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ABSTRACT

This paper discusses reading achievement in mathematics. Suggestions for improving the reading level of students in mathematics, as well as for reading abstract symbols, are given, including: assisting students in developing a mathematics glossary, having students write their own problems, diagnosing reading and writing, having students keep diaries, having students read and write mathematics test items, reading to solve word problems, and using computers in mathematics class. (MKR)

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Reading Achievement in Mathematics

by
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READING ACHIEVEMENT IN MATHEMATICS

There are problems in reading, unique to the academic area of mathematics. If a learner does not attain well, the problem may lie in the area of reading of subject mattor. Sometimes teachers may confuse ability with experience. Thus if a pupil is not attaining as adequately as the teacher would wish, the mathematics teacher may speak of the pupil as lacking in ability. Rather than lacking in ability, the pupil may lack background experiences which hinder in mathematics achievement. A rich background of experiences can certainly aid the pupil in attaining more optimally. I recommend very strongly that teachers provide a variety of rich experiences so that the learner may acquire knowledge and skills, as well as quality attitudes. All pupils need to experience success in the mathematics curriculum so that a better self concept evolves. Adequate background experiences should accrue so that improved reading in mathematics is an end result.

Improvement in Reading

Pupils do differ from each other in quality of reading exhibited in mathematics. Ideally, a learner should be able to read approximately 95- 98 per cent of the running words encountered without any previous practice. As the learner pronounces fewer than 95 per cent of the running words correctly, comprehension will tend to go downhill. If more than 98 per cent of the running words are read correctly, recreational reading is in evidence. This kind of reading is good for leisure time reading, but not adequate for continued growth to occur in reading. Thus with an approximate 95 to 98 percent of running words pronounced correctly without previous practice, there is room for growth in learning to identify additional new words. Those whose reading level, without previous practice, is below the 95 per cent of words pronounced correctly from the content contained in the reading selection may well need additional assistance. The assistance might come in the form of help given in pronouncing words correctly in mathematics. The teacher, another pupil, or a high school student who is a member of the Future

Teacher's Association (FTA) may provide this assistance. This assistance can give the help need for the pupil to do well in mathematics. I would recommend here that a pupil be given a chance to pronounce an apparently unknown word correctly. I recommend that a learner be given about five seconds to determine the unknown word before the teacher or an aid pronounces that word. Pupils do need time to ascertain what an apparent unknown word is in terms of pronunciation. The teacher wants to develop independent readers of mathematics content.

For all pupils, the mathematics teacher should identify unknown words and print these on the chalkboard clearly for learners to see. Undivided learner attention to these new words should assist pupils to recognize them when reading from the basal. The teacher needs to be certain here that pupils are on task and receive necessary definitions for understanding the meaning of these new words. Thus success in contextual reading may be possible for most learners. With this learning opportunity, pupils develop their reading vocabularies in mathematics to take care of the unknown words in the 95-98 running words category of words pronounced correctly without previous practice.

Should phonics be emphasized in the mathematics reading curriculum? I would answer with generally "no" it should not be. However, the teachable moment is there in which assisting a learner with a word in which an unknown consonant or vowel is in evidence may take seconds of a teacher's time to do a little bit of teaching in phonics to guide learners to read more proficiently in mathematics. As a whole, phonics instruction belongs in the language arts areas. But, increased relationship among different curriculum areas is being emphasized in teaching- learning situations, such as reading across the different academic areas. Phonetic analysis a part of the act of reading.

Reading Abstract Symbols in Mathematics

Starting with the kindergarten level and progressing sequentially through the ensuing school years, pupils need to read meaningfully numerals used in the basic four operations, the number names in word form, the abstract symbols for greater than and less than, parenthesis and brackets used in mathematics, radius, diameter, and radius squared, among others. Reading of these abstract symbols presents a unique kind of reading peculiar to mathematics alone. Thus reading the set of counting numbers — 1, 2, 3, 4, 5, 6, 7 ... represents skill in being able to read mathematics content and ideas. Or the operation of multiplication and addition that has the following expression: 3x7+5x4= indicates that reading is not always done in a left to right progression. Several of my teacher education students over the years have responded with 104 as being the correct answer to the above expression. A rule needs to be learned here in that operations pertaining to multiplication must be completed first prior to any operation in addition. The correct answer would then be 89 instead of 104. If a parenthesis is in evidence, then the operation is performed first pertaining to what is expressed therein, such as — 3x(7+5)x4= . The answer here is 144. In many cases then in mathematics, one does not read from left to right in sequence. There are definite rules to follow in performing operations on numbers. As additional examples, notice the following whereby generally most would start the operations from the right and move to the left:

$$\begin{array}{r} 134 \\ \underline{\times 84} \end{array}$$

Mathematics teachers need to provide a variety of rich learning opportunities when pupils encounter objectives pertaining to abstract symbols. Concrete materials should be used to guide pupils in understanding abstract symbols, such as in using markers (sticks, pencils, and seeds, among others) to show meanings attached to the concept of addition — Three pencils and four pencils are how many pencils all together? This could be shown also in the semiconcrete with pictures of three pencils and four pencils, among other illustrations. In the abstract, this would read 3+4= . With the use of concrete and semiconcrete materials of instruction sequentially, learners tend to understand the abstract better in order of learning activities applicable in teaching-learning situations. When viewing the number sentence 3+4=7, primary grade pupils should read the contents as the teacher points to the words in a left to right sequence. Being able to read mathematics content with understanding is of utmost importance. Otherwise, a pupil might have wasted his/her time in reading subject mater.

A Mathematics Glossary

Pupils with teacher guidance should have ample opportunities to become independent in attaching meaning to words read. With the use of context clues, the learner may ascertain the identification and meaning of a word by noticing the surrounding words within the sentence. If a pupil, for example, does not identify and know the meaning of the underlined word, the rest of the words in that sentence might take care of the unknown: The word pi is pronounce the same way as the pie that you eat. Pi has a value of 3.1417. I truly believe that most pupils would be able to attach meaning to the Greek symbol "pi" in context in these two sentences. The teacher then needs to assist learners to use context clues in reading mathematics subject matter. The use of context clues is a powerful means of recognizing new words as well as determining their meanings.

I would suggest that teachers assist pupils to develop a mathematics glossary individually or within a committe. This activity indicates that pupils can be authors and be empowered with their very own writing. Arranging words alphabetically is involved here as well as the correct spelling of words. Relevant terms need to appear in the glossary. Definitions for each word must be clear. Examples may clarify meanings of mathematics terms sooner than definitions. It would be good to use each term in a sentence within a contextual situation. If a learner forgets the definition/use of a term, he/ she may refer to the glossary. The glossary should be in loose-leaf form so that entries may be added as necessary. Pupils need to become independent in recognition of words and their respective meanings. It also saves the teacher's time when a pupil does not need assistance. The teacher might then provide help to those who need it to progress more sequentially. The mathematics glossary should assist pupils to become increasingly better readers than would otherwise be the case. Diagrams might be added to a term if this makes the meaning more clear and distinct. Mathematics does have its own unique vocabulary as well as words that intersect with other academic disciplines and yet the word may have a separate meaning pertaining to mathematics.

Pupils Write Their Own Problems

Some very successful classrooms in the teaching of mathematics that I have observed stress pupils writing mathematics problems. There are learners who do an excellent job of writing mathematics problems. Numerous educators emphasize the importance of writing across the curriculum. When pupils are actively involved in writing in mathematics, increased skills in written work are then being emphasized. I copied down several word problems that pupils have written in observational visits made to diverse schools. These are following:

1. Al had three shirts and his parents bought him two more. How many shirts did Al then have? This problem was dictated to the first grade teacher who in return wrote what was stated.
2. Tony's father had fifty- two dairy cows. Six were sold. How many were left? This problem was written by a third grader who lives in a rural area.
3. During vacation time, Mary's parents drove 612 kilometers the first day, 386 the second day, 456 the third day, and 511 the fourth day. How many kilometers were driven all together? This problem was written by a fifth grader pertaining to an imagined number of days driven.
4. Bill has a circular garden. If the radius is seven meters, what is the area of the garden? This problem was written by a sixth grade pupil.

Pupils can assist each other in proofing the final written product. Problems may be written individually or within a committee. If a pupil cannot not spell words well, this should not hold back a learner from active participation in writing in mathematics. Learners should assist each other in correct spelling of words. Reading of problems written by learners can be very satisfying to many pupils. When proof reading is done, pupils tend to read critically and creatively with the intent of solving problems and that is to write clearly stated content. Pupils need to experience a variety of reading situations in mathematics. The teacher may present a mathematics situation and have learners write the problem and also solve it. A teacher had sixth grade pupils look at a cylinder, a large empty fruit container, and ask for the volume of this container in cubic centimeters. An example of the final written problem as provided by a committee was the following:

An empty fruit can is shaped like a cylinder and is 45 centimeters high. The radius of the base or circle is 10 centimeters. How many cubic centimeters does the can hold?

For early primary grade pupils, the teacher may write what learners have given pertaining to a mathematics situation. Thus if the teacher shows two spoons in a set followed by two more spoons in a second set, how many are there all together? I have observed pupils who provided the necessary information clearly to the teacher. The teacher printed in neat manuscript letters that which the learners had presented orally for the mathematics problem. The problem in its final form can be printed in large manuscript letters on suitable paper and put away for future reading by learners. Pupils tend to like to read that which was completed previously.

Diagnosis in Reading and Writing in Mathematics

The teacher needs to diagnose weaknesses that pupils exhibit in writing. The specifics diagnosed should then be remedied. Which errors may learners then make in written work?

1. numerals that are reversed such as for 3, for 7, and for 2.
2. words or sentence parts that are reversed such as "was" for 'saw" or "He/she the numbers added" for "He/she added the numbers."
3. improper agreement of subject and predicate in writing word problems such as "He ride the bicycle" instead of "He rides the bicycle."
4. lack of proper arrangement of numerals for column addition

such as the one's, ten's, and hundred's columns not being aligned appropriately, thus making for errors in adding.

5. not copying a problem correctly from the basal text in order to solve it at the learner's desk.

6. failure to rename the minuend in subtraction when compound sul raction is being emphasized.

6. incorrect regrouping in compound addition when any column has a value of ten or more.

7. not identifying geometrical figures and shapes correctly so that areas and perimeters can be determined with the use of formulas.

8. incorrect procedures used in the basic four operations.

9. a general lack of neatness which hinders in responding correctly in written work in mathematics.

10. accuracy in written work not being in evidence.

There are many additional areas of diagnosis that can be mentioned here such as not writing the whole and counting numerals correctly; not using the commutative, associative, and distributive properties correctly in writing; being unable to regroup and rename in the basic four operations on number; not being able to count in writing by twos, threes, fives, and tens; not writing negative numerals correctly; and inability to attach meaning to content written.

The teacher of mathematics needs to observe daily work of learners carefully to notice errors made. Each error should be corrected unless it is minor in consequences. Accuracy, creativity, and interest are salient factors in reading and writing in the mathematics curriculum.

Diary Entries in Mathematics

Pupils individually or in committees may write diary entries pertaining to sequential days of instruction in mathematics. These entries might then be shared with others in the classroom setting. The following are examples of specific diary entries which are dated:

October 10. We worked on multiplying a fraction by a fraction. This appeared meaningless until the teacher showed the meaning of 1/2 times 1/2 = 1/4 . The teacher showed 1/2 of a circle. Then the 1/2 was divided into two equal parts to show the answer as being 1/4. Pupils were asked to think of how fractions can be used in everyday life. Everyone agreed that pies were divided into parts within a family and the portion size depended upon the number of family members. Then too, there are times when a part of the pie is left over for the next meal and needs to be divided among the number in the family whereby each may get a small slice indeed.

October 11. The teacher guided the class to review selected operations on fractions that had been learned previously. Thus the teacher showed pupils a cardboard pie divided into five parts. Each part was a fifth of the pie. The fifths were added to show a value of one. So one pie divided into five parts is equivalent to five fifths. This was very clear when viewing the whole pie being divided into fifths. There would then be five equal parts.

October 12. The teacher assisted us to understand that a mixed number can be changed to an improper fraction. If 1 and 1/2 circles are being considered, how many halves are there? The single circle was changed to 2/2's. Two halves and one- half can be seen as 3/2's with the use of the paper pie parts. The teacher assisted us to see practical application of division with fractions. Thus if there are five candy bars to divide among ten pupils, what fractional part does each receive? The actual candy bars or some other food items could actually be used to have learners attach meaning to the abstract fraction.

In addition to dairy entries, pupils individually or in committees may read and write log entries. Logs cover a longer period of time as compared to diary entries. A log could cover one week's amount of time given to the teaching of mathematics. The diary entries might then be used to write the log. Thus a summary of what has been learned will accrue. Logs are valuable to write due to the following:

1. main ideas need to be written to summarize content.

2. higher levels of cognition must be used by learners when writing main ideas which cover much content. For each day's recordings, one

main idea should be adequate. A main idea may even summarize a week of school work in mathematics activities.

3. specifics in written work may be stressed such as legibility in handwriting, correct spelling of words, proper paragraphing, quality sequencing of ideas recorded, and neatness of the final product being in evidence.

4. logs, as well as diary entries, may be saved for future reading by pupils.

5. committee skills may be developed by learners if rules are developed prior to group endeavors. The rules need to be enforced.

The teacher should have pupils read and write for a variety of purposes in mathematics. Mathematics content is retained for a longer period of time if it is used such as in written work. Learners tend to forget that which is not or rarely used in every day life. Pupils tend to remember what has been learned if it is used in diverse ways.

Reading and Writing Test Items

Pupils can use what has been learned through the reading and writing of test items in mathematics. Multiple choice test items might be written when pupils reveal readiness factors. Each multiple choice test item usually has a stem and four responses, one of which is correct. The stem together with each of the four responses should be grammatically correct. The following model of a multiple choice item may be used by pupils:

Which of the following shows the intersection of two or more circles?

(a) the formula for the area of a circle.

(b) Venn diagrams .

(c) the commutative properties.

(d) the property of closure.

Each response must be plausible in the multiple choice test item. For example, if Mickey Mouse had been listed as a response, the concept of being plausible would have been violated. I believe the above test item makes it so that learners need to differentiate each response. Pupils should learn to write test items in mathematics to be exchanged with others to notice achievement. Learners need to be assisted to notice when trivia gets in the way of developing quality in test item writing.

Essay test items may be written by learns for others to respond to. Essay items need to be adequately delimited so that a general, clear cut answer can come from the learner. The other extreme is to write the essay test item so that it is completely factual and involves little in terms of higher levels of thinking. Notice the following essay item which is too broadly stated: Discuss addition. This item is so broad that an entire book could be written on the concept of addition. It does not delimit what a pupil is to write about addition. The following is so delimited that a fact is wanted instead of a discussion: What is the answer to 269 plus 186? This number pair could be written in a computation section of the test. The following is adequately delimited and permits higher levels of cognition: Discuss the differences in finding the area of a circle and the volume of a rectangular solid. Determine at least five differences.

Additional test items that learners may write in mathematics include matching, true- false, and completion. Peers may assist each other in proofing test items written. Improvement in clarity and meaning of each test item is vital. Improvement in reading and writing in mathematics is a salient end result.

Reading to Solve Word Problems

Word problems, also called story problems, in textbooks may provide selected difficulties to pupils. In solving word problems, a first step is that pupils comprehend the abstract symbols which make for words and sentences. Being able to read with meaning is a very first step in solving word problems. Second, pupils need to possess background experiences in solving these word problems. Background experiences provide readiness for problem solving in mathematics. Third, pupils need to understand what is being asked for in the word problem so that problem solving can come about. Fourth, leaners need to view the problem in a holistic manner in that salient ideas are needed from the entire word problem in order that solutions may be found. Fifth, mathematical operations need to be performed to arrive at an answer. The answer should be perceived as being tentative. not an absolute. Sixth, the pupil needs to reflect upon the tentative solution(s). Thus the learner looks at weaknesses that might be inherent in the solution. Pe study of the tentative answer has many benefits. Pupils must be able to explain why they did what was done in securing the necessary answer.

Computer Use in Mathematics

Computer use should be an inherent part of learning opportunities for pupils so that objectives might be attained more effectively. Carefully selected programs which emphasize simulation may benefit learners much in the area of problem solving in mathematics. Tutorial programs can guide pupils to achieve new content sequentially in ongoing units of study. Drill and practice programs should assist learners to review what has been acquired previously. Diagnosis and remediation programs attempt to pinpoint that which has caused difficulties for learners in ongoing lessons and units of study. Remedial work should follow the point of diagnosis. Games in terms of mathematics programs provide enjoyment in mathematics as well as extend content studied previously. Each program should assist pupils to attain sequentially and meaningfully. Interest in learning mathematics is vital and salient.

When readiness is in evidence, pupils need to experience the use of the word processor in writing as well as in reading of subject matter in mathematics.

In Closing

Pupils need to experience a variety of reading activities in mathematics. There are commercially published materials for pupils to read. These should be on the understanding levels of individual learners. If the reading level therein is too complex, the pupil will not comprehend the contents. Feelings of frustration and failure may be an end result here. Should the commercial reading materials be too easy to read, boredom and a lack of challenge may enter in.

There are numerous opportunities to read what pupils have comprehended from a variety of concrete and semiconcrete experiences and put in written form. Here reading and writing become one, not separate entities. What has been written may be saved for future reading by learners. Adequate background experiences assist pupils to be able to record ideas in written form. Learners need to practice the skill of reading so that it is continually refined. Mathematics has its very own terms that are unique to this academic discipline. It also has its own areas of concern, such as problem solving, which makes it imperative that learners learn to read mathematics content with meaning and understanding.

Selected References in Mathematics

Ediger, Marlow. Teaching Mathematics in the Elementary School (A Collection of Essays), ERIC Clearing House— Resources in Education, 1985.

Kennedy, Leonard M. and Steve Tipps. Guiding Children's Learning of Mathematics. Seventh Edition. Belmont, California: Wadsworth Publishing Company, 1994.

National Council Teachers of Mathematics. Curriculum and Evaluation Standards for School Mathematics. Reston, Virginia, 1989.

National Council Teachers of Mathematics. Student Math Notes. Reston, Virginia, 1989.

National Council Teachers of Mathematics. An Agenda for Action. Reston, Virginia, 1980.

National Council Teachers of Mathematics. The Mathematics Education of Exceptional Children and Youth, an Interdisciplinary Approach, Reston, Virginia, 1981.

Slavin, Robert. "Student Team Learning in Mathematics, in Neil Davidson (Editor), 1990, Cooperative Learning in Mathematics Menlo Park, CA: Addison- Wesley, pp. 89- 97.