Hungry Ants Explore Multiplication

Caitlin Dickinson

Looking back at my own experiences as an elementary mathematics student, I recall so many fellow students asking the inevitable question: "Why do we have to learn this?" Such a question was inevitably followed by the bold statement, "We'll never use this in real life!" The challenge that my own teachers faced was to convince my classmates and me that the concepts we studied in class were valuable and relevant; in particular, they searched for ways to engage us to prevent us from giving up before we'd begun. Literature can be an ideal medium through which students can personally connect to mathematics because it can provide interesting context for a problem and help students look at mathematics in a broader way.

This multiplication lesson uses the children's book *One Hundred Hungry Ants*, by Elinor J Pinczes. In *One Hundred Hungry Ants*, a colony of ants is on its way to procure food from a picnic site. The leader is trying to rush the colony along because he does not want to arrive when all of the food is gone. To speed their progress, he stops periodically to command the ants to regroup and form different arrays, inadvertently taking up *more* time and resulting in their being late to the picnic!

General Outcomes

- Develop number sense (Alberta Education 2007, 88)

Specific Outcomes

- Demonstrate an understanding of multiplication (two- or three-digit by one-digit) to solve problems by
  1. using personal strategies for multiplication with and without concrete materials,
  2. using arrays to represent multiplication,
  3. connecting concrete representations to symbolic representations,
  4. estimating products and/or
  5. applying the distributive property. [C, CN, ME, PS, R, V] [1] (Alberta Education 2007, 88)

Mathematical Processes

- **Communication**: Students will use base-10 blocks to demonstrate their understanding by showing the multiplication process and will participate in discussion and whole-class problems in which they will communicate their understanding verbally or by using the interactive whiteboard manipulatives. They will create their own problems and solve them using manipulatives, recording the processes they used pictorially and symbolically.
- **Connections**: Students will connect their prior experiences with arrays and single-digit by single-digit multiplication to single-digit by two- or three-digit multiplication. They will have the opportunity to connect this concept to their own lives by identifying a real-world situation in which such multiplication could occur when they create their own problems, and when discussing problems with their classmates.
- **Mental Mathematics and Estimation**: Students will break down larger multiplication problems into more manageable parts using the distributive property, and perform simpler mathematical problems mentally. They will estimate the product of two factors by simplifying the problem in a way they can understand and compensating afterwards, visualizing it in their minds, and so on.
- **Problem Solving**: Students will explore ways of solving these problems and experiment with different methods of finding an answer.
- **Reasoning**: Students will use their observations from using the distributive property to understand that the product of two factors does not change if the factors are split.
- **Visualization**: Students will use base-10 blocks to develop a mental image of single-digit by two- or three-digit multiplication. This helps them to visualize this process as a rectangle or an array.

Technology Tip

Using SMART Notebook, create a row at the bottom of a page that contains one of each of the virtual manipulatives (a 100s block, a 10s block, and a 1s block). Right-click on each of them and select Infinite Cloner. You can now drag an infinite number of copies of that shape away to use as examples and to help students show their work without needing to repeatedly create new ones.

Achievement Indicators

- Students can model a given multiplication problem using the distributive property.
- Students can use base-10 blocks to represent multiplication and record the process symbolically.
- Students can estimate the product of a one-digit and a two- or three-digit factor. (Adapted from Alberta Education 2007, 88)

Introduction

Review ways of using manipulatives to show multiplication:

- Have students use base-10 blocks to solve a problem (for example, I have three boxes, and each has eight marbles inside. How many marbles do I have?)
- As a class, discuss the different methods students used. Ask students to think about how they solved the problem and to tell a partner about it (National Council of Teachers of Mathematics 2011). Invite students to tell the entire class about this method. Did some students make groups and add them up? Did some students use an array? Ask students what the symbolic representation of this question would be, and invite one of them to write it on the board.
- Have students solve another problem using base-10 blocks, but have them use a different method to solve it (for example, I have 8 books, but Amelia has 9 times the number of books I have. How many books does Amelia have?)
- Ask students what the symbolic representation of this question would be and invite one of them to write it on the board. As a class, discuss the different methods students used. Which method did they find easiest to use? Was one of them better suited for the problem with larger factors?

Development

- Introduce the story *One Hundred Hungry Ants* (Pinczes 1993) by telling students the premise of the story and explaining that they must use the base-10 blocks to model the formations of the ants.
- Observe students as they perform this task:
  - Do they use various values of blocks appropriately? (For example, when creating a row of 100 ants, do they attempt to count out 100 1s blocks, or do they use 10 10s blocks?)
  - Can they successfully create the correct formation using the blocks?
- Go through some of the arrays of ants and ask students to build them again on their desks while one student builds it on the interactive whiteboard. Invite the students to figure out the symbolic representation for this array.
- Model the format for using base-10 blocks and the distributive property to solve a multiplication problem by adding on to this example—place the virtual base-10 blocks outside of the x and y axes and model the steps for solving it; involve the students by asking questions throughout the process (see Appendix A). Discuss how each section relates to the original equation (for example, "We really solved the problem as $(10 \times 5) + (10 \times 5)$").
- Task students with creating a multiplication problem (one-digit by two- or three-digit) and solving it, recording their process pictorially and symbolically. When they have finished, invite each group to solve the problems that the students in that group created.
  - The problem should be more than symbolic; students should create scenarios or identify real-life situations in which they can use multiplication to solve a problem.
- Model task: Create a problem (for example, on a very hot summer day, there were three lines at the ice cream stand. There were 212 kids in each line! How many kids were lined up in total?) Begin by estimating what the final product will be; discuss estimation techniques and methods. Ask students to compare solving methods with peers at their table. Did anyone solve the problem differently? Solve the problem together on the interactive whiteboard.
- Students will estimate the product and record what they think it might be and how they got that answer. They will then solve the problem using base-10 blocks and record their process pictorially and symbolically. They will then discuss their problems within their groups, and the group will work together to solve each one.
- Observe students as they perform this task:
  - Does their problem make sense as a multiplication problem? Are they able to represent it using concrete materials (base-10 blocks)?
  - Are they able to use an efficient method to solve the problem?
  - Can they record their multiplication process symbolically?

Closure

- Discuss
  - Did everyone in the group solve the problem exactly the same way? How were your methods the same? How were they different?
  - Could you solve all of the problems?
  - How close were your estimates?

Differentiated Instruction

- Support Activity
  - Perform the above activity using the base-10 blocks. This time, create an equation whose single-digit factor is 1 and whose second factor has either two or three digits (eg, 1 × 25 or 1 × 362). Invite the students to create such a problem, putting it in a real-world context, and solve it using the base-10 blocks. When they solve and record this problem, the students should rewrite their problem, replacing the factor 1 with 2 and performing their solution again. This simplifies the task and familiarizes students with the process.
  - If the students struggle with basic multiplication facts, they may benefit from using a grouping method in which they make groups of the factors (eg, in 6 × 124, make 6 groups each containing 1 100s block, 2 10s blocks, and 4 1s blocks) and, beginning with the blocks with the lowest values, trading in for blocks of higher values (for example, if the student has 24 1s blocks, she can trade 20 of them for 2 10s blocks). This method correlates to the traditional multiplication algorithm (Small 2009, 179).
- Extension Activity
  - Broken Calculator Problem (Adapted from Small 2009, 182): Give students an image of a calculator, with an X through the 8 button, and ask them to solve the problem 6 × 98 using the calculator without using the broken 8 button. They should use the base-10 blocks and their knowledge of the distributive property to determine the steps they would take to solve the problem with the calculator. There are many possible solutions to this problem. If (6 × A) + (6 × B) = 6 × 98, however, "A + B" must equal 98.

Assessment

- Observations Checklist (Small 2009, 608)
  - The teacher will use her observations of students' work to fill out an observations checklist (Appendix B) that lists the skills and concepts students are expected to utilize. The teacher will walk through the classroom and ask prompting questions if necessary to assess student understanding in these areas.
  - Prompts
    - How do your blocks show the groups?
    - How did you get to the product?
    - How would you write this down on paper?
    - How did you see these numbers when you estimated the product?
  - Criteria
    - Array
      - Students will use base-10 blocks during the story (and possibly during subsequent activities if they choose to use this method) to create arrays that represent multiplication.
    - Manipulatives
      - Students will use base-10 blocks during the story to solve given multiplication problems and to create and solve original multiplication problems.
    - Records process symbolically
      - Students will translate their concrete/pictorial representations of the problem symbolically, ensuring that they record the process that *they* used when solving the problem.
    - Estimates product
      - Students will estimate the product of two factors by rounding, using the distributive property, or by using other personal strategies.

Note

1. Key:

C	Communication
CN	Connections
ME	Mental Mathematics and Estimation
PS	Problem Solving
R	Reasoning
V	Visualization

Source: Alberta Education 2007, 4.

References

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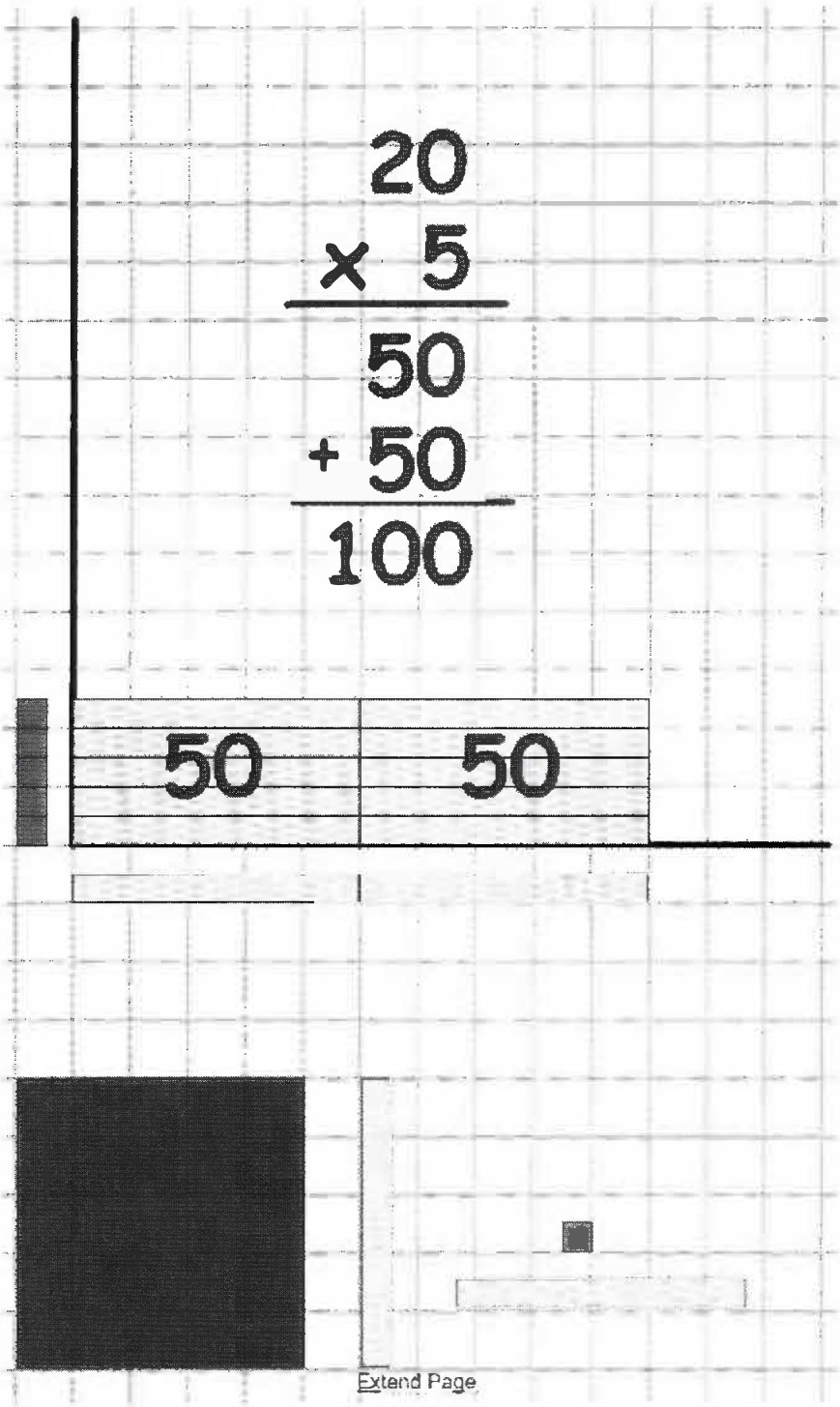
Caitlin Dickinson is completing her BEd at the University of Alberta. She has spent two years as a natural history interpreter, teaching children and adults about the world around them and the creatures in it. She has a passion for music as well as for learning and looks forward to learning alongside her students as she gains experience in the classroom.

Appendix A



Appendix B

Multiplication Assessment Checklist

√ = Student demonstrates clear understanding/performs this task accurately

• = Student needed assistance and/or prompting to demonstrate understanding/perform this task

/ = Student was unable to demonstrate clear understanding/perform this task without exceptional assistance

Name	Uses an array to represent multiplication	Uses manipulatives (or pictorial versions) to demonstrate multiplication process concretely/pictorially	Records personal process for multiplication symbolically	Estimates product using personal strategies