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ABSTRACT

The extent of any relationship of problem solving in mathematics to reading was investigated. A review of similar research studies indicated a need for further research because of the lack of agreement among authorities concerning this relationship. Two contrasting populations of third-grade students were selected for the study. One group was from a city school in a large metropolitan area in western New York. The second was from a village school in a farming community in northern Indiana. All were from upper-lower and lower-middle class backgrounds. The children were given reading and arithmetic tests, and the correlation coefficients were computed. In each instance, the total reading and problem-solving achievement scores were converted to percentile ranks. A positive relationship between problem solving in arithmetic and reading was found for both groups, but it was not judged to be of sufficient magnitude to be an accurate predictor of performance of one variable from the other. It was, however, concluded that the arithmetic teacher must teach certain reading skills. Tables and references are included. (NH)

MATHEMATICS TEACHER - A READING TEACHER?

Virginia R. Harvin and Mary A. Gilchrist

INTRODUCTION

Problem solving in mathematics continues to be a concern of elementary teachers. A question remains, "Do children have difficulties in problem solving because they have reading difficulties?" To investigate this area of concern, this paper purposes to investigate to what extent problem solving is related to reading. There seems to be a need for this study:

1. The tendency in our elementary schools is toward the use of a new approach to mathematics.
2. The new discovery approach involves the introduction of new terminology and vocabulary.
3. Pupils are required to read and to solve a mathematical problem independently.

Reading in arithmetic is somewhat different from the reading in other subject areas. It is generally agreed that arithmetic problems are usually compact. The reading may be complicated by the intermingling of words and numerical symbols within sentences. The problem is further complicated by the use of technical terms, the inclusion of familar words which have particular mathematical connotations, and difficult words which have no particular arithmetic meaning but which are germaine to the setting of the problem. Teachers advise students to read problems carefully before attempting to solve them. The correct interpretation is an important factor before students attempt the manipulation of given data to formulate an answer. It occurs that a reading barrier may exist before the pupil begins to solve a given arithmetic problem.

Regardless of what the problem is, whether graphic, geometric or pure mathematics, the problem is stated in words that are to be read and understood before problem solving. Every problem begins with words that tell the story involved. This is then followed by a series of numbers or mathematical symbols, or values, and finally the reader is asked to solve the problem.

BACKGROUND

It seems quite evident that reading is a very important factor in problem solving, if a child is to be efficient in arithmetic. The importance of reading in the

arithmetic program is stressed in the Journal of Reading, "Reading in Mathematics," by I. E. Aaron (1). Aaron identified several specialized reading skills unique to mathematics:

1. The mathematics' vocabulary.
2. The concept background necessary for understanding ideas.
3. The ability to select skills and rates appropriate for the mathematics being read.
4. The proficiency in the special reading tasks of mathematics such as reading word problems, equations, charts, graphs, and tables.
5. The skill in the interpretation of mathematical symbols and abbreviations.

Aaron seems to suggest that systematic attempts to develop specific reading skills in mathematics will result in better readers and higher achievements in mathematics.

The Journal of Educational Research cites a study done by Carrie M. Scott (12). Part of the study was to learn whether a gain in reading achievement was related to a gain in arithmetic reasoning. The highest correlation in this study was between intelligence and arithmetic. Findings indicated that improved reading ability may lead to improvement in arithmetic, social studies and science.

Carison (2) reported a study done in California. The investigation produced a summary related to reading and mathematics. The study reported that when a mean I.Q. and

reading score were analyzed for children classified by level of reading and computation ability, a direct relationship was found between I.Q. and reading ability and between I.Q. and computational skill. It was found, too, that when intelligence was controlled, both higher levels of computation and reading resulted in higher scores in problem solving. It was claimed that computation in arithmetic was a more important factor in problem solving than was reading ability.

In the investigation conducted by Muscio (10) the purpose was to determine the relationships between sixth grade pupils' quantitative understanding and certain mental abilities. One concern was reading ability and arithmetic achievement. After the testing was evaluated, one of the findings stated: "Achievement on the measure of quantitative understanding is closely related to achievement in measures of general reading ability." (10:261).

Another study related to arithmetic and reading was reported in 1964 (8). This study placed emphasis on solving verbal problems in mathematics. The researchers concluded that practical arithmetic experiences had a greater bearing on problem solving than did reading.

The importance of vocabulary as a part of the reading problem found in problem solving has been underscored by various analyses of vocabulary in arithmetic

textbooks. From studies such as those reported by Heddens and Smith (6), Stauffer (15), and Repp (11), it might be concluded that there is:

1. A lack of commonality of words introduced at a given grade level between basic reading series and arithmetic series.
2. A lack of commonality of technical words used at a given grade level among arithmetic series.
3. A failure to keep the reading load compatible with the grade-level assignment of the arithmetic material.

When one considers the amount of encoding and recoding which the young reader must do in order to read his way to a solution to a problem, it becomes evident that the arithmetic teacher has a particular responsibility.

Other writers, Lyda and Duncan (9), Johnson (7), Hansen (4), and Treacy (16), give support to the theory, vocabulary is important to problem solving. Vanderline wrote, "The precise nature of the relationship between language factors and successful problem solving is not sufficiently understood." (17:144)

A review of the foregoing studies reflects a lack of agreement among authorities. This suggests that further research would be of value in attempting to discover the relationship between problem solving and reading

PROCEDURES

The subjects selected for the study consisted of two contrasting populations of third grade children. One group (N=121) was selected from a city school in a large metropolitan area in western New York while the other group (N=93) was drawn from a village school in a farming community in northern Indiana. Both groups were classified by their principals as coming from upper-lower and lower-middle class backgrounds. All the subjects were taught in heterogeneously grouped, self-contained classrooms. The subjects were the total population of the third grade in their respective schools. Data were found for each self-contained class in the New York system as well as in the Indiana system. In this study, these classes will serve as the sub-groups, A, B, C and D.

The instruments used for the New York group were reading and arithmetic tests, Form A, recommended by State Education Department for use in the elementary schools in New York state. The Indiana group was measured with the Stanford Achievement Tests, Form W. In each instance, the classroom teacher administered the tests following the directions prescribed in the respective manuals.

Correlation coefficients were computed for the sample populations. In each instance the total reading and problem solving achievement scores were converted to percentile ranks. The test manuals were used to make this conversion.

RESULTS

To determine the significance of the relationship between achievement in problem solving and reading, correlation coefficients were computed for the sample population. When total reading and problem-solving achievement scores were converted to percentile rank, the relationship was found to be .761 for the total New York sample (N=121). The data were analyzed also to determine the relationship for each of the four subgroups contained within the sample. The correlation coefficients for Group A (N=30) were .377, for Group B (N=31) .706, for Group C (N=29) .799 , and for Group D (N=31) .515.

A correlation coefficient of .612 was found for reading and problem solving when the data were analyzed for the total Indiana group (N=93). When the data were analyzed for the four subgroups contained within this sample, the correlation coefficients for Group A (N=24) were .582, for Group B (N=24) .576, for Group C (N=22) .704, and for Group D (N=23) .641. Table I presents this data.

TABLE I

CORRELATION COEFFICIENTS FOR TOTAL READING AND PROBLEM SOLVING

Group	A	B	C	D	All
New York	.377*	.706	.799	.515	.761
Indiana	.582	.576	.704	.641	.612

*$p < .05$, all others $p < .01$ (3); n=range 22-31; N=121, 93

Since a correlation coefficient is not a proportion, the degree of relationship between reading and problem solving may be more meaningful if thought of in terms of the square of the correlation coefficient. Table 2 presents this data.

Table 2

r^2 FOR TOTAL READING AND PROBLEM SOLVING

Group	A	B	C	D	All
New York	.142	.499	.638	.265	.579
Indiana	.339	.331	.496	.410	.375

Examination of Table 2 indicates that the degree of overlap in the relationship between reading and problem solving is approximately 58 per cent for the total New York group. For the total Indiana group, only 37.5 per cent of factors measured were shared in common in total reading and problem solving. The percentage of total association between reading and problem solving tends to be less than 50 per cent.

SUMMARY

1. A positive relationship between problem solving in arithmetic and reading was found for two heterogeneously-grouped, third-grade populations in two distant geographic areas.
2. Although a relationship between problem solving and reading was found, it was not of sufficient magnitude to be an accurate predictor of performance of one variable from the other.

3. Both high-and-low-achieving readers were included in the sample. The correlation coefficients indicated that the high achiever in reading was not necessarily the high achiever in problem solving. The low-achieving problem solver, in contrast, was not necessarily the low-achieving reader as measures on these particular instruments. This may mean that the reading skills of the high achiever in reading do not necessarily serve him with equal facility in the problem-solving situation. On the other hand, the skills learned in reading were those needed in problem solving in mathematics.

4. The particular reading skills, or special application of those skills in the mathematics setting necessary for success in problem solving, remain for further investigation.

5. Factors which may need future consideration in the study of the association between problem solving and reading are the precise nature of the terminology of mathematics as well as the discrepancy which may exist between problems in achievement tests and problems studied in the classroom.

6. The study indicates teachers must teach reading in mathematics. While the regular reading program provides instruction in basic word attack and comprehension skills, the arithmetic teacher has the responsibility to develop, in context, the special vocabulary needed for comprehension. He also has the responsibility to reinforce certain comprehension skills as selection and

organization of relevant detail, identification of process, perception of relationships, and inference in their particular arithmetic setting.

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