The effects of instruction in problem-solving strategies including reading word problems on student achievement in solving word problems

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THE EFFECTS OF INSTRUCTION IN PROBLEM-SOLVING STRATEGIES INCLUDING READING WORD PROBLEMS ON STUDENT ACHIEVEMENT IN SOLVING WORD PROBLEMS

AN ABSTRACT
SUBMITTED TO THE FACULTY OF THE SCHOOL OF EDUCATION, ATLANTA UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF SPECIALIST IN EDUCATION

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APRIL 1986
The purpose of the study was to determine if there was a significant difference between the traditional method and the experimental or structured method of instruction in word problem solving and translating them into almost wordless sentences. Two groups of ninth graders in a general mathematics course on reading and solving word problems were selected for the study. At the beginning of the study a pre-test for achievement differences was administered. The test results indicated there were no significant achievement differences between the groups when the test was initiated.

Word problem solving instruction was given to the experimental group, but the control group was allowed to ask questions only for clarification of the problems which possibly enabled them to pick up ideas on how to analyze word problems during the questioning session. The treatment consisted of problems on how to find discounts, commission, interest and sales tax. The t statistic and a .05 level of significance were used. A posttest was administered to both groups after the treatment, and the findings of the test results indicated that there was no significant difference in achievement. Therefore, teaching the reading of word problems did not affect the experimental method more than the use of the conventional method.
of data indicated that there was no significant difference in achievement between the two groups.

It was suggested that because the control group was permitted to ask questions, students in that group may have learned how to analyze word problems during the questioning sessions.

It was recommended that there should be more interaction between students and teachers through questions and answers during word problem-solving instruction. Teaching word problem solving should begin early in the elementary school and sequentialized in the middle and high school. In-service teaching on word problem solving should be provided. Calculators should be used by students only after they have mastered the basics of arithmetic.
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ACKNOWLEDGEMENTS

The writer wishes to acknowledge his indebtedness to Dr. Ruby Thompson, Dr. Ralph Frick, Mrs. Miriam Jellins, Dr. Charles Davis, and Dr. Mary Atwater, who served as the committee for this study.

Also, many thanks are given to Dr. Olivia Boggs and Dr. Harriet Walton, who gave encouragement and valuable suggestions for this research.
CHAPTER I

INTRODUCTION

Rationale

In recent years, problem solving difficulty among students appears to have increased significantly. This increase demands a more complete look be taken at possible factors that will assist in the alleviation of this problem.

Osborne and Kasten received financial support from the National Science Foundation to prepare a report on problem solving in the curriculum for the 1980s. They conducted a survey of the opinions of professionals and lay persons about the importance of nine curricular strands in mathematics. Of the nine strands, problem solving received the highest priority rating. The researchers summarized the report with these conclusions: Problem solving should receive more emphasis in the school mathematics program during the coming decade. The instructional strategies

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should be geared to (1) translating a problem to an equation, (2) constructing a table and searching patterns, (3) drawing pictures or diagrams to represent a problem, and (4) solving a simple problem first and extending the solution to the original problem was identified as appropriate content for both the secondary and elementary school level. However, there was no explicit teaching methodology recommended for problem solving by any group. It was emphasized that problem solving is important for all students and should begin early in their mathematical experience. Also, it was recommended that a modification of the mathematics curriculum in problem solving be made for special groups, such as women, college bound and ethnic minorities.

Mervis stated that the skills necessary to solve word problems should be taught in school; how well these skills are developed determines whether a child will also solve problems of growing complexity.¹

Because of prominence of problem solving in the curriculum as validated by national surveys, because of the continued problems which students encounter, and because of the responsibility of the teacher in developing problem solving skills, it is obvious that all avenues related to the area should be explored. One significant area is in word problem solving.

Evolution of the Problem

Based on the writer's experiences, it was theorized that if direct instruction given in word problem solving is presented at students' verbal levels of comprehension, then students would achieve at a higher level in word problem solving. Hence the evolution of the problem is an outgrowth of the writer's awareness of this national problem as it is manifested in his educational setting and of his experiences in teaching word problem solving to high school students.

In the fall of 1981 a pilot study was conducted with 52 students from a total of 407 ninth graders randomized into 16 sections by computer. One section was called a control group, the other, an experimental group.

At the beginning of this project, all students were assumed to be equal relative to age, and mental ability, etc. No pretest was given. But, during the two-week period, quizzes were administered to determine the amount of reteaching of concepts on word problem solving before the posttest.

The findings from the pilot study suggested that teaching word problem solving employing a structured method appeared to increase problem solving achievement among high school students. The results also suggested that reading ability is a factor in solving word problems. The results of the pilot study supported the research design and
experimental procedures as well as the study time and instruments.

**Purpose of the Study**

The main purpose of the study was to determine if direct, systematic instruction in word problem solving is an effective approach to strengthening student skills in this area.

**Statement of the Problem**

The problem addressed in this study is embodied in this question: Is there a significance difference in the word problem solving achievement of students given direct instruction in word problem solving and students given incidental instruction?

In order to answer the question, the following hypothesis was tested:

There is no significant difference in mean achievement scores on a word problem solving test between students who are taught word problem solving and students who are not taught word problem solving.

This study examined differences in achievement scores resulting from two different treatments in mathematics instruction.

**Definition of Terms**

1. A word problem is a verbal arithmetic which involves the use of computations to find an unknown solution.
2. Problem solving is defined as a situation in which an individual or group is called upon to perform a task for which there are no readily accessible algorithms which determine completely the method of solutions.¹

3. Instructional strategy is defined as a composition of displays or a sequence of displays, and the relationship among the displays that are presented to the student.²

4. Achievement refers to learners' status on a teacher-made test.

5. Non-verbal problems refer to computational problems.

Limitations of the Study

At least two limitations were recognized as inherent in this study: (1) the individuals were not randomly assigned to groups, and (2) the validity of the instruments used was assumed since problems on the instruments were selected from the textbook.


Contribution to Educational Knowledge

The results of the study should answer pertinent questions about instruction in problem solving and should enable educators to make decisions about course content and the place of problem solving in mathematics curriculum. Various studies have presented numerous strategies and suggestions for helping students overcome difficulties in problem solving. These studies recommended no particular method to alleviate the problem, but they emphasized that concrete procedures should be employed to simplify problem translation at students' level of comprehension.
CHAPTER II

REVIEW OF THE LITERATURE

Introduction

The literature has been summarized and reported under three headings: (1) Student Achievement in Problem Solving, (2) Verbal Problem Solving, and (3) Instructional Strategies for Problem Solving.

Student Achievement in Problem Solving

Charles and others presented some findings on 12 fifth-grade and 18 seventh-grade teachers implementing a mathematical problem solving program for 23 weeks. Eleven fifth grade and 13 seventh grade teachers taught control classes. The experimental classes scored significantly higher than the control classes on measure of ability to understand problems, plan solution strategies, and get correct results. Trend analysis showed different student growth patterns for the three measures of problem solving performance. Data from interviews with teachers supported the results of the quantitative analysis and suggested that
both students and teachers had changed positively with respect to attitudes toward problem solving. ¹

Moyer and Moyer did an investigation on whether there is a difference in the performance of children in grades 3-7 on story problems presented in a verbal format and a reduced telegraphic verbiage format and whether any difference in performance across formats might be related to problem solving ability. Students in each grade were administered a different pair of test forms with problems in the verbal format and problems in the telegraphic format. Findings indicated that the telegraphic format did not facilitate performance on story problems. In fact, the researchers stated that the format with a conventional syntax appeared to be easier to interpret for students of high ability.²

Carpenter and others examined children's solutions to simple addition and subtraction word problems in a three-year longitudinal study that followed 88 children from grades one to three. The children received instruction in addition and subtraction strategies based on three levels of abstraction: direct modeling, counting and number fact strategies. They were asked to solve six types of problems


and were interviewed periodically during each school year. It was found that the children were able to solve the problems using a variety of modeling and counting strategies even before they received formal instruction in arithmetic. Four levels of problem solving ability were found. At the first level, children could solve problems only by externally modeling them with physical objects. Modeling strategies were gradually replaced with counting strategies.¹

Durch and others examined the effectiveness of a method that teaches fourth graders to translate word story problems into mathematical equations form in a step by step explicit manner. This translation method was compared to a method developed from a composite of the four basal arithmetic texts adopted for use in the state of Oregon. The present study also examined the effects of providing extra lessons to students who failed to master each of three units in the eleven lesson curriculum packages. The target population was seventy-three skill deficient fourth graders, who were randomly assigned to four teaching conditions. The dependent measure was a twenty-six item test that asked children to translate word problems into equations. Post-test results indicated a sufficient positive effect, but no effect for provision of extra review lessons regardless of teaching method. On a test administered two weeks later,

the children in the explicit group had received extra lessons performed significantly better than children in the comparison groups.¹

In a study conducted by Clute, it was found that students with high mathematics anxiety tend to score lower on a mathematics achievement test than the students with low mathematics anxiety. She reported that anxiety level appears to be a factor that needs to be considered in predicting mathematics achievement. She stated that confidence in one's ability to learn mathematics is significantly correlated with mathematics achievement. If one lacks confidence in one's ability to perform mathematical tasks it seems reasonable to conclude that there is a lack of respect for or trust in one's own instincts or judgements when it comes to learning mathematics. However, the results of the study may provide new evidence that high anxiety students may benefit more in terms of achievement when taught using an expository method or well-structured controlled plan for learning, whereas low anxiety students may benefit more when taught by a discovery method. Students high in confidence tend to have more interactions with their teachers concerning mathematics than students low in confidence do.²


²Pamela S. Clute, "Mathematics Anxiety Instructional Method and Achievement in a Survey Course in College
Roberge and others did a study on the effects of field dependence-independence or the level of operational development of the mathematics achievement of children in the lower elementary school grades, which involved the administration of concrete operational tasks such as classification, conservation and seriation. The study examined the influence of these factors on the mathematics achievement of 450 sixth-eighth graders by using formal operational tasks such as combinations, propositional logic and proportionality. Data were analyzed using total mathematics achievement test scores as well as scores on subtests of computation, concepts, and problem solving. Field-independent students scored significantly higher than field-dependent students on the total mathematics concepts, and problem-solving tests. High-operational students scored significantly higher than their low-operational peers on all tests. The findings of the study suggested the need for investigation of different approaches to instructional design that should be geared to the developmental capacities and cognitive styles of the individual learner.1


in mathematics versus verbal areas. It was proposed that certain academic areas in mathematics are more likely than others to pose difficulties at the start; therefore, the necessity of surmounting difficulties favors certain achievement orientations. To test the hypothesis that children's academic orientations interact with the demands of academic material to determine performance, 57 male and 37 female fifth graders were classified as helpless or mastery oriented on the basis of their attributions, and assigned one of two learning conditions. One condition involved programmed confusion during learning, while the other was a non-confusion condition. When the learning task contained confusing material in the initial sections, students with a mastery oriented style significantly outperformed those with a helpless style. However, when the identical task was presented without the confusing material, both groups learned with equal facility. Results support the notion that achievement differences can result from the fit between children's achievement orientations and the demands of particular skill areas.¹

Shields and others obtained data from thirty-two 29-36 year old low-income black parents and their thirty-five 8-13 year old children, the latter of whom were designated as good or poor readers by the Spache Diagnostic Reading

Scales, Howard University Phonics Test, and Morrison-McCall Spelling Scale. It was hypothesized that (1) there would be differences in the input of low-income parents of good and poor readers; (2) there would be differences in educational beliefs and practices of low-income parents of good and poor readers; (3) good readers would have different self-perceptions of themselves; (4) there would be differences in parental practices reported by good and poor readers; and (5) there would be no differences in responses of parents and children to interview questions. Results showed major differences between parents of good and poor readers in practice but not in knowledge or belief categories. The only significant difference in educational belief and practices of low-income parents of good and poor readers was ownership of references. Successful readers were more aware of their reading strength and tried to figure words out themselves. Parental practices found to be significant for children included providing educational books, school visitation, and rewards for good grades. Parents and children differed in their responses to interviews. Thus, low-income black families with successful readers tend to embrace middle-class educational traditions.

Verbal Problem Solving

Bosel examined how the formulation of a problem affected problem solving in groups of tenth, eleventh, and twelfth grade students. He found that presentation of a mathematical problem in colloquial language can be complicated by several factors such as complex sentence structure, the addition of irrelevant information, information referring to incorrect solving model or any combination of these.

Eight different formulations of the same problem, which included the addition of irrelevant information, were presented to groups of 114 high school students; each formulation was presented to 13 or 14 students to investigate which factors influenced problem solving abilities.

Results showed that the complexity of sentence structure had little influence on problem solution and problems in which the irrelevant information was well integrated into the text, or when the figures of their irrelevant information corresponded with figures in the main text to show an 11 to 12 percent higher error quotient. The older students were more likely to come up with an erroneous solution due to the addition of irrelevant information. Since they took the test at the end of the day, this deviation may have been due to an unplanned fatigue factor.¹

Pace implied that if students are to have any success with verbal problems, they must have some understanding of the fundamental processes. She insisted that students should be free to use different processes and the teacher should provide for the development of the understanding of the fundamental process. She indicated that the development of understanding is a gradual process and cannot be treated in terms of money. Therefore, she concluded that students show gains in problem solving ability by practicing or doing.¹

Burns and Reidesel suggested that problem solving be approached by giving the learner verbal problems without numerals, thus allowing the learner to analyze the problem to determine what method should be used to arrive at a solution. They also recommended that this procedure be followed by presenting problems with numerals and allowing the student to formulate a verbal problem without numerals from it.²

Banks argued that problem solving is not devoted to computational skill alone, but identified problems as verbal statements and exercises as numbers and operational signs. He believed that problems lend numerous drill


experiences and the time spent on problems is a good investment. He suggested further that problem solving ability requires sufficient and coherent body of knowledge. He feels that through concrete practical situations the child develops mathematical abstractions.¹

Earp contended that the reading teacher specialist can effectively work on some content skills, but the only place to teach some of the reading pertinent to a content area is in the class dealing with that material. For any student to achieve problem solving, he must have the proper conceptual background for understanding the verbalism and the arithmetical symbolism before he can read effectively. The child who has a weak conceptual background in vocabulary signs and symbols of arithmetic will read poorly no matter how much reasoning instruction he has had.²

In reference to reading procedures, the following steps are widely prescribed in literature on problem solving:

1. Use a first reading to visualize the situation, to get a general grasp of it.

2. Reread to get the facts, paying particular attention to the information given and the key question which is the

¹Houston Banks, Learning and Teaching Arithmetic (Boston: Allyn and Bacon, Inc., 1965), pp. 404-415.

basis for programming the problem

3. Note problem vocabulary or concepts and explore these with the help of the teacher.

4. Reread as a help in planning the steps for solution.

5. Read the problem again to check your procedure and solution, to note if all work has been done.

Henny held that children must be able to recognize words and comprehend thought units in the problem, logically interpret the problem in such a way as to lead to an answer to the stated question. Computational skill is definitely necessary, but it is useless without the ability to read the problem accurately.¹

Henny also noted that in mathematics the style of writing is quite different from that usually found in narrative materials. It is compact and lack of rich content which makes word identification difficult. Reading verbal problems requires more intense concentration than that needed for reading narrative materials. Time must be taken to reflect on what has been read, to search for relations in the information given and to apply appropriate mathematical skills for the solution of the problem.²

She recommended that a special reading program be designed for the mathematics department as follows:


²Ibid.
1. Analyze grammatical structure of problem
2. Recognize and comprehend words out of context.
3. Visualize the situation to decide what the problem is about and compare it in terms of the child's experience.
4. Finding the main idea, noting details, recognizing relevant information, and referring relationships.

Other suggestions in problem solving, produced as a service to schools by the Laidlaw Brothers, are as follows:

Steps to Success in Problem Solving

Read

Be sure you understand the problem.
Retell it in your own words if necessary.

Ask

1. What must I find?
2. What information is given?
3. Do I have all the information I need?
4. Is there extra information I don't need?

Plan

Pick a strategy or strategies to help you solve the problem, such as:
1. Choose an operation
2. Look for a pattern
3. Guess and check
4. Ask questions
5. Use a model or act out the problem
6. Organize information
7. Make a drawing or diagram
8. Solve a simpler problem
9. Check for hidden assumptions
10. Logical reasoning
11. Use probability and prediction
12. Work backwards
13. Use a formula
14. Estimate an answer

Compute

Carry out your plan.
1. Do any computation
2. Complete a table, graph, or drawing if you need to.
Answer

1. Use the result from step 3 to answer the question posed in the problem.
2. Write your answer in a sentence.
3. Write the answer in terms that fit the problem such as dollars, meters, days and so on.

Check

Look back at the problem.
1. Is the answer reasonable?
2. Are the computations correct?
3. Estimate a reasonable answer if that helps you check.

Earle insists that reading in mathematics is centered around the following definition:

Reading involves the visual perception of written symbols and the transformation of the symbols to their explicit or implicit oral counterparts. The oral responses then act as stimuli for a thoughtful reaction on the part of thought induced by the stimuli as determined, in part, by the intent and the background of the reader and nature of the materials. In addition, the effort expended in the perceptual act and the intellectual impact of the written materials on the reader are influenced by his interest in the specific selection and by his attitude toward reading in general.

He believes this definition can serve as a base for any mathematical reading. And it is comprehensive enough to be used by teachers who are not reading specialists. In addition, he strongly supports the proposition that success of any mathematical reader requires the following levels of activities:

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1Steps to Success in Problem Solving, in the Using Mathematics Program (Chamblee, Ga.: Laidlaw Brothers, Publishers).


3Ibid., p. 6.
Perceiving Symbols - accurate recognition and pronunciation of any words or other symbols essential to a particular objective.

Attaching Literal Meaning - the student must locate and identify symbols integral to a given task and assign meaning to them by sorting out his prior knowledge or by seeking new knowledge. He must note the order of symbols in a particular task and seek clarification if their placement is not in proper perspective.

Analyzing Relationships - sometimes students are required to identify important unstated relationships among literal facts; if they indicate a weakness in this area then it is the role of the teacher to focus the student's attention on the essential literal statements, help note missing or superfluous details, and provide hints as to the type of relationships for constructing and using a structured overview—as follows:

A. Analyze the vocabulary necessary for the learning task and list all words that are representative of the major concepts that we want students to understand.

B. Arrange the list of words which show the interrelationships among the concepts particular to the learning task.

C. Add to the vocabulary concepts those concrete ideas we believe are understood by students in order to show relationships between the learning task and the discipline as a whole.

D. Solving word problems

Step 1. Read through the problem quickly. Try to obtain a general grasp of the problem situation and visualize the problem as a whole. Don't be concerned with the actual names, numerals or values.

\[\text{Ibid.}, \text{pp. 33-34.}\]
Step 2. Examine the problem again. Try to understand exactly what you are asked to find. This may be stated as a question or command. Although it often comes at the end of the problem, it may appear anywhere in the problem.

Step 3. Read the problem again to note what information is given. At this point you are looking for exact numbers and values.

Step 4. Analyze the problem carefully to note the relationship of information given to what you are asked to find (steps 2 and 3). Note information which seems to be missing, also surplus information.

Step 5. Translate the relationships to mathematical terms. Indicate both the values and operations. This almost always involves planning a sequence of steps which correspond to the operations. The end results will be one or more mathematical sentences or equations.

Step 6. Perform the necessary computations.

Davis emphasized that many children find story problems one of the most difficult challenges in mathematics and do not like them. He says that success leads to positive attitudes and so we must begin with success by eliminating any obstacles to improving children's successful skills. Some effective methods are:

1. Creating appropriate problems--create and use problems that are not trivially easy or beneath the dignity of the children.
2. Acting out and representing problems--acting out or representing a problem to help children understand the problem's applicability to real life. Occasionally change the problem statement and leave the wording unchanged, but provide additional aid which will assist children to master the real situation the problem is describing.
3. The importance of explaining--there will be some children who get it and some who don't. Therefore,
it is the responsibility of the teacher to clarify the process that fits the problem.¹

In the study of the effects of special reading instruction, Henney divided 179 fourth graders into two groups. Over a period of nine weeks, Group 1 (N = 88) received 18 lessons in reading verbal problems. On alternate days during this time period, Group 2 (N = 91) studied and solved verbal problems in any way that they chose under the supervision of the same instructor as Group 1. Although both groups improved significantly from pretest to posttest on a verbal problems test, the difference between the mean posttest scores of the groups was not significant. However, the girls in Group 1 made a higher mean score on the verbal problem posttest than the boys in that group.²

Instructional Strategies for Problem Solving

Johnson did a study on the implementation of computing in school and college mathematics. The major interest was computer programming by students in a laboratory like context: can this contribute to the learning of selected concepts and problem solving? He found a


large-scale research using the Foster Instrument on 5,000 students in grades 7-12 to determine whether the findings could be replicated in a large or less controlled setting. His findings supported the conjecture that more computing means better performance on the problem solving test.¹

Wheatley did a study to compare problem solving processes of 6th grade pupils using calculators with those of pupils not using calculators. There were 46 with above average ability, who equally received 23 subjects in each treatment group. Both groups received six weeks of training in which the calculator group was taught to use the calculator with all assignments. The non-calculator group did the same problems without the assistance of the calculator. The conclusion was since calculators have the potential for relieving the computational burden during problem solving one would suspect that calculator availability would facilitate problem solving. Results on the computational error analysis revealed that the calculator users made less errors in computational skills than non-calculator users. Moreover, the calculator group used 152 facilitative processes compared to 104 for the non-calculator group.²


Schoefeld believes that instruction in problem solving strategies has an advantage over problem solving experiences on student's problem solving performance. He conducted a study at the University of California, Berkeley, to determine if students being taught problem solving strategies for solving problems performed the same as students solving problems without being taught problem solving strategies. The subjects were seven science and mathematics majors selected as volunteers. Four were randomly selected as the experimental group and the other three as the control group. At the end of the experimental period of two weeks a posttest was administered using the same process that was used for the pretest. It was concluded that the experimental group significantly outperformed the control group on the posttest. It was assumed that the instruction of the five strategies made the difference.\(^1\)

Hudgins used questioning in a study designed to examine the relative effectiveness of problem solving by groups and by individuals. He was concerned with the answer to two questions: (1) Do children working together in groups learn techniques of problem solving which they can apply later in similar situations? (2) Does interaction contribute to superiority of group problem solving?

It was concluded that problem solving experiences in a group improved individual ability more than individual experiences. The subjects were 128 fifth graders selected in equal numbers from four public schools in a midwestern city. The findings indicated that, although groups of students working cooperatively solved more problems than students working alone, there was no significant improvement in the problem solving performance because of the group experience.¹

Harris did a study on the effects of unstructured peer-tutoring on 25 fourth and fifth graders. He allowed members of this group to tutor each other on the same problems as they worked. Then in another setting he did not allow the same group to interact with each other. He found both settings did well in problem solving, but students in the tutoring setting scored higher than students in the non-tutoring setting. It was concluded that children demonstrate improvement in problem solving when they are allowed to tutor each other.²

LeBlanc reported that increased awareness of problem solving instruction in the elementary schools has resulted in an increased effort to identify specific instructional


techniques for teaching problem solving skills. He revealed two types of mathematical problems found in the elementary school mathematics curriculum; namely textbook problem and process problem. He stated the textbook problems proposed concrete or real world context and presentation of pictures, short phrases or sentences in the lower grades. As the children advance in grade level, the problems are presented in short phrases and sentences with a minimum of situational information.

In contrast, process problems are used to encourage a practice or problem strategies within children to devise creative methods of solutions and build confidence in solving problems.¹

Example of a process problem is: There were 8 people at a party. If each person shook hands with everyone else, how many handshakes were there in all?²

This type of problem stresses the process of obtaining the solution rather than the solution itself.

Randall presented a paper that provided an overview of a process-oriented instructional program and reported the results of an evaluation of that program. Twelve fifth-grade and 10 seventh-grade teachers implemented the mathematical problem solving program for 23 weeks. Eleven fifth-grade and 13 seventh-grade teachers taught control


²Ibid., p. 105.
classes. The experimental classes scored significantly higher than the control classes on measures of ability to understand problems, plan solution strategies, and get correct results. Trend analysis showed different student growth patterns for the three measures of problem solving performance. Data from interviews with teachers supported the results of the quantitative analysis and suggested that both students and teachers had changed positively with respect to attitudes toward problem solving. In addition, teachers gained confidence in their ability to teach problem solving.¹

Quintero reported that when solving multistep word problems, children may have difficulty in either understanding concepts and relationships or organizing a solution method. Both factors of problem difficulty were studied by means of interviews with 36 children (ages 9 to 14) who solved problems having the same structure but varying in context and in numbers used. The child's representation of a problem was probed by tasks involving repetition of the problem statement and selection of drawings. The meaning of concepts and relationships was a major source of difficulty, and levels were identified in understanding the concepts of ratio. The solution method also was a source of difficulty, but its nature was less clear.

The results underline the importance of a careful analysis of problem types in studying sources of difficulty.¹

Mussey reported that, although arithmetic has dominated learning and applying computational algorithms in solving problems, the emphasis in this electronic age should be not on performing algorithms in a rote manner, but on developing and using algorithms to solve problems. He reported if a strategy based point of view is adopted, critical questions must be confronted as follows:

1. What techniques do we employ in problem solving?
2. What problem solving strategies do we employ in school mathematics?
3. What are some ways we can promote problem solving in that classroom?

In addition, he listed some problem solving strategies which he feels can be taught in the high school:

1. Trial and error: is perhaps the most direct method of problem solving. It involves applying allowable operations to the information given.

2. Patterns: looks at selected instance of the problem. Then solution is found by generalizing from these specific solutions.

3. Solving a simpler problem: temporary retreat from complicated problems to a shortened version. Several strategies may be required to reach a satisfactory solution.

4. Working backward: it begins with the goal, or what is to be proved rather than the given.


From that point, we seek a statement or statement that will include the goal.¹

Kulm reports that as the use of calculators and computers increases in mathematics education, more and more educators are beginning to recognize the gradual shift from emphasis on computational skills to that of problem solving. Current methods focus on teaching skills of translating from words to symbols. Often, algorithmic-like methods are taught for solving specific types of problems. These approaches not only fail to teach important processes, but there is evidence to suggest that they may interfere with good problem solving by emphasizing irrelevant or unimportant aspects of problems. Good problem solvers recognize problems by their structure rather than their contextual setting.

The characteristics of concrete and formal operational thought are related to the thinking used in mathematical problem solving. The concrete operational students can order and organize that which is immediately present but do not recognize and evaluate the possible. They are unable to dissociate physical context from the structure of a situation. The concrete operational child is unable to reason from hypotheses not attached to reality.


¹Ibid., pp. 137-143.
Formal operational individuals are capable of hypothetical thought and propositional logic. They have developed the ability for reversal in thinking between reality and possibility. They are capable of combinatorial thinking, making it possible for them to form all combinations of objects and to isolate variables. Finally, formal thought includes the ability to work with proportions which requires the construction of relations on relations.

It is generally found that formal operational students use more efficient strategies than concrete students and are better in problem solving.\(^1\)

Fischbein and others conducted a study of 623 students enrolled in the fifth, seventh and ninth grades with difficulties in multiplication and division in verbal problem solving. He stated that arithmetical operations were assumed to remain with some primitive behavioral models even after the learner has had solid formal algorithmic training. Such models may sometimes facilitate the source of problem solving, but very often they may slow down or even block the solution process when contradictions emerge between the model and the solution algorithm. The two models are interpreted as follows:\(^2\)

---


The model for multiplication is conjectured to be repeated addition, and two primitive models (partitive and quotative) were seen as linked to division. In the partitive interpretation of division, the divisor must be a whole number and both divisor and quotient must be smaller than the dividend. In the interpretation of division, the divisor must be smaller than the dividend.

He noted that if teachers in the elementary schools continue to use those primitive models in their instructional program, then such dilemmas would continue to exist in this manner:

The initial didactical models seem to become so deeply rooted in the learner's mind that they continue to exert an unconscious control over mental behavior even after the learner has acquired formal mathematical notions that are solid and correct.¹

He concluded that adolescents and adults alike continue to face difficulties when they have to solve elementary problems in arithmetic with numerical data that lead to conflict between the correct operations and the constraints of the corresponding tacit model. But such problems can be alleviated if teachers provide learners with efficient mental strategies that would enable them to control the impact of these primitive models.²

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¹Ibid., p. 16.
²Ibid.
Summary of Related Literature

In the summary of related literature the researcher identified distinct techniques contributing to problem-solving analysis and/or abilities published from 1960 through 1984. The findings are reported as follows:

Student Achievement in Problem Solving

1. Brooks emphasized that the students' attitude toward the teacher is important in mathematics attitude and the teacher should be aware of the fact that teacher's attitude toward mathematics may be a determinant of students' attitude toward mathematics.

2. Cathcart found that students who hesitate before responding should not be underrated since their hesitation may be due to their cognitive style rather than to their lack of ability.

3. Carpenter examined children's solutions to simple addition and subtraction word problems in a 3 year longitudinal study that followed 88 children from grades one to three. It was found that the children were able to solve the problems using a variety of modeling and counting strategies even before they received formal instruction in arithmetic.

4. Charles presented some findings on 12 fifth grade and 18 seventh grade teachers implementing a mathematical problem solving program. Eleven fifth grade and 13 seventh grade teachers taught control classes. The
experimental classes scored significantly higher than the control classes on measure of ability to understand problems and plan solution strategies.

5. Clute found that high anxiety students may benefit more in terms of achievement when taught using an expository method of well structured controlled plan for learning, whereas low anxiety students may benefit more when taught by a discovery method.

6. Durch examined the effectiveness of a method that teaches fourth graders to translate word story problems into mathematical equations form in a step by step explicit manner. Posttest results indicated a sufficient positive effect, but no effect for provision of extra review lessons regardless of teaching method. On a test administered two weeks later, the children in the explicit group had received extra lessons significantly better than children in the comparison groups.

7. Ethington reported a study called the high school and beyond. He concluded that sex has a significant effect on mathematics achievement even after controlling for sex differences in spatial abilities, background in mathematics and interest in mathematics.

8. Licht and others supported the notion that achievement differences can result from a fit between children's achievement orientations and the demands of a particular skill area.
9. Moyer conducted an investigation on whether there is a difference in the performance of children in grades three-seven on story problems presented in a verbal format and a reduced telegraphic format and whether any difference in performance across formats might be related to problem solving ability. Findings indicated that the telegraphic format did not facilitate performance on story problems. It was concluded that conventional syntax appeared easier to interpret for students of high ability.

10. Roberge and others suggested the need for investigation of different approaches to instructional design that should be geared to the developmental capacities and cognitive style of the individual learner.

11. Shields and others concluded that parental practices found to be significant for children as good readers provided educational books, school visitation and reward for good grades. Whereas practices of low-income parents offered no references or rewards.

Verbal Problem Solving

1. Bosel concluded that the presentation of mathematical problem in colloquial language can be complicated by several factors such as complex sentence structure, irrelevant information, information referring to incorrect solving or any combination of these.

2. Burns and Reidesel suggested that problem solving be approached by giving the learner verbal problems
without numerals, allowing them to analyze a problem to determine what should be done to arrive at a solution.

3. Davis concluded that children's story problems are one of the most difficult challenges in mathematics. He says that success leads to positive attitudes, so we must begin with success and eliminate any grade level and start with easy problems.

4. Henney concluded that the style of writing word problems is quite different from that usually found in narrative materials. It is compact and lack of rich content which makes word identification difficult. Reading verbal problems requires more concentration than needed for reading narrative materials.

5. Jacobson concluded that children's problem solving abilities should begin as early in school as possible.

6. Mussey concluded that, although arithmetic has dominated on learning and applying computational algorithms to solve problems, the emphasis should not be on performing algorithms to solve problems.

7. Pace concluded that if students are to have any success with verbal problems, they must have some understanding of the fundamental processes.
Instructional Strategies

1. Harris concluded that children indicate improvement in problem solving when they are allowed to tutor each other.

2. Hudgins concluded that problem solving experiences in a group improve individual experience.

3. Johnson concluded that computer programming by students in a laboratory like context contributes to the learning of selected concrete ideas and problem solving.

4. Kulm concluded that as the use of calculators and computers increased in mathematics education, more and more educators are beginning to recognize the gradual shift from emphasis on computational skills involving problem solving.

5. LeBlanc concluded that increased awareness of problem solving instruction in the elementary schools has resulted in an increased effort to identify specific instructional techniques for teaching problem skills.

6. Quintero concluded that when solving multistep word problems, children have difficulty in either understanding concepts or relationships of organizing a solution method.

7. Randall concluded from an overview of a process-oriented instructional problem between an experimental and control class that the experimental class scored higher than the control class on measures of
ability to understand problems, plan solution strategies and get correct answers.

8. Schoefeld concluded that instruction in problem solving strategies has an advantage over students' problem solving performance.

9. Wheatley concluded that since calculators have the potential for relieving the computational burden during problem solving, calculator availability would facilitate problem solving.
CHAPTER III

RESEARCH DESIGN

Introduction

The purpose of this study was to determine if direct, systematic instruction in word problem solving is an effective approach to strengthening students' skills. The study addressed this problem: Is there a significant difference in the word problem solving achievement of students given direct instruction in word problem solving and students given incidental instructions? To answer the question the following hypothesis was tested: There is no significant difference in mean achievement scores on a word problem solving test between students who are taught word problem solving and students who are not taught word problem solving.

This chapter is divided into four parts: Part one describes the research method; part two describes the research locale population and sampling procedure; part three describes experimental procedures; and part four describes the data collection and analysis strategies.
Research Method

This study employed the quasi experimental method using two treatment groups—one control and one experimental. A pretest-posttest was used to measure pre- and post-treatment performance of each group. The paradigm below shows the non-randomized control group pretest-posttest design. The paradigm shows that: (1) two groups were involved in the design (two rows of symbols), (2) each group was measured or observed at the same time before the treatment was applied to one group (the first column of $Y_1$'s); (3) each group was measured at the same time after the treatment had been applied (the second column of $Y_2$'s); (4) the subjects were non-randomized assigned to the two groups (E and C in each row); and (5) the first group received the experimental treatment, whereas the second group did not (X in the first row and a blank space in the second).

<table>
<thead>
<tr>
<th>Group</th>
<th>Pretest</th>
<th>Independent Var.</th>
<th>Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>$Y_1$</td>
<td>$X$</td>
<td>$Y_2$</td>
</tr>
<tr>
<td>C</td>
<td>$Y_1$</td>
<td></td>
<td>$Y_2$</td>
</tr>
</tbody>
</table>

There are many situations in educational research in which it is not possible to conduct a true experiment.
with randomly selected students. Therefore, a non-randomized design was more appropriate for this study because the researcher was able to select groups in the study locale without disruption of the program.

Subjects
This study population consisted of 44 ninth grade students. Twenty-three (23) students comprised the experimental group, and twenty-one (21) students were in the control group.

Selection of Subjects
In the total number of students in this study, Teacher A has worked with three classes. Classes were selected at random from a chance of three drawings and assigned experimental group (E). Teacher B has control over two classes. She selected a class from a chance of two drawings and assigned it control group (C).

Experimental Procedures
The non-randomized pretest-posttest control group design was used for this study. It called for an experimental group (E) and a control group (C). The groups consisted of 23 and 21 students respectively. Each group met for three weeks, five days per week during the study period. Each group was taught by the regular mathematics teacher. To assure the freedom of bias in the group, groups were chosen by drawing one number from the number of classes
taught by each of the participating teachers and determined which group was assigned to the experimental treatment and which one was assigned to the control group.

The Experimental Group

The daily class treatment for the experimental group (E) in translation of word problems consisted of instruction and the assistance of instructional aids. Each student possessed a list of problem-solving instructions to assist him or her in analyzing word problems listed as follows:
1. Read the problem quickly to get an overview.
2. Re-read the problem at a slower rate, to determine what facts are given.
3. Think of the order in which the facts are to be used in answering the question raised in the problem.
4. Think of the operations required for solving the problem.
5. Work the problem by performing the appropriate operations.
6. Go back to the first step if the answer seems unreasonable.

Students were tutored by the teacher or placed in small groups with the better students. Each group met every day for 50 minutes during the study period. The mathematical operations on how to find sales tax, discount prices, commission, profits and losses were taught and their applications in everyday life examined.
The Control Group

There was daily class instruction in solving non-verbal or computational problems only. The students worked in small groups or individually. The solving of word problems was not taught to this group; but students were exposed to word problems similar to the ones on the pretest-posttest and allowed to ask questions for clarification of the wording of the problem. No assistance, however, was given as to what mathematical operation should be used to solve the problem or in the problem-solving process.

Data Collection and Analysis of Data

At the end of the study period of three weeks, the same teacher-made pretest was administered as a posttest to the experimental and control groups. The results indicated both groups scored better on the posttest.

The items on the pretest-posttest were selected and prepared by the researcher from the following resources: Whitcraft's General Mathematics for junior high school students;¹ Stein's Refresher Mathematics with practical applications.²


The t-test was used to determine if there was significant difference in the pretest-posttest achievement of the two groups as measured by the teacher-made test.

All problems used during the three weeks of instruction and on the pretest and posttest were selected according to the reading level of the students.
CHAPTER IV

PRESENTATION AND ANALYSIS OF DATA

Introduction

The main purpose of the study was to determine if direct, systematic instruction in word problem solving is an effective approach to strengthening student skills in this area. This chapter contains the data obtained from the administration of four tests; namely, the pretest-posttest for the Experimental E-group and the pretest-posttest for the Control C-group. The test used to measure the difference in pretest-posttest performance of both groups was similar in numerical structure. They were administered in an interval of a three-week treatment to determine the difference in the achievement of mean scores. This chapter is divided into three parts. Part one contains the analysis of the data from the pretest. Part two contains the analysis of the data from the posttest. Part three summarizes the results.

Pretest Data

The scores in the E-group ranged from a low of 0 to a high of 5 from the maximum of 10 points. Seven or 30.4 percent of the students scored above the mean, while nine or 39 percent scored below the mean.
Seven or 30.4 percent of the students scored within the class interval containing the mean.¹

Fig. 1. Distribution of pretest scores by E-group

Figure 1 is a histogram of the pretest scores. A distribution curve passes through it in a positive skewed manner. It indicates the students scored higher in the class intervals from 2 to 4 and 4 to 6 above the means.

¹See Data in Appendix A.
Figure 2 is a histogram of the pretest scores. A distribution curve passes through the histogram in a positive skewed manner indicating the group scored higher above the mean at the pretest level. The scores in the C-group ranged from a low of 0 to a high of 5 from the maximum of 10 points. Nine or 42.9 percent of the students scored above the mean, while seven of 33 percent scored below the mean. Five or 23.8 percent of the students scored within the class interval of the mean. ¹

¹See Data in Appendix A.
Overall, the distribution of scores indicate that they were about the same between the C-group and the E-group at the beginning of the study. Table 2 shows the mean scores and the standard deviation for the pretest of groups E and C.

**TABLE 2**

**PRETEST MEAN SCORES AND STANDARD DEVIATION**

<table>
<thead>
<tr>
<th>Group</th>
<th>Number of Students</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>23</td>
<td>2.69</td>
<td>1.43</td>
</tr>
<tr>
<td>C</td>
<td>21</td>
<td>2.38</td>
<td>1.89</td>
</tr>
</tbody>
</table>

The difference between the two means was .31 and the standard error of difference between the means was .52. The t statistic was found to be .60 with 42 degrees of freedom. This value was found to be less than the significant t of 2.021 with 40 degrees of freedom at the .05 level of significance. Therefore, it may be concluded that the Experimental group E and Control group C did not differ significantly in achievement at the beginning of the study.
Posttest Data

The scores in the E-group ranged from a low of 0 to a high of 8 from a maximum of 10 points. Seven of 30.4 percent of the students scored above the mean, while ten or 43.5 percent scored below the mean. Six or 26.1 percent of the students scored within the class interval containing the mean.1

Fig. 3. Distribution of posttest scores by E-group

In figure 3 a distribution curve passes through the histogram in a negative skewed manner. This indicates that the E-group scored higher above the means at the posttest level after a three week treatment in problem solving.

1See Data in Appendix A.
It indicates that the E-group scored higher above the mean at the posttest level than it scored at the pretest level. It appears evident, since a treatment was administered to the experimental group.

The scores in the C-group ranged from a low of 0 to a high of 10 from the maximum of 10 points. Six or 28.6 percent of the students scored above the mean, while ten or 47.6 percent scored below the mean. Five or 23.8 percent scored within the class interval containing the mean.¹

Fig. 4 Distribution of posttest scores by C-group

¹See Data in Appendix A.
In Figure 4 a distribution curve passes through the histogram in a positive skewed manner. It indicates that the C-group scored lower above the mean at the posttest level than it scored on the pretest level. It appears evident, since no treatment was administered to the group.

Comparatively, the E-group scored higher than the C-group on the pretest-posttest, but no significant difference was found between the scores. Table 3 shows the mean scores and the standard deviation for the posttest of groups E and C.

**TABLE 3**

**POSTTEST MEAN SCORES AND STANDARD DEVIATION**

<table>
<thead>
<tr>
<th>Group</th>
<th>Number of Students</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>23</td>
<td>4.57</td>
<td>3.91</td>
</tr>
<tr>
<td>C</td>
<td>21</td>
<td>3.57</td>
<td>4.24</td>
</tr>
</tbody>
</table>

The difference between the two means was 1, and the standard error of difference between the means was .73. The t statistic was found to be 1.37. Since this value is less than the significant t, 2.021 at 40 degrees of freedom at the .05 level of significance, it may be concluded that the three week experimental treatment did not effect
significant differences in achievement. Therefore, the hypothesis in this study is not rejected.

**Summary of Results**

An analysis of posttest scores revealed no significant difference between the experimental and control groups. The null hypothesis of this study was not rejected. On the first and second Friday in the three week period of this study, a quiz was administered to each group for observation purposes in test scores. Each time the quiz was administered, the results indicated an improvement over the pretest. Results from the posttest indicated an improvement over the scores in the pretest, but no significant difference was found between the scores of both groups.
CHAPTER V

CONCLUSIONS, IMPLICATIONS AND RECOMMENDATIONS

Introduction

This chapter is divided into three parts. Part one states the conclusions, part two presents the implications, and part three lists the recommendations to educators in various educational institutions.

The main purpose of the study was to determine if direct, systematic instruction in word problem solving is an effective approach to strengthening student skills in this area.

It was theorized that if direct instruction given in word problem solving is presented at students' verbal level of comprehension, then students would achieve at a higher level in word problem solving.

The problem addressed in this study is embodied in this question: Is there a significant difference in the word problem solving achievement of students given direct instruction in word problem solving and students given incidental instruction?
This period of study was three weeks and the subjects for this study were divided in two ninth grade general mathematics classes assigned to two different teachers. The classes consisted of 23 and 21 students respectively. The students were selected from a total of one hundred forty-five. During the beginning of this project a pretest was given. However, at the end of each weekly session quizzes were administered to determine the amount of reteaching of word problem concepts needed before the administration of the posttest.

The contents of the test consisted of problems on how to find discounts, commission, interest, and sale tax. The $t$ statistic was employed to test the statistical significance between the posttest means for the two groups. The difference between the two means was 1 and the standard error of difference between the means was .73. The value of $t$ for the posttest was 1.37 which was less than 2.021 at 40 degrees of freedom and at the .05 level of significance.

Conclusions

Teaching word problem analysis, employing a structured method did not increase problem solving achievement among high school students significantly more than the use of the conventional method. The mean posttest score for the experimental group was not significantly higher than the posttest score of the control group. Teaching students word problem solving, employing algorithms did not effect
significant achievement in the E-group more than the non-algorithmic employment in the C-group. Therefore, the results suggest the treatment made no difference in word problem solving achievement.

**Implications**

Since a treatment on word problem solving was not administered to the control group, but the control group was allowed to ask questions for clarification of the problems, there is a possibility that they picked up ideas on how to analyze word problems during the questioning session. Also, the time element could have been insufficient for adequate treatment with the experimental group, since the test scores did not differ significantly.

**Recommendations**

The findings, conclusions and implications of this study support the following recommendations:

There should be more interaction between students and teachers through questions and answers relative to word problem solving instruction. Teaching word problem solving should begin early in the elementary school and sequentialized in the middle and high school. In-service teaching on word problem solving should be provided. Calculators should be used by students only after they have mastered the basics of arithmetic.
APPENDIX A
GENERAL AND SPECIFIC OBJECTIVES

Definition: Per cent is a whole divided into one hundred parts, where each part is indicated in hundredths and numerically expressed in common fractions, decimals and percent form and percentage represents a part of a whole of any existence that can be expressed mathematically.¹

A. General Objectives:
   1. To change a decimal fraction to a percent.
   2. To change a percent to a decimal fraction.
   3. Percentage = rate x base.

B. Specific Objectives:
   1. How to find sales tax.
   2. How to find discounts.
   3. How to find commission.

C. Specific Objectives Defined:
   1. Sales tax--Finding the rate or percent for each $1 value of an item. This may be by changing the given percent to a decimal and multiplying the decimal by the price of the given item and rounding it to the nearest cent. The result is the sales tax on the price of the item.

   2. Discount price--The discount of an item is a reduction in the original price. It is determined by changing the discount percent to a decimal and multiplying it by the original price of an item and rounding it to the nearest cent. The results are deducted from the original price where the difference is called the discount price.

¹Researcher
3. **Commission**--A commission is a compensation rendered to an agent for his services such as real estate agent, collection agent etc. It is determined by the percent of commission when changed to a decimal and multiplied by the price of involvement and rounded to the nearest cent.

4. **Profit**--Profit is the amount in excess of the cost plus operating expenses.

5. **Loss**--Loss is the amount less than the selling price of an item.

Regardless of the profit or loss of an item, the percent of profit or loss is determined by changing the percent to a decimal and multiplying by the selling price and rounding to the nearest cent.
DUPlicated MASTER (Almost Wordless Problems)

NAME ___________________________ DATE ___________________________

CLASS ___________________________ TEACHER _______________________

ALMOST WORDLESS

A.

1. Rate of commission: 8%
   Amount of sales: $17,250
   Amount of commission: ______

2. Sales price of car: $3,850
   Percent down: 20%
   Amount of down payment: ______

3. Amount of purchase: $58
   Rate of sales tax: 6%
   Amount of sales tax: ______

4. Regular price: $24.96
   Special discount rate: 25%
   Amount of discount: ______

5. Earnings: $986
   Rate of Social Security: 5.85%
   Amount paid to Social Security: ______

6. Amount of deposit: $5,000
   Rate of interest: 7½%
   Amount of interest: ______

7. Amount of loan: $1,482
   Rate of interest: 12%
   Amount of interest: ______

8. Total number of students: 1,350
   Percent in debate club: 8%
   Number of debate club members: ______

9. Amount of purchase: $12.25
   Amount of sales tax: 49c
   Rate of sales tax: ______

10. Amount of sales tax: $151.80
    Rate of sales tax: 6%
    Amount of sales: ______

B.

Rate of interest: 4½%
Amount of deposit for 1 year: $752
Amount of interest: ______

Amount of Purchase: $38.20
Rate of discount: 15%
Amount of discount: ______

Family income: $23,728
Rate of tax: 16%
Amount of tax: ______

Amount charged: $66.00
Monthly rate of interest: 1½%
Monthly service charge (interest): ______

Amount borrowed: $1,000
Rate of interest per month: 3/4%
Amount of interest for 1 month: ______

Earnings: $843
State disability insurance: 1%
Amount of insurance: ______

Regular price: $19.80
Sale: 30% off!
Amount of discount: ______

Total number of students: 1200
Number on yearbook staff: 75
Percent of students on yearbook staff: ______

Total sales: $14,000
Amount of commission: $1,050
Rate of commission: ______

Amount of commission: $1,113
Rate of commission: 7%
Total sales: ______
TEACHER-MADE TEST

Word Problems

Pretest

1. How many problems did Joan have right if she received a grade of 85% in a mathematics test of 20 problems?

2. Mr. Becker bought a house for $18,250 and made a down payment of 20%. What is the amount of the mortgage?

3. If the sales tax is 6%, what would the tax be on a purchase of $17.10?

4. How much trade discount is allowed if the catalogue lists a Kitchen cabinet sink at $98.75 and the discount sheet shows a 16% discount? What is the net price?

5. Richard received a grade of 60% in a spelling test of 25 words. How many words did he misspell?

6. What is the net price of a refrigerator listed at $227.50 with a trade discount of 12% and an additional cash discount of 5%?

7. Sales by Mr. Hayes amounted to $826.50. His commission was 12%. How much did he earn?

8. A department store employs 1,842 people. If 87% are sales help, 5% office help, and the remaining employees are supervisory employees, how many people are employed in each of these groups?

9. Mr. Jones sold Mr. Smith's farm for $25,000 and received a commission of 5%. Find the commission and net proceeds.

10. Mrs. Washington shipped 180 baskets of tomatoes to a commission merchant. Tomatoes sold for 85 cents a basket. Commission paid for the sale of tomatoes was 3%. Find the net proceeds.

11. Mrs. Turner bought a washing machine for $216. She paid 25% in cash and the balance is to be paid in 12 equal monthly installments. How much must she pay each month?

12. A salesman sold 9 window fans at $39.95 each and 7 air conditioners at $279.75 each. At 4% commission, how much did he earn?

13. How many questions out of 28 may a pupil miss and still get a grade of 75%?

INSTRUCTIONS: Solve any ten (10) problems.
TEACHER-MADE TEST

Word Problems

Posttest

1. How many problems did Joan have right if she received a grade of 75% in a mathematics test of 40 problems?

2. Mr. Becker bought a house for $20,360 and made a down payment of 25%. What is the amount of the mortgage?

3. If the sales tax is 7%, what would the tax be on a purchase of $19.20?

4. How much trade discount is allowed if the catalogue lists a kitchen cabinet sink at $78.55 and the discount sheet shows a 18% discount? What is the net price?

5. Richard received a grade of 65% in a spelling test of 30 words. How many words did he misspell?

6. What is the net price of a refrigerator listed at $330.35 with a trade discount of 15% and an additional cash discount of 6%?

7. Sales by Mr. Hayes amounted to $576.40. His commission was 14%. How much did he earn?

8. A department store employs 1632 people. If 68% are sales help, 6% office help, and the remaining employees are supervisory employees, how many people are employed in each of these groups?

9. Mr. Jones sold Mr. Smith's farm for $30,000 and received a commission of 8%. Find the commission and net proceeds.

10. Mrs. Washington shipped 160 baskets of tomatoes to a commission merchant. Tomatoes sold for 65 cents a basket. Commission paid for the sale of tomatoes was 4%. Find the net proceeds.

11. Mrs. Turner bought a washing machine for $220. She paid 24% in cash and the balance is to be paid in 12 equal monthly installments. How much must she pay each month?

12. A salesman sold 9 window fans at $35.65 each and 7 air conditioners at $295.75 each. At 5% commission, how much did he earn?

13. How many questions out of 35 may a pupil miss and still get a grade of 80%?

INSTRUCTIONS: Solve any ten (10) problems.
<table>
<thead>
<tr>
<th>Number</th>
<th>E-group Pretest</th>
<th>E-group Posttest</th>
<th>C-group Pretest</th>
<th>C-group Posttest</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>5</td>
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BIBLIOGRAPHY

Books


Yearbooks


Program


Journals


**Reports**


Microfilm