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AUTHOR Sadowski, Barbara R.
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ABSTRACT

The paper describes strategies for remediating mathematics difficulties (particularly the process of regrouping or "borrowing" in whole number subtraction) in children. Three interrelated aspects of the process (the meaning of subtraction, understanding of non-standard numerals, and the function of the subtraction algorithm), are considered. The set-subset model for learning subtraction, in which children manipulate concrete objects in an illustration of the part-whole inclusion relationship, is described. The difficulties facing children with reversal problems in dealing with value concepts are noted. The part-total terms is illustrated as one way of teaching the subtraction algorithm, while the comparison model is viewed as an alternative approach. The author suggests that parents and teachers should be wary of computer materials designed for learning disabled children. (CL)

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Developing Remedial Mathematics Strategies

by

Barbara R. Sadowski
Director of Research
University of Houston
(713) 749-7103

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Barbara R. Sadowski
University of Houston

The first step in developing effective strategies for remediating difficulties in mathematics is a comprehensive diagnosis of a child's difficulty in learning mathematics. Such a diagnosis may begin with error pattern analysis (Ashlock, 1978), continue with diagnosis of preferred modality (Uprichard, et. al., 1975), and may include diagnosis of cognitive style preferences (Speer, 1979). Other factors to be diagnosed are levels of maturity (Engelhardt, 1980), congruity between abstract and concrete models (Sadowski, 1981) and visual-spatial ability (Fleishner, J. E. and Frank, 1979; Flinter, P. F., 1979). Recent research has shown a relationship between computational errors and errors in understanding numeration (Englehardt, J. M. and Wiebe, J. H., 1981), a finding which supports clinical observations of many children diagnosed as learning disabled in arithmetic (Ashlock, R. B., Wilson, J. W. and Hutchings, B., 1976). The remedial strategies described in this paper have been used successfully with learning disabled children receiving help in an interdisciplinary clinic at the University of Houston. The strategies will focus on the remediation of difficulties in the process of regrouping in whole number subtraction, sometimes called "borrowing". The remediation will focus on three interrelated aspects of the difficulty. These are the methods and materials to build an understanding of the meaning of 1) subtraction, 2) non-standard numerals, and 3) the subtraction algorithm. Two alternate strategies for the subtraction algorithm will conclude the presentation.

The Meaning of Subtraction

Subtraction usually is taught as a "take-away" or removing process, and as a result, children do not associate it with previously learned knowledge. For example, if subtraction is taught as "take-away" then a problem like 9 - 5 is not related to an addition fact 4 + 5 = 9 which the child may already know. However, if subtraction is taught as an operation for finding a part when the total and one part are known, then the relationship to addition becomes apparent, for addition is an operation used to find a total when the parts are known. Using the terms part and total not only enable the child to relate the operations at a symbolic level, but also to tie the written and spoken symbols to iconic and concrete models.

A child can depict 9 - 4, using a manipulative like reversible felt squares, by placing a total set of 9 on the flannel board, and then turning over part (4) of them. The child's verbalization is usually something like: The total set is nine squares, and part of the set is blue (4). The part that is not blue has five squares. Thus 9 - 4 = 5. A picture using tally marks can show 9, with part crossed out, what remains is a part not crossed out. An excellent manipulative is the set of Hainstock blocks which would show 9 white beads with five on one side of the partition and four on the other. By placing one finger over the side showing the five beads, the 9 block can be used to model 9 - 4. Arithma-blocks, a bar with holes which can be filled with removable pegs, are excellent for requiring kinesthetic input from the child as she/he verbalizes the relationship. Of course, a picture of nine objects with a ring drawn around four of them would also be appropriate. Note that in each model, the objects are not moved or taken-away. This permits the child to also talk about the addition problem 4 + 5 = 9 as represented by the same diagram or manipulative.

Thus, the child has to learn fewer terms to relate addition facts to subtration facts. The one drawback with this model, called a set-subset model is that not all children readily understand the part-whole inclusion relationship. For such children, an alternative model, called the comparison model is useful. This model will be presented after a brief discussion of non-standard numerals.

Non-Standard Numerals

Numeration concepts, sometimes called place value concepts, underlie many of the difficulties children have with regrouping in subtraction. While time does not permit a complete discussion of numeration concepts which affect computation difficulties, some critical points should be noted. First, there are three values associated with the position of a digit within a numeral. For example, in 732, the 3 has a face value of 3, a place value of 10, and a total value of 30 (3 X 10). Thus, when 1 of the 3 tens is regrouped in the subtraction example 732 - 97, the standard numeral 732 becomes a non-standard numeral 6 hundreds, 12 tens and 12 ones, represented as $6{}^{1}2{}^{1}2$. Children need to use base ten blocks to put a visual image with the regrouping of 1 ten to ten ones. The exchanging activities using Chip Trading materials, pocket charts, and bundles of sticks are activities which precede using the manipulatives for modeling non-standard numerals. One digression is pertinent here. Learning disabled children often are asked to practice writing numerals as a way to remediate place value difficulties. They frequently write 71 for seventeen, reversing the position of the digits because of what is heard first in the spoken word. In looking at computer materials for children, the child is asked to enter a 7 followed by a 1 in a problem like 34 X 5. (The ones digit is entered first, then the tens digit and hundreds digit.) Thus, even though the child is thinking "seventeen", it is entered as 71. What effect computer practice will have on written test results is unknown. Software developers, when questioned about the apparent reinforcement of reversals, seem unconcerned. The programs sell and most children don't have any problems. However, it's ironic that such programs are designed for and used by many children with learning disabilities.

The Subtraction Algorithm

In teaching the subtraction algorithm, say an example like 732 - 197, the two methods discussed earlier come together. The first question to be considered is: Can 197 be a part of 732? Note that this is based on the meaning of subtraction as presented earlier. Once the affirmative answer is given, then each place in turn is examined with the question like: Can 7 ones be a part of 2 ones? If not, then what must be done? Answer: regroup 1 ten to 10 ones giving 12 ones in the total. Now can 7 ones be a part of 12 ones? Yes. What is the other part? Five. The question continues for the tens place. Can 9 tens be a part of 2 tens? No. Regroup 1 hundred to 10 tens, leaving 6 hundreds. The pattern for tens follows that for ones.

Notice that numeration terms are used appropriately and would normally follow this activity done with base ten blocks. The part-total language used is exactly what was learned with the basic facts. This method has been most successful with children receiving remediation at our clinic. However, the alternative model of using a comparison set is sometimes needed.

The Comparison Model

In setting up the comparison model for 7 - 3 = 4, the student first uses objects to model the 7, and then more objects to model the 3. The question <u>cannot</u> be is 3 a part of 7, for the three objects are separate from the seven objects. The question to be asked is: Can 3 (objects) be matched with a part of the total set of 7 (objects)? With this question, the child does "see" both the 3, and 7, but focuses on the unmatched part as the answer to the subtraction example. For some children, the comparison model is essential to an understanding of subtraction. Note that the part-total language is still used, and the model can be extended to subtraction beyond the basic facts.

In conclusion, I would like to make two suggestions regarding remedial strategies. One is to begin with the child's strengths and not always focus on the practice of symbolic end-product in this case subtraction computation. The second is to be critical of computers materials designed for the learning disabled child. Just because instruction is delivered with sound, graphics and interactive responses via a microcomputer does not make it appropriate for the learning disabled child in mathematics. As parents and teachers, you should demand software that is designed to meet the needs of all children. While it may be more expensive for software developers to design, test, and program, children deserve no less than the highest quality instruction that can be delivered by a computer.

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