td>
</tr>
<tr>
<td>quality</td>
<td>Students will participate in all intervention activities and correctly complete (at least 85%) final number check</td>
</tr>
</tbody>
</table>

E. Instructional Sequence

1. Pre-instructional Phase (preparing learners: attention, motivation, expectancy)

   To prepare students for the activities, start by asking about different ways that they can show/represent numbers. *(Draw attention to the fact that they can be written in number form, in word form, drawn with some representation, or represented with some actual manipulative)*

   Introduce to the students that they will be participating in some different activities to work on representing numbers in different ways – especially larger numbers.

2. Instructional Phase (engaging learners with essential content)

   Introduce and explain each activity. *(You may introduce each activity separately or introduce them all at once. If introducing separately, repeat the pre-instructional phase at the beginning of each new activity to activate prior knowledge)*

   **Activity 1 (Name that number):** Students will work on this individually. Each student in the intervention group will get a set of laminated cards. There are three types of cards –
some will have numbers (2, 356, 20, etc.), some will have written numbers (two, three-hundred-fifty-six, twenty, etc.), and the remainder will have some sort of visual representation of the number (tally marks). Students will sort their card set and match the number with the written word and visual. Once students sort all of the cards do a check.

**Activity 2 (Memory):** Students can work in pairs or small groups for this. Give each group a set of cards – half of the cards have numbers and then other half will have the written version of the same numbers. Lay numbers face down and have students play memory to match up the numbers with the words – continue playing until all of the matches are collected.

**Activity 3 (Stack It):** Students will each have their dry erase boards for this activity and have access to base ten blocks. Give students a number out loud. First, have students write the number that you gave out loud. After students have the number written down, have the put base ten blocks on top of the number that equal that quantity. Check that the number and base ten blocks match and that it was the number said by the teacher.

3. **Post-instructional Phase (strengthening learning through continued practice)**

Have students participate in the activities. *(For a small group you can do one activity a day and change up activities on different days. For whole group or larger group, you could have students rotate through the activities)*

Close the intervention by recapping what was done and asking students to reflect – what did they learn? Do they feel like it helped? Are they more confident in their ability to represent numbers in different ways?

F. **Summative Assessment (Consistent with Instructional Objective, Part D)**

*[provide any additional details related to implementing the instructional objective]*

G. **Resources**

1. **Materials**
   a. **Activity 1:** Card sets (1 per student)
   b. **Activity 2:** Memory card sets (1 per group)
   c. **Activity 3:** Base ten blocks, white boards, dry erase markers and erasers
   d. **Other:** Final worksheet

2. **Advance Preparations**
   a. **Activity 1:** Make/print out card sets
   b. **Activity 2:** Make/print out card sets
   c. **Other:** Preparing pre- and post-test of numbers to test their number sense

3. **References**
A. Instructional Goal (with Learned Capability specified)
Students will be able to demonstrate fluency in subtraction

B. Pennsylvania Academic Standard(s)
CC.2.1.3.B.1 – Apply place value understanding and properties of operations to perform multi-digit arithmetic

C. Essential Content (only what is necessary to perform the instructional goal)
Subtraction facts using numbers up to 1000

D. Instructional Objective (Summative Assessment Strategy, same as Part F)

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</table>

E. Instructional Sequence

1. Pre-instructional Phase (preparing learners: attention, motivation, expectancy)

   To prepare students for the activities, ask first what they know about subtraction – rules, strategies, things that might be tricky, etc. *(Point out things like regrouping, paying attention to zeros, paying attention to place value, and any other areas that you notice students might be struggling with)*

   Introduce to the students that they will be participating in some different activities to work on their subtraction skills.

2. Instructional Phase (engaging learners with essential content)

   Introduce and explain each activity. *(You may introduce each activity separately or introduce them all at once. If introducing separately, repeat the pre-instructional phase at the beginning of each new activity to activate prior knowledge)*

   **Activity 1 (Find-a-Fact):** Students will be given the “Find-a-Fact” worksheet and work with a partner. Have students pair up and take turn coloring out (with a dry erase marker)
two numbers that make a subtraction fact (the minuend number and the subtrahend number) and then solve for the difference number. Once there are no more possible subtraction facts or time is up, have students erase the worksheet and put materials away.

**Activity 2 (Say it, Make it, Write it):** Students will be given a laminated worksheet with 3 boxes. First the teacher will give a subtraction problem by saying it out loud and have students repeat it (SAY IT) while also writing it in the first box. Next, students will create a visual representation of the problem by either using base-ten blocks or (if they are comfortable) drawing base ten blocks in the second box (MAKE IT). Finally, students will make a number sentence to represent their computation (WRITE IT). After each problem, check and then have students erase and prepare for the next problem.

**Activity 3 (Regroup away):** Have stirrers in groups of 100, 10, and individuals. Give students a subtraction problem that involves regrouping and have them write out the problem on their white board. Let students lay stirrer groupings out to represent the problem (For the number 436 they would have 4 ‘100’ groups, 3 ‘10’ groups, and 6 single stirrers). Let students move the stirrer groups around as a manipulative to solidify the problem and practice regrouping. Demonstrate the way that regrouping looks in a written problem and practice doing this while showing it with the stirrers.

3. Post-instructional Phase (strengthening learning through continued practice)

Have students participate in the activities. (For a small group you can do one activity a day and change up activities on different days. For whole group or larger group, you could have students rotate through the activities)

Close the intervention by recapping what was done and asking students to reflect – what did they learn? Do they feel like it helped? Are they more confident in their subtraction skills?

F. Summative Assessment (Consistent with Instructional Objective, Part D)

[provide any additional details related to implementing the instructional objective]

G. Resources

1. Materials
   a. Activity 1: “Find-a-Fact” laminated sheet, dry erase markers and erasers
   b. Activity 2: Laminated worksheets, dry erase markers and erasers
c. **Activity 3:** Stirrers (18 ones, 18 groups of 10, 18 groups of 100), whiteboards, dry erase markers and erasers
d. **Other:** Final worksheet

2. **Advance Preparations**
   a. **Activity 1:** Laminating worksheets
   b. **Activity 2:** Laminating worksheets
   c. **Activity 3:** Group stirrers
d. **Other:** Preparing pre- and post-test of subtraction facts that you would like to test students on

3. **References**
A. Instructional Goal (with Learned Capability specified)
Students will be able to demonstrate fluency in the use and application of base ten

B. Pennsylvania Academic Standard(s)
CC.2.1.2.B.2 – Use place value concepts to read, write, and skip count to 1000

C. Essential Content (only what is necessary to perform the instructional goal)
Understanding of place value in whole numbers and decimals and how base ten blocks coordinate: one’s place, ten’s place, hundred’s place, thousand’s place, tenth’s place, hundredth’s place, thousandth’s place, etc.

D. Instructional Objective (Summative Assessment Strategy, same as Part F)

<table>
<thead>
<tr>
<th>context</th>
<th>Given a small group intervention focusing on base ten comprehension</th>
</tr>
</thead>
<tbody>
<tr>
<td>performance: capability</td>
<td>Students will be able to demonstrate fluency in the use and application of base ten</td>
</tr>
<tr>
<td>performance: action</td>
<td>By successfully completing the intervention</td>
</tr>
<tr>
<td>quality</td>
<td>Students will participate in all intervention activities and successfully completing (at least 85% correct) the worksheets</td>
</tr>
</tbody>
</table>

E. Instructional Sequence

1. Pre-instructional Phase (preparing learners: attention, motivation, expectancy)

To prepare students for the activities, ask first what they know about base ten – rules, strategies, things that might be tricky, etc. *Point out things like regrouping (ten 1s into one 10), paying attention to zeros, the connection to place value, and any other areas that you notice students might be struggling with)*

Introduce to the students that they will be participating in some different activities to work on their base ten skills.

2. Instructional Phase (engaging learners with essential content)

Introduce and explain each activity. *You may introduce each activity separately or introduce them all at once. If introducing separately, repeat the pre-instructional phase at the beginning of each new activity to activate prior knowledge*
**Activity 1 (Base Ten Dice):** Students can work on this activity in partners as a way for students to check as they go. Each group will be given 3 base ten dice – a one’s dice, ten’s dice, and hundred’s dice – and, on their turn, will roll each dice once. Students will record what they roll on their worksheet. They will write what they rolled on each dice and then record what their number would be if they were all put together.

**Activity 2 (Base Ten War):** Students will work in small group or pairs for this game and each group will get one set of cards. Each card will have a picture of a combination of base ten blocks on them. Students will play normal war where everyone lays down a card at the same time and then the person who has the highest number from the base ten blocks wins and collects all the cards laid down.

**Activity 3 (Cup Spin):** Students can work in pairs or small groups for this activity. One person in the group will hold the stack cup and will rotate (according to instruction) the cup to make a number. They will read the number out loud to their partner. The partner will then use base ten blocks to represent the number that they were given. When the partner building the number is done, the stack cup partner or third group member will check for correctness.

3. **Post-instructional Phase (strengthening learning through continued practice)**

Have students participate in the activities. *(For a small group you can do one activity a day and change up activities on different days. For whole group or larger group, you could have students rotate through the activities)*

Close the intervention by recapping what was done and asking students to reflect – what did they learn? Do they feel like it helped? Are they more confident in their base ten skills?

F. **Summative Assessment (Consistent with Instructional Objective, Part D)**

[provide any additional details related to implementing the instructional objective]

G. **Resources**

1. **Materials**
   - a. **Activity 1:** Dice sets (1 per group), worksheet
   - b. **Activity 2:** Card sets (1 per group)
   - c. **Activity 3:** Stack cups (1 per group), base ten blocks

2. **Advance Preparations**
   - a. **Activity 1:** Making dice and worksheet
   - b. **Activity 2:** Making card sets
   - c. **Activity 3:** Making stack cups

3. **References**
A. **Instructional Goal (with Learned Capability specified)**
Students will be able to demonstrate fluency in understanding place value

B. **Pennsylvania Academic Standard(s)**
CC.2.1.2.B.2 – Use place value concepts to read, write, and skip count to 1000

C. **Essential Content (only what is necessary to perform the instructional goal)**
Understanding of place value in whole numbers and decimals. One’s place, ten’s place, hundred’s place, thousand’s place, tenth’s place, hundredth’s place, thousandth’s place, etc.

D. **Instructional Objective (Summative Assessment Strategy, same as Part F)**

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<thead>
<tr>
<th>context</th>
<th>Given a small group intervention focusing on place value comprehension</th>
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<td>Students will be able to demonstrate fluency in understanding place value</td>
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<tr>
<td>performance: action</td>
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<td>quality</td>
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</tbody>
</table>

E. **Instructional Sequence**

1. **Pre-instructional Phase (preparing learners: attention, motivation, expectancy)**

   To prepare students for the activities, ask first what they know about place value – rules, strategies, things that might be tricky, etc. *(Point out things like regrouping (ten 1s into one 10), paying attention to zeros, the connection to base ten, and any other areas that you notice students might be struggling with)*

   Introduce to the students that they will be participating in some different activities to work on their understanding of place value.

2. **Instructional Phase (engaging learners with essential content)**

   Introduce and explain each activity. *(You may introduce each activity separately or introduce them all at once. If introducing separately, repeat the pre-instructional phase at the beginning of each new activity to activate prior knowledge)*
Activity 1 (Task Cards): Students will travel around the room and completing task cards to fill out their worksheet. Students will have a worksheet with numbered boxes that align with the numbers on the task cards. They will walk around the room and stop at each task card. The task card will ask them to solve some type of place value related problem. Students will record the answer in the matching box on their worksheet and can do a quick check of their answers once finished.

Activity 2 (Place Value Puzzles): Students will be given puzzles for a few different numbers and will have to put the correct puzzles together. Each puzzle has 5 pieces: the center piece is the number and the surrounding pieces are different representations of the number using place value. Students will have to assemble the puzzle for each number. This can be done individually or in small groups/pairs.

Activity 3 (Whack it!): This is a group activity that can be played with students. First, divide students into 2 teams and give one person from each team a fly swatter. Write down a multi-digit number on the board and ask students to ‘whack’ a certain place value in the number. Whoever hits the number first wins the round – their team gets a point and that person gets to make the number that will be used for the next round. This can be played up to a certain number of points or in a certain time period.

3. Post-instructional Phase (strengthening learning through continued practice)

Have students participate in the activities. (For a small group you can do one activity a day and change up activities on different days. For whole group or larger group, you could have students rotate through the activities)

Close the intervention by recapping what was done and asking students to reflect – what did they learn? Do they feel like it helped? Are they more confident in their understanding of place value?

F. Summative Assessment (Consistent with Instructional Objective, Part D)

[provide any additional details related to implementing the instructional objective]

G. Resources

1. Materials
   a. Activity 1: Place Value worksheet, task cards
   b. Activity 2: Number puzzles
   c. Activity 3: Fly swatters (2)

2. Advance Preparations
   a. Activity 1: Create worksheet, create and laminate task cards
   b. Activity 2: Create puzzles

3. References
A. Instructional Goal (with Learned Capability specified)
Students will be able to demonstrate an understanding of how to pull out the necessary information in word problems and solve them.

B. Pennsylvania Academic Standard(s)
CC.2.2.3.A.4 – Solve problems involving the four operations, and identify and explain patterns in arithmetic.

C. Essential Content (only what is necessary to perform the instructional goal)
Understanding of how to solve algebraic problems involving addition, subtraction, multiplication, and division. Understanding of how to pull out the important information from a word problem and determining what the problem is asking you to solve for. Understanding of how to turn a word problem into an algebraic equation.

D. Instructional Objective (Summative Assessment Strategy, same as Part F)

<table>
<thead>
<tr>
<th>context</th>
<th>Given a small group intervention focusing on understanding and solving word problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>performance: capability</td>
<td>Students will be able to demonstrate an understanding of how to pull out the necessary information in word problems and solve them</td>
</tr>
<tr>
<td>performance: action</td>
<td>By successfully completing the intervention</td>
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<tr>
<td>quality</td>
<td>Students will participate in all intervention activities and successfully completing (at least 85% correct) the worksheets</td>
</tr>
</tbody>
</table>

E. Instructional Sequence

1. Pre-instructional Phase (preparing learners: attention, motivation, expectancy)

To prepare students for the activities, ask first what they know about word problems – strategies for solving word problems, key words they pick out when solving word problems, questions/concerns they have about solving word problems.

Introduce to the students that they will be participating in some different activities to work on their skills in solving word problems.

2. Instructional Phase (engaging learners with essential content)
Introduce and explain each activity. *(You may introduce each activity separately or introduce them all at once. If introducing separately, repeat the pre-instructional phase at the beginning of each new activity to activate prior knowledge)*

**Activity 1 (Strategies Chart):** Each student will be given the blanket sheet to create an organizer and will create it in along with the class and the teacher can go over this as a whole class or in small groups. Students will be able to organize it based on the information and strategies they want. Teacher should discuss different strategies and tips; such as highlighting important information, going through Polya’s principles, etc. Students can hold on to this organizer and can use it as a guide when solving word problems.

**Activity 2 (See It to Solve It):** For this activity, students will use laminated worksheets with two boxes to solve word problems. In the first box, students will draw some kind of visual that represents the information that they received from the problem and are solving for. In the second box, students will solve the problem and write the answer.

**Activity 3 (Highlight, Rewrite, Solve, Reflect):** This activity will use Polya’s problem solving principles and have students solve word problems using this format. Polya’s four step process is: 1) Understanding the problem, 2) Devising a plan, 3) Carrying out the plan, 4) Looking back. At the start of this activity, we will go over all of the principles and what it looks like to go through this process. Students will be given a number of word problems and will go through each step in the process to solve the problems.

2. **Post-instructional Phase (strengthening learning through continued practice)**

Have students participate in the activities. *(For these activities, it is probably best to first have students go through activity 1 and allow students to use that worksheet as a resource during activity 2 and activity 3)*

Close the intervention by recapping what was done and asking students to reflect – what did they learn? Do they feel like it helped? Are they more confident in reading word problems, pulling out the important information, and solving word problems?

F. **Summative Assessment (Consistent with Instructional Objective, Part D)**

[provide any additional details related to implementing the instructional objective]

G. **Resources**

1. **Materials**
   a. **Activity 1:** Blank paper for students to create an organizer for problem solving strategies
   b. **Activity 2:** Word Problems worksheet and word problem examples
   c. **Activity 3:** Note cards and word problem examples

2. **Advance Preparations**
   a. **Activity 2:** Create worksheet
b. **Activity 3**: Create worksheet
A. Instructional Goal (with Learned Capability specified)
Students will be able to demonstrate an understanding of times (hours, minutes, seconds) and how they fit together

B. Pennsylvania Academic Standard(s)
CC.2.4.3.A.2 – Tell and write time to the nearest minute and solve problems by calculating time intervals

C. Essential Content (only what is necessary to perform the instructional goal)
Understanding of both analog and digital representations of clock times. Understanding of how hours, minutes, and seconds fit into each other and how many hours are in a day.

D. Instructional Objective (Summative Assessment Strategy, same as Part F)

<table>
<thead>
<tr>
<th>context</th>
<th>Given a small group intervention focusing on telling time</th>
</tr>
</thead>
<tbody>
<tr>
<td>performance: capability</td>
<td>Students will be able to demonstrate an understanding of times (hours, minutes, seconds) and how they fit together</td>
</tr>
<tr>
<td>performance: action</td>
<td>By completing the intervention and the final worksheet</td>
</tr>
<tr>
<td>quality</td>
<td>Students will participate in all intervention activities and successfully completing (at least 85% correct) the final worksheet</td>
</tr>
</tbody>
</table>

E. Instructional Sequence

1. Pre-instructional Phase (preparing learners: attention, motivation, expectancy)
To prepare students for the activities, ask first what they know about time – how different components of time fit into each other, how to tell time from digital and analog clocks, etc. (Point out things like how many seconds are in a minute, how many minutes are in an hour, how many minutes are between each number on analog clock, etc.)

Introduce to the students that they will be participating in some different activities to work on their ability to tell time.

2. Instructional Phase (engaging learners with essential content)
Introduce and explain each activity. (You may introduce each activity separately or introduce them all at once. If introducing separately, repeat the pre-instructional phase at the beginning of each new activity to activate prior knowledge)
Activity 1 (Clock Foldable): This activity is a foldable that students can use as a resource to practice and help them reinforce their understanding of time. Students will have to cut out both clock circles. On the ‘Hour’ circle, students will go around the clock and label 1-12. On the “Minute” circle, students will go around and label 0-60 (labeling in 5-minute segments). Have students line up the clock and then glue the centers together (with the hour clock on top). Students can cut along the line of the hour clock so that the can be folded down to expose the corresponding number on the minute clock.

Activity 2 (Elapsed Time): Students will complete the elapsed time worksheet. Each box has a clock showing a time and then directions for how to change the time. Each student should write the new time in the box. Once finished, students should get their answers checked and then hold onto the worksheet as a check.

Activity 3 (Around the Clock): This is a game students will play in pairs. Both people in the pair should have a different colored dry erase marker or select a different mark to draw for each of their clocks. For each turn, students will roll the dice and move the number of circles around the outside border. The student will read the time that they land on and then mark or color in the analog clock that matches the time. Students do not get to fill in a clock if they get the answer wrong. Students will continue taking turns and continue playing until all of the clocks are colored in. The student with the most clocks colored in wins.

2. Post-instructional Phase (strengthening learning through continued practice)

Have students participate in the activities. *(For these activities, it is probably best to first have students go through activity 1 and allow students to use that worksheet as a resource during activity 2 and activity 3)*

Close the intervention by recapping what was done and asking students to reflect – what did they learn? Do they feel like it helped? Are they more confident in telling time and being able to add or subtract increments of time?

F. Summative Assessment (Consistent with Instructional Objective, Part D)

*[provide any additional details related to implementing the instructional objective]*

G. Resources

1. Materials
   a. **Activity 1**: Hour and minute clock circles, glue, scissors, writing utensils (markers, crayons, colored pencils, etc.)
   b. **Activity 2**: Elapsed Time worksheet
   c. **Activity 3**: Around the Clock laminated worksheet, dice, dry erase markers and erasers
   d. **Other**: Final worksheet

2. Advance Preparations
a. **Activity 1:** Create hour and minute clock circles  
b. **Activity 2:** Create Elapsed Time worksheet  
c. **Activity 3:** Create and laminate Around the Clock worksheet  
d. **Other:** Create final worksheet  

3. **References**  
A. Instructional Goal (with Learned Capability specified)
Students will be able to demonstrate an understanding of shapes and their characteristics

B. Pennsylvania Academic Standard(s)
CC.2.3.3.A.1 – Identify, compare, and classify shapes and their attributes

C. Essential Content (only what is necessary to perform the instructional goal)
Understanding of shapes (triangle, square, rectangle, trapezoid, parallelogram, pentagon, hexagon, octagon, circle, etc.): what they look like, their basic properties (i.e. number of sides, number of angles, types of angles, sets of parallel sides, etc.), and how different shapes relate to one another

D. Instructional Objective (Summative Assessment Strategy, same as Part F)

<table>
<thead>
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<th>context</th>
<th>Given a small group intervention focusing on understanding shapes</th>
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<td>performance: capability</td>
<td>Students will be able to demonstrate an understanding of shapes and their characteristics</td>
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<td>Students will participate in all intervention activities and successfully completing (at least 85% correct) the worksheets</td>
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</table>

E. Instructional Sequence

1. Pre-instructional Phase (preparing learners: attention, motivation, expectancy)
To prepare students for the activities, ask first what they know about shapes – different kinds of shapes, properties of shapes, things that differentiate shapes (Point out things like the difference between 4 sided shapes and different types of triangles)

Introduce to the students that they will be participating in some different activities to work on their familiarity with shapes.

2. Instructional Phase (engaging learners with essential content)
Introduce and explain each activity. (You may introduce each activity separately or introduce them all at once. If introducing separately, repeat the pre-instructional phase at the beginning of each new activity to activate prior knowledge)
Activity 1 (Name and Describe): Students will be given worksheets that have description boxes for each shape. The shape will be pictured in the box and then students will fill in the information about each shape. This worksheet can be used as a resource for students to practice recognizing shapes and their characteristics.

Activity 2 (I am…): Students will be given a worksheet that has numbered boxes for each of the “I am” cards. Students will go around the class to find the cards and have to read the description of the shapes. Once students guess what the shape is, they will record their answer in the matching box on their worksheet. Students can check their worksheets once finished.

Activity 3 (Build me using…): Students will be given a worksheet that has numbered boxes for each of the “Build me” cards. Students will go around the class to find the cards that ask students to build a shape using other shapes. Students will build the build with the geometry blocks and then draw a picture of their answer in the matching box on their worksheet. Students can check their worksheets once finished.

2. Post-instructional Phase (strengthening learning through continued practice)

Have students participate in the activities. (For these activities, it is probably best to first have students go through activity 1 and allow students to use that worksheet as a resource during activity 2 and activity 3)

Close the intervention by recapping what was done and asking students to reflect – what did they learn? Do they feel like it helped? Are they more confident in differentiating between and naming different shapes?

F. Summative Assessment (Consistent with Instructional Objective, Part D)

[provide any additional details related to implementing the instructional objective]

G. Resources

1. Materials
   a. Activity 1: Shapes worksheet
   b. Activity 2: “I am” cards and worksheet
   c. Activity 3: “Build me” cards and worksheet, geometry blocks

2. Advance Preparations
   a. Activity 1: create worksheet
   b. Activity 2: create cards and worksheet
   c. Activity 3: create cards and worksheet

3. References
   a. https://www.tes.com/us