A LESSON PLAN FOR TEACHING TEACHERS

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Many students enter a Mathematics for Elementary Teachers course with the ability to perform standard mathematical procedures but lacking an understanding of the concepts underlying these procedures. In collaboration with Lynn Hart from Georgia State University, the authors wrote activity-based learning modules about operations with whole numbers to be used in a Mathematics for Elementary Teachers course. The purpose of these modules is to encourage good pedagogical practices in the college faculty teaching the course, while increasing the breadth and depth of preservice teachers' knowledge of mathematics.

This project was supported by a grant from the Board of Regents of the University System of Georgia, and one of its goals was collaboration and articulation between instructors at the two-year college, Georgia Perimeter College (GPC) and instructors at its primary transfer institution, Georgia State University (GSU). While the Mathematics for Elementary Teachers course was required for many students at GSU, it was not included in the Teacher Education Program at GPC. The learning modules were created to support the development of this course at GPC, and to provide materials to use for teaching prospective teachers at both institutions.

Because of the central role that operations with whole numbers play in elementary school mathematics, the modules were written for these topics. The module for each operation (addition, subtraction, multiplication and division) included a list of general concepts that students should know for the operation, followed by activities and teacher's notes, in the following format:

(1) The module begins by identifying the goals and the concept(s) being explored;
(2) The activities presented are problems designed for individual or small group work, followed by class discussion;
(3) Teacher's notes for each problem give some ideas and strategies for classroom use.

These modules are intended to provide materials which individual instructors can both use "as is" and modify for additional topics in the course. The subtraction module that follows is included as an example, with its components numbered (1),(2),(3) to correspond to the list above.

Topic: Whole Number Subtraction

(1) Goals

- To develop number sense about subtraction of whole numbers
- To develop confidence in using subtraction as a skill in problem solving

What do I want the students to *know* (concepts and skills)?

- Inverse relationship of addition and subtraction
- Three conceptual models for subtraction (take-away, comparison, missing addend)
- Physical/pictorial models (base ten blocks, pictorial)
- Subtraction algorithm (standard)
- Strategies for mental subtraction (compatible numbers, substitution, equal differences)
- Strategies for estimation (rounding, compatible numbers, front-end)
- Checking subtraction with addition

(2) Activity I: Inverse relationship of addition and subtraction

Problem:
1. (a) Write an addition sentence to model: Start at 4 and move 8 units to the right on the number line. (b) Write a subtraction sentence to model start at twelve and move 8 units to the left on the number line. (c) On the number line, if you start at 4 and move 8 units to the right, then move 8 units to the left, where do you end up?
2. Write a story elementary students would relate to that illustrates the inverse relationship of addition and subtraction.

(3) Notes for Activity I: Students should be comfortable with adding and subtracting on the number line with whole numbers. The students should be able to verbalize the result of adding a number followed by subtracting the same number.

(2) Activity II: Three conceptual models for subtraction

Problem: Draw a picture and write a mathematical sentence for each situation:

- Mary has eight balloons and three of them burst. Now she has five balloons.
- Kim has eight balloons and Sam has three balloons. How many more balloons does Mary have than Sam?
- Ahn has three balloons. How many more balloons does he need so that he will have eight balloons?

(3) NOTES for Activity II: Many students will model these problems easily using the take-away concept. You may need to discuss $8 - 3$ vs. $3 - 8$. The comparison (second bullet) and missing addend (third bullet) highlight the inverse relationship between addition and subtraction.

(2) Activity III: Physical/pictorial models (Use only if Activity II has been completed)

Problem:
1. Use base-ten blocks to model $1327 - 584$ and give the advantages and disadvantages of using the blocks.
2. Choose a different physical model like colored chips to solve the subtraction problem. Give the advantages and disadvantages of this physical model.

(3) NOTES for Activity III: All models require trading and are valuable to the investigation of subtraction. The students will likely use the take-away method. If you use chips, the students may move to a non-proportional model.

The modules provide activities to promote the deep content understanding needed by prospective teachers for effective instruction, as well as experience with instructional methods that model the NCTM, AMATYC, and MAA standards for mathematics education. It is important to remember that students (the prospective teachers) quickly determine what we value in mathematics by what we assess. When we use these materials we must also develop assessment strategies that support conceptual thinking.

These modules provide a starting point for faculty who teach Mathematics for Elementary Teachers, and will hopefully encourage them to create additional activities and materials. They reinforce the importance of both content and pedagogy in instruction for preservice teachers, and support the effort to develop effective teachers of mathematics at the elementary school level.