AN ANALYSIS, AS REVEALED BY THE WIRE RECORDER, OF THE METHODS USED BY TEN SELECTED BUSINESS MATHEMATICS STUDENTS IN SOLVING STATED PROBLEMS

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CHAPTER I

INTRODUCTION

Purpose of the Study

Many studies have been made concerning the difficulties which business mathematics students have in solving stated problems. Such studies have been made by analyzing the student's errors as they appear on written solutions to problems, and, as a result, many errors are overlooked. Errors in the thinking process, and failure to read the problem a sufficient number of times are responsible for many errors made by students. Such errors are not apparent on written solutions, but would be revealed through oral solutions as recorded on a wire recorder. The purpose of this study, then, is to analyze the errors revealed by a wire recorder, along with errors on written solutions, and to classify and tabulate the errors from both sources.

Justification of the Problem

Business mathematics teachers have long been aware of the difficulties which students encounter when they attempt to solve stated problems. The writer recently became very interested in the inability of many of his students to solve such problems, and this study is a result of that interest. If only a few of the more common errors can be determined and corrected as a result of this study, then, students should benefit from it.

Limitations of the Problem

This study is limited to ten selected students, all of whom were members of a business mathematics class at North Texas State College during the spring semester, 1949. Three of the students are "A" students who have proven their ability to solve stated problems. A second group of three students is made up of average or "C" students, and the remaining group is made up of four failing or "F" students.

The length of the test was necessarily limited because the maximum recording time of the wire recorder is one hour. The six-problem test used in the study requires approximately one hour for an average student to work.

Definition of Terms

In order that a clear understanding may be had, the following terms are defined, or explained, as they are used here.

"Wire recorder."--One of the many instruments which is used to preserve the voice or other sounds for future use is a wire recorder.

"Stated problems."--These are problems which have the facts of the problems presented in sentence form. They differ from problems which include figures only.

Sources of Data

The data in this study come from primary sources. Both the students' written solutions to the problems and their recorded oral solutions to the problems are primary data.

Method of Procedure

The research procedure employed in this problem revolves around the wire recorder. Each student was given a copy of the test and instructed to work the problems. He was also instructed to talk as he worked, explaining as best as he could the reasoning behind his procedure of solving the problems. In other words, he was told to explain his method of solving the problems so that his solutions could be followed by listening to a play back of the wire recorder. As was expected, some of the students had difficulty in giving oral solutions to the problems. In general their ability to explain what they were doing paralleled their ability to solve the problems; that is, the good students were able to relate what they were doing while the poor ones had difficulty in making oral explanations. However, as a whole, the students did well enough for the writer to be able to follow their methods of procedure.

Review of Related Literature

Several studies which are similar to this one were very helpful in writing this report. Most of the related studies, however, deal either with pure mathematics or arithmetic on the elementary and secondary school level. Guy Thomas Buswell and Charles Hubbard Judd's Summary of Educational Investigations Relating to Arithmetic is a review of the studies made in arithmetic prior to 1925. Most of the studies were made in elementary arithmetic, although many of the tables were useful

in this study. An Analysis of the Arithmetic Knowledge of High School Pupils, by Jacob S. Orleans and Emanuel Saxe, is concerned with the errors made by the pupils in solving arithmetic problems, with particular attention given to commercial arithmetic. The same authors, Orleans and Saxe, in their book, Commercial Arithmetic Knowledge of Students in a Collegiate School of Business, give much help in selecting the method for presenting the problem. The problem-by-problem analysis used in Orleans and Saxe's book is followed in this study. Elizabeth N. Boyd's A Diagnostic Study of Students' Difficulties in General Mathematics in First Year College Work, although dealing with pure mathematics, was helpful in this study because many of the errors which she reported in her book were also found in this study. The Twenty-Ninth Yearbook of the National Society for the Study of Education contains a great many articles on studies made in arithmetic which closely parallel this one. Other less similar studies were read in an effort to get background material on what had been done in the way of educational research in the field of arithmetic. Some of these are: The Effect of Certain Factors in the Verbal Arithmetic Problem Upon Children's Success in the Solution, by Grace A. Kramer; Diagnostic Studies in Arithmetic, by G. T. Buswell; The Relation of Problem Solving Ability in Arithmetic to Comprehension in Reading, by Lorena B. Stretch.

Organization of the Study

The study is organized into seven parts. The introductory

chapter states the purpose of the problem, the justification, the limitations, definition of terms, sources of data, method of procedure, review of related literature, and the organization of the study. The second chapter discusses the manner in which all three groups of students work a stated problem dealing with fractions. The next chapter tells how the students work a percentage problem. The methods students use in solving a problem involving bank discount are related in the fourth chapter, and a marked price problem and the students' solution to that problem are discussed in the fifth chapter. The sixth chapter is concerned with a problem on inventory and turnover. The seventh and final chapter presents the findings of the study, the conclusions drawn, and the recommendations offered by the writer.

CHAPTER II

AN ANALYSIS OF THE METHODS USED IN SOLVING A STATED PROBLEM INVOLVING FRACTIONS

Most students who come to college have been thoroughly schooled in working problems which involve fractions. According to Jessup, the majority of the elementary schools begin instruction of fractions in the fifth grade.[1] After that early introduction to fractions, the students are exposed to problems involving fractions throughout all their mathematics courses during the remainder of their pre-college education. Even in high school algebra and other pure mathematics courses fractions are used frequently in the problems presented as parts of those courses. As a result college students should be familiar with fractions, and should certainly be able to apply the fundamental processes to fractions. However, as most college mathematics professors know, this is not the case. Thus, a problem which dealt with fractions was selected and included on the test. The methods that the students used in solving that problem are the subjects of discussion in this chapter.

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[1] Guy Thomas Buswell and Charles Hubbard Judd, Summary of Educational Investigations Relating to Arithmetic, p. 20, citing Walter A. Jessup, Current Practices and Standards in Arithmetic.

The Problem

The problem submitted to each student was as follows:

> Mr. James owned 4/5 of a baseball club and sold 2/3 of his share for $16,800.00. What is the value of the whole club at this rate? What fractional part of the club does he still own?[2]

Correct solution.--The correct solution to the problem is as follows:

The portion of the ball club which the man sold was 2/3 of 4/5. He sold that portion for $16,800.00. Therefore:

2/3 x 4/5 = $16,800.00
8/15 = $16,800.00
1/15 = $ 2,100.00
15/15 = $31,500.00 which is the total value of the club.

If he sold 2/3 of 4/5, then he still has 1/3 of 4/5 left.

1/3 of 4/5 = 4/15 which is the fractional part of the club the man still owns.

General Method of Attack

Good students.--For the purpose of this study, the three good students will hereafter be known as students A, B, and C.

Student A was the best student of the entire group. Her ability to grasp the meaning of a problem was apparent from the beginning of the test, although she did have a few difficulties. In this particular problem she saw the method needed to solve the first part immediately. After reading the problem only

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[2]Walter Maxey Williams, "Development of a Workbook for Business Mathematics Based on the Needs of Students at North Texas State Teachers College" (Unpublished Thesis, North Texas State College, August 1947), p. 78.

once, she made a correct decision on where to start and what to do. The fact that two fractions were involved in the problem gave her no trouble whatsoever.

In the second part of the problem, however, she was definitely confused. She never completely understood what the problem called for, and simply worked with some fractions until she had an answer that sounded reasonable. It is interesting to note that she realized that her answer was incorrect, but she left it as her answer nevertheless.

Student B likewise had no trouble with the first part of the problem. She read the question only once, determined the correct course of action, and proceeded to work the problem without difficulty. The second part of the problem troubled her, however. She used a method that was completely illogical.

Student C, unlike A and B, had trouble with the first part of the problem. She made a false start on the problem, but soon caught her mistake and after rereading the problem a second time immediately decided upon a correct solution. After a second reading of the second part of the problem she correctly solved it without any of the trouble experienced by students A and B.

Average students.--The designations given each of the average students in this section will remain the same throughout the report. The average students will be known as D, E, and F.

Student D made no effort whatsoever to work the problem. After reading the problem three times and deliberating on it

for a period of about four minutes, she proceeded to the following problem.

Student S was not sure of his procedure. After reading the problem once he started on the correct solution, and after arriving at that solution did not realize he had finished the first part of the problem. More computation made his otherwise correct answer wrong. In the second part of the problem he chose the same procedure as student B and thus had an incorrect answer.

Student P, the next student, actually stated the correct beginning to the solution of the first part of the problem, but then reread the problem and abandoned the correct solution in favor of another method. The second part of the problem was read twice before an attempt to work it was made, and then a wrong solution was effected.

Poor students.--The letters assigned to the poor students in this section are to remain the same for the entire report. Letters G, H, I, and J indicate the poor students.

Student G read the problem twice before attempting to solve it. After arriving at an answer and realizing that it was not correct, she read the problem again and started on a correct solution to the problem, but did not finish that solution. Then she decided that the first answer she had obtained was the correct one after all. No attempt was made to solve the second part of the problem; it was not even reread.

Student H was ready to work the problem after only one reading; he started right, but strayed before arriving at the

final answer. Before attacking the second part of the problem he read it again, and with no further computation took one of the fractions he had used in the first part of the problem as his answer to the second part.

Student I, after reading the problem twice, selected a wrong method of procedure. As for the second part of the problem, she orally stated the correct solution but when working the problem used another solution altogether.

The last student, J, worked the problem after reading it only once, and his solution was incorrect. The second part of the problem was not attempted nor even reread.

Errors and Their Apparent Cause

The errors discussed below were observed from both the oral and written solutions to the problems. The cause, when apparent, is also discussed in this section.

Good students.--The only error made by A in the first part of the problem was an error in the multiplication of two fractions. Evidently she was working so fast that she made the mistake, and she did not catch her error until she had multiplied for a third time. Her error in the second part of the problem, however, was due to a lack of understanding of the problem. She assumed that Mr. James owned the entire club, and that if he sold 8/15 of it he would have 7/15 left.

The second student, B, made no mistake in the first part of the problem, but in the second part she subtracted 2/3 which

he sold from 4/5 and her answer was 2/5. Had she subtracted 8/15 from 4/5 she would have been correct.

Student C made her mistake in the first part of the problem. She ignored one of the two fractions necessary in the solution of the problem, but soon saw her error and corrected it. This student made no error in the second part of her work.

Average students.--The errors of students D, E, and F are noted and commented on in this part of the discussion.

Student D made no attempt at all, so the only conclusion that can be drawn about the cause of her not attempting the problem is that she was totally unable to comprehend the problem.

The error made by E was an apparent inability to realize that he had the correct answer. Another reading of the problem might possibly have kept him from adding another step to his correct solution. His error in the second part was the same as B's; he subtracted 2/3 from 4/5 instead of subtracting 8/15 from 4/5.

The last average student, F, like C, omitted one of the fractions in the solution to the first part of the problem. The error made in the second part of the problem is not evident either on his written solution or in his oral solution.

Poor students.--As might be expected, the poor students took more time and made more errors than did either of the other two groups.

The first poor student ignored one of the fractions in the first part of the problem, but she later stated the correct solution to the problem. Her error appears to be a lack of

understanding of the problem, and the correct oral solution was just a trial-and-error attempt.

Student H started quickly and correctly, but erred in his thinking before the end of the problem. He computed the fraction 8/15 as the amount of the ball club that was sold, but for some reason H assumed that 8/15 was the amount kept, so 7/15 was the fractional part of the club that was sold. Then in the second part of the problem he reversed his thinking in the first part, and decided that 7/15 was the amount of the club that Mr. James still owned.

Student I took a great deal of time, but omitted one of the fractions in the first part and therefore had a wrong solution. In the second part of the problem she stated the correct method of procedure, but did not use that method in her written solution. She let 3/3 equal the entire club, subtracted 2/3 from it, and arrived at 1/3 as the fractional part of the club still owned.

J, the final student, also omitted one of the fractions and solved the first part of the problem. His not attempting the second part of the problem indicates a lack of comprehension of the problem.

Summary

The results of the solutions to this problem are presented in Table 1. There were only three students who arrived at the correct answer to the first part of the problem, and these students read the problem an average of one and one-third times each.

TABLE 1

SUMMARY OF SOLUTIONS TO PROBLEM 1

Student	Correct Answer		Number of Times Problem Was Read		Types of Errors									
					Failure to Comprehend		Omission of Essential Data		Method of Attack		Partial Understanding		Fundamental Process	
	Part		Part		Part		Part		Part		Part		Part	
	1	2	1	2	1	2	1	2	1	2	1	2	1	2
A	Yes	No	1	1	..	..	..	..	..	..	..	X	X[a]	..
B	Yes	No	1	1	..	..	..[b]	..	..	..	..	X	..	..
C	Yes	Yes	2	2	..	..	X	..	..	..	..	..	..	..
D	No	No	3	3	X	X	..	..	..	..	..	..	..	..
E	No	No	1	1	..	..	..	..	..	..	X	..	..	..
F	No	No	2	2	..	..	X	..	..	X	X	X	..	..
G	No	No	3	2	..	..	X	..	..	..	X	X	..	..
H	No	No	1	2	..	..	..	..	X	..	X	X	..	..
I	No	No	2	2	..	..	X	..	X	X	..	..	..	..
J	No	No	1	1	..	X	X	..	..	..	..	..	..	..

[a]Error in multiplication
[b]Error later corrected

The students who did not get the correct answer read the problem an average of one and eighty-six hundreths times each. In the first part of the problem, then, getting the correct answer evidently did not depend on reading the problem several times, for two students worked it correctly after reading it only once each. The main difference between the method used by the students who solved the problem correctly and those who solved it incorrectly is that the students who were unable to solve it omitted one of the fractions in the problem. As Table 1 indicates, five of the six students who attempted but missed the problem omitted an essential element. They did not see the relation between the two fractions, while the ones who worked it correctly immediately noticed the relationship.

Only one student, C, was able to work the second part of the problem correctly. She read the problem two times, and then worked it without any false starts. The other nine students, read the problem an average of one and two-thirds times each, indicating that insufficient reading was partly responsible for the incorrect solutions. Student C had no trouble in understanding the problem, while five other students had only a partial understanding of the problem, as is shown in Table 1. Of those five, two of them read the problem only once. Student J, who was unable to comprehend the problem, also read the problem only once.

CHAPTER III

AN ANALYSIS OF THE METHODS OF SOLVING STATED PROBLEMS INVOLVING PERCENTAGE

The subject of percentage cannot be adequately covered in one problem. There are so many processes involved in percentage that several problems are necessary to include them all. As Edwards puts it:

> Handling percentage is not a single thing to be learned; rather it involves various skills, aspects, processes, or phases, or a heirarchy of processes. In any one example not all these processes appear. The correct working of any given example demands of the pupil not only that he use the correct response, but also that he do not use other responses which in other examples would be correct.[1]

Two problems which dealt with percentage were included on the test. Actually, the two problems were worked exactly alike, but the wording of each problem was such that a thorough understanding of each problem was necessary before the student could realize that the same process was needed for each problem. Also, the problems were separated so that it would be more difficult for the students to realize that the problems were actually the same type.

The Problem

The first problem in percentage was as follows: "The

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[1]Arthur Edwards, "A Study of Errors in Percentage," Report of the Society's Committee on Arithmetic, Twenty-Ninth Yearbook of the National Society for the Study of Education, Part II, p. 628

costs of advertising of a certain concern amounted to 18 per cent of its gross sales. If the expenses amounted to $3,850.00, find the gross sales."[2]

Correct solution.--The correct solution to the problem required the knowledge that $3,850.00 was 18 per cent of some number, and that number was gross sales. To find the gross sales, $3,850.00 should be divided by .18, and the answer is $21,388.89.

The second problem concerning percentage was, "An agent received $35.00 commission on a sale. If he received 8 per cent on the sale, the sale amounted to how much?"[3]

Correct solution.--Exactly the same procedure used in the first problem was required here. $35.00 is 8 per cent of what number? To find that number, divide $35.00 by .08, and the answer is $437.50.

General Method of Attack

Good students.--Student A began working the problem after reading it only once, but she started wrong because she did not understand it sufficiently. After some meaningless calculation, she realized she was not attacking the problem correctly, and read the problem a second time. After the second reading she immediately stated "$3,850.00 is 18 per cent of

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[2]Walter Maxey Williams, "Development of a Workbook For Business Mathematics Based on the Needs of Students of Business at North Texas State College"(Unpublished Masters thesis, North Texas State College 1947), p. 120.

[3]Ibid, p. 153.

what number, and that number is the gross sales." From that time the problem gave her no further trouble, and after arriving at the correct answer she checked it to make sure she had worked it correctly.

The second problem gave her no difficulty, possibly because she recognized it to be the same type as the first percentage problem. She read it once, worked it correctly, and checked her answer to be sure it was right.

The second student took time to read the first problem twice before attempting it, and then she worked it correctly. The second reading of the problem was made necessary by the fact that she did not completely understand the relationship of the words "costs" and "expenses" as they were used in the problem. As soon as she realized that the two words meant exactly the same thing, the problem was worked quickly and correctly.

The second percentage problem required only one reading for B to understand what was required. She stated, "$35.00 is 8 per cent of X, and to find X you would divide $35.00 by 8 per cent."

Student C had some difficulty also in associating the meaning of the words "costs" and "expenses", but one reading of the problem was sufficient for her to understand and work the problem.

The second problem gave C no trouble at all; she understood it after one reading, and proceeded to work it.

Average students.--Student D, who was completely unable to comprehend the problem involving fractions, had very little trouble on the percentage problems. The first percentage problem was read twice by D, who then stated, "$3,850.00 equals 18 per cent. Sales equal 100 per cent. Divide $3,850.00 by 18 per cent." Problem two was also easy for her; only one reading was necessary for her to decide on the correct course of action.

Student E read each of the two problems once, worked them both alike, and both solutions were wrong. In the first problem he subtracted 18 per cent from 100 per cent before dividing, and in the second problem he subtracted 6 per cent from 100 per cent before dividing. He undoubtedly had the general idea of how the problem should be solved, but was unsure of the details.

The following student, F, also read each of the two problems once, and worked one of them correctly and one of them wrong. He multiplied in the first problem, and correctly divided in the second one. Evidently the problems were not the same type as far as he was concerned.

Poor students.--Three readings and a great deal of thought were necessary before G could comprehend the method needed to solve the first of the two percentage problems. The two words "costs" and "expenses" gave her trouble, and necessitated the three readings. However, after reading the second problem only once she was able to work it correctly.

Student H evidently had no understanding of this type of percentage problem. He read each of the problems twice, gave them some thought, but was unable to make a start on either one.

I, who took longer on the test than did any other student, did not devote enough time to these two problems. She read each of them only once, then proceeded to work them in the same, incorrect manner. Her answers were both obtained by the process of multiplication instead of division.

The procedure used by the last student, J, is similar to F's procedure. In the first problem he multiplied instead of dividing, and arrived at the same answer F did. However, the second problem was read only once, and then J stated "6 per cent of what number is $35.00? That would be $35.00 divided by 6 per cent." He arrived at the correct solution except for a minor error which will be pointed out later. The fact that J worked the problems differently indicates that he, too, could see no relationship between them.

Errors and Their Apparent Cause

Good Students.--The first student's false start in working the first problem was apparently due to a lack of understanding of the problem. She first subtracted 18 per cent from the gross sales, 100 per cent, and then stopped, realizing that she was using the wrong procedure. After reading the problem a second time, she worked it correctly and there was no error whatsoever in the last problem.

Student B's only error was a failure to carry out her answer to the nearest two places in the first problem. Her answer was one cent less than the correct one; in all, five of the students were guilty of this same, careless error.

A mistake in division was C's only error in the first problem. Her method was entirely correct, but in dividing she made a mistake which caused her answer to be $56.00 less than the correct answer. She checked her answer, realized that it was wrong, but did not correct it. In the second problem she did not carry her division far enough to obtain an accurate answer.

Average students.--A near perfect solution to both problems was given by D. She read them both, knew what method was needed, and made only a minor error in not carrying her first answer to the nearest cent.

The procedure which E used in solving both problems indicated that he had only a general idea of the method needed to work the problems. He first subtracted the percentages from 100 per cent, and divided the remainders into the amounts given in the problems. This method gave him, in the first problem, the gross sales minus expenses (instead of gross sales), and the sale minus the commission (instead of the commission) in the second problem. A clearer understanding of the problem, and a check would have shown E that his answers were incorrect.

The wrong procedure was used altogether by F in the first problem. He multiplied, then subtracted, just as E did in

both of the problems. In the second problem, however, he used the correct method without hesitating. It is entirely possible that in the first problem the words "costs" and "expenses" were responsible for his failure to work it correctly.

Poor students.--G was the only one of the poor students who was able to comprehend the meaning of both of the percentage problems. She deliberated for quite awhile about the words "costs" and "expenses", but as soon as it was clear to her that they meant the same thing she was able to work the problem using the proper method. The second problem was solved by this student without difficulty.

Student H simply did not comprehend either of the percentage problems. Two readings of each problem did not help him, and it is evident that he was totally unfamiliar with the problems.

Student I evidently did not understand the problems, but she at least made an attempt to work them. She multiplied each of the percentages by the amounts given in the problems, then subtracted the products from those given amounts. Her procedure, like E's, was entirely wrong, and may have been a result of the fact that the way she worked the problems was the easy way to solve them.

The last student, J, did essentially the same thing that F did in solving the two problems. The first one was worked by multiplication instead of division, while the second one was worked as correctly and quickly as it was by any other student.

It is quite possible that J was also troubled by the words "costs" and "expenses" in solving the first problem.

Summary

Table 2 indicates that only one student, A, was able to solve the first problem entirely correctly, although there were four other students who would have had the correct answer if they had carried their division out further. Thus, we can assume that five out of the ten students worked the problem correctly if we omit the minor error which four of them made that caused their answers to be one cent less than the correct answer. These five students read the problem an average of two times each, while the other five read the problem an average of one and one-fifth times each. This problem was short, but the results indicate that to work it successfully it was necessary for the student to read it at least two times.

The results also indicate that two of the students who were unsuccessful in working the problem had some difficulty with the wording. For that matter, three of the students who worked the problem correctly had some difficulty with the wording. In this case we cannot assume that the students are entirely at fault; this is a good example of the fact that stated problems are not always clearly worded.

Five students successfully solved the second percentage problem, and two others would have if they had carried their division out further. Of the remaining three who did not arrive at an answer anywhere near the correct one, two of them

TABLE 2

SUMMARY OF SOLUTIONS TO PROBLEMS 2 AND 4

Student	Correct Answer		Number of Times Problem Was Read		Types of Errors									
					Method of Attack		Funda-mental Process		Division Not Com-pleted		Failure to Com-prehend		Trouble With Ter-minology	
	Problem		Problem		Problem		Problem		Problem		Problem		Problem	
	2	4	2	4	2	4	2	4	2	4	2	4	2	4
A	Yes	Yes	2	1	..	..	..	..	..	..	..	..	..	..
B	No	Yes	2	1	..	..	..	..	X	..	..	..	X	..
C	No	No	1	1	..	..	X[a]	..	X	X	..	..	X	..
D	No	Yes	2	1	..	..	..	..	X	..	..	..	..	..
E	No	No	1	1	X	X	..	..	..	..	..	..	..	..
F	No	Yes	1	1	X	..	..	..	..	..	..	..	X	..
G	No	Yes	3	1	..	..	..	..	X	..	..	..	X	..
H	No	No	2	2	..	..	..	..	..	..	X	X	..	..
I	No	No	1	1	X	X	..	..	..	..	..	..	..	..
J	No	No	1	1	X	..	..	..	..	X	..	..	X	..

[a]Error in Division

used identical methods of attack. They both multiplied the percentages by the amounts, whereas it was necessary to divide the percentages into the amounts. Table 2 shows that the other student who did not get the correct answer made no attempt to work it, and also did not try to work the first percentage problem.

CHAPTER IV

AN ANALYSIS OF THE METHODS USED IN SOLVING A STATED PROBLEM INVOLVING BANK DISCOUNT

Business men often make use of the procedure of discounting commercial paper at the bank in order to obtain ready cash. As Williams says:

> When a business man is in need of immediate funds, he may make a short-term loan from a commercial bank on his own note, or if he is in possession of promissory notes or trade acceptances of his customers, he may sell these notes. This procedure is known as discounting notes.[1]

A problem in bank discount involves several different procedures. First of all, the student must be able to compute interest in order to work a discount problem. Knowledge is also needed of the proper method of counting the days in the discount period, and several terms which are frequently used in dealing with bank discount must be a part of the student's vocabulary.

The particular bank discount problem used on this test includes all the items listed above. If a student was unfamiliar with one or more of them, then he could not cope with the problem. He might make an attempt, but to be successful he must use all of the items which are listed.

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[1]Walter Maxey Williams, "Development of a Workbook For Business Mathematics Based on the Needs of Students of Business at North Texas State College" (Unpublished Masters thesis, North Texas State College 1947), p. 157.

The Problem

The following discount problem was the one used on the test: "Everett gives Fowler a $750, 5 per cent note for one year. Four months after receiving it Fowler discounts it for 7 per cent. What are the proceeds?"[2]

Correct solution.--The following steps should be taken in this order: first, find the maturity value of the note; second, determine the number of days the note still has to run in the discount period; third, find the amount of the discount; fourth, find the proceeds.

The maturity value of the note is found by multiplying the face value, $750, by the rate of interest, 5 per cent, and adding the answer thus obtained to $750. The maturity value is $787.50.

To determine the number of days the note has to run from the discount date to the maturity date, subtract the total number of days for which the note was made, 360, from the number of days it ran before being discounted, 120. The number of days in the discount period is 240; however, 245 days was also acceptable as the correct discount period, because banks count the exact number of days in discounting a note.

The amount of the discount is found by multiplying the maturity value of the note, $787.50, by the discount rate, 7 per cent, by 240 days, and dividing by 360 days. The bank charge, or discount, is $36.75.

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[2]Ibid, p. 162.

The proceeds are found by subtracting the bank discount, $36.75, from the maturity value, $787.50. The proceeds are $750.75.

General Method of Attack

Good students.--The first student read the problem only once and immediately stated the correct solution to the problem. She knew exactly what to do, step by step, although at one point in the process she stopped momentarily to have a look at her procedure to make sure it was right. The correct answer was not obtained, however, because of a minor error.

B was also able to comprehend the problem after reading it only once, and her method of procedure was very similar to the one outlined in the correct solution section. However, she made two attempts at working the problem. She worked it once, and then later after she had solved all the problems on the test and was checking some of them, she found an error that she had made and she reworked part of the problem and obtained the correct answer.

The third student read the problem twice before she attempted to work it. She started correctly, but then made an error that is very common in bank discount problems. Her error was in basing the bank discount on the face value of the note. The poorer students were expected to make this kind of error, but this good student was not.

Average students.--Whether D was unfamiliar with this type problem, or whether the interest section of the problem troubled

her, is not clear, but after reading the problem two times she left it and started reading the following problem.

E's habit of reading the problem one time only probably caused him to miss this problem just as he has missed some of the problems previously discussed. He again had the correct general procedure, but in the second step he made an error which could have been eliminated easily by an additional reading of the problem.

It is evident that F was not sure that he understood the problem after his one complete reading of it, for he continually referred to parts of the problem as he worked it. His lack of understanding is also evident from his method of attack, which was just about as wrong as any method could be for this type of problem. He probably knew no more about the problem than D, who did not even make an attempt to work it.

Poor students.--Student G's first reading of the problem undoubtedly gave her as much understanding of the problem as twenty readings would have. She did not know what to do first; for that matter, she just did not have any idea how the problem should be worked, and after a short calculation she arrived at an answer that was hopelessly illogical.

The following student, H, was as wrong as was G. He read the problem two times in an effort to determine what should be done first, but used an entirely incorrect method of attack, and his answer, although not completely illogical, was much too small to be the correct answer.

Slow-reading, slow-working I read the problem twice and worked it in the same manner that G did, and arrived at nearly the same, illogical answer that G did. The answers differed by 87 cents, but were some $727 from the correct answer. I used several methods before finally deciding on the one similar to G's. It seemed that her numerous methods were trial-and-error starts, and she never was sure that any one of them was more nearly right than any other.

The last student read the entire problem once, then the last part of it again, and surprisingly worked the problem by the right procedure until the very last step. This type of problem was evidently clear in his mind, but the final step showed that he was not familiar with all the details. However, it is worth mentioning that only the three good students had better methods of procedure than did J who consistently misunderstood almost all the rest of the problems.

Errors and Their Apparent Cause

Good students.--The first student knew how to work the problem, but she stated that she was not sure whether the bank discount was based on the maturity value or the face value of the note. Her indecision was due to the fact that she first worked the problem through, basing the discount on the maturity value, and her answer was more than the face value of the note. She did not think it was possible, at first, for the proceeds to exceed the face value of the note, but finally decided that was correct although she was never quite sure of that point.

Her answer, almost correct, was wrong because of an error in multiplication in the final step.

Student B correctly stated, step by step, the procedure needed to work the problem. She followed that procedure too, except during an inexplicable moment in which she decided that the note had six months instead of eight to run during the discount period. However, after working the rest of the test, B came back to this problem, read it again, rechecked her work, and discovered and corrected the error she had previously made. Her final answer was the only correct solution to this problem.

C made a minor error in subtraction in this problem, which she later corrected, but her big error went unnoticed. She based the bank discount on the face value of the note instead of the maturity value. This is a common error in bank discount problems, and probably results from a lack of understanding of the bank's reasoning in discounting a note.

Average students.--No explanation can be given for D's failure to attempt a solution except that she was unable to comprehend; this was the second problem that D omitted.

Two errors were responsible for the failure of E to work this problem correctly. First of all, he used the bank discount period as the length of time the note had run before the discount date, instead of the length of time it had to run from the discount date to maturity. Then in solving the problem using this wrong procedure, he misplaced a decimal which made his answer too small, when because of the method he used it

should have been too large. Using the wrong period of time as the discount period is another common error in bank discount problems, and also results from the lack of a clear understanding of the situation.

Student F's attempt to work the problem shows that he had little knowledge of the method for working it. He completely ignored the fact that the note was interest-bearing; thus he neglected to determine the maturity value of the note which was the first step of the correct solution. Actually, all F did was to discount a $750 note at 7 per cent for eight months, and that he did correctly, but of course his answer to the problem was incorrect.

Poor students.--Student G did numerous things wrong. First she found the correct amount of interest which the note would earn during one year, but failed to add the interest to the face value. Next, she found what the bank would charge to discount a $750 note at 7 per cent for four months, and in doing this she made an error in division and arrived at $14.13 instead of $35.00. Then she simply subtracted the incorrect bank discount from the amount of the interest which the note would earn in one year, and arrived at the illogical answer of $23.37. Evidently she did not know what "proceeds" meant; she did not know what she was trying to find.

Student H's method of attack was similar to F's. He neglected the fact that the note was interest-bearing, and simply discounted a $750 note at 7 per cent for four months,

and of course arrived at a wrong answer. His only difference from F's solution was that H used four months as the discount period, and F used eight.

Student I never did find the maturity value of the note, although she did find the correct bank discount based on the face value of the note. Then she found how much interest had been earned on the note for the four months before the note was discounted, and subtracted that amount from the amount she first found. This method was similar to the one used by G, and the answers would have been the same but for G's error in division. If both of the students had thoroughly understood the words "net proceeds," surely they would have realized that their answers were not correct.

J worked a large part of this problem correctly before faltering on the final step. He correctly found the maturity value, discounted that maturity value for the number of days in the discount period, but failed to divide by 360 days in finding the bank discount. Also he added the bank discount to the maturity value instead of subtracting. The reason he added in the last step is due to a lack of understanding of "net proceeds." He simply said, "Add the bank discount to the maturity value to find the net proceeds." Regardless of these errors, his <u>method</u> was more nearly correct than those of most of the other students.

Summary

Student B, as Table 3 shows, was the only one of the ten

TABLE 3

SUMMARY OF SOLUTIONS TO PROBLEM 3

Student	Correct Answer	Number of Times Problem Was Read	Types of Errors				
			Maturity Value Not Found	Wrong Discount Period	Fundamental Process	Method of Attack	Trouble With Terminology
A	No	1	..	..	X[a]	..	..
B	Yes	2	..	X	..	..	..
C	No	2	..	..	X[c]	..	..
D	No	2	..	..	..	..	X
E	No	1	..	X	X[d]	..	..
F	No	1	X	..	..	..	..
G	No	1	X	..	X[b]	X	X
H	No	2	X	X	X[a]	..	..
I	No	2	X	..	..	X	X
J	No	1	..	..	X[a]	X	X

[a]Error in multiplication
[b]Error in division
[c]Error in subtraction
[d]Misplaced decimal

students who obtained the correct answer. She read the problem twice, found the maturity value of the note, determined the correct discount period, and then arrived at the bank discount. After finding the bank discount, she subtracted it from the maturity value to find the proceeds. This was the necessary procedure for the correct solution to the problem.

The other nine students were unable to solve the problem correctly. None of them read the problem more than twice, and most of them read it only once, as Table 3 shows. They read it an average of one and four-ninths times each, which proved to be insufficient; four of them used the wrong method of attack, probably as a result of not reading the problem a sufficient number of times to thoroughly understand it.

Four of the nine students failed to find the maturity value of the note, which should have been the first step in working the problem. Four students also were unable to carry out all the steps necessary in the solution of the problem. Of these last four, two of them did not know what to subtract in the last step to find the proceeds, while another one added the bank discount to the maturity value to find the proceeds. These last four students were unfamiliar with the terminology; they did not know what "net proceeds" meant, and, as a result, did not know what they were trying to find.

Two students could not determine the correct discount period, which is a common error in bank discount problems. Even student B had trouble on this part, and it was not until

she was checking her solutions that she discovered she had previously erred in determining the discount period.

Five students, as indicated in Table 3, could not have solved the problem correctly even if they had known each step necessary to solve it. Errors in the fundamental processes actually did keep two students from arriving at the correct answer, while the other three students made other errors in addition to a fundamental process error.

CHAPTER V

AN ANALYSIS OF THE METHODS USED IN SOLVING A STATED PROBLEM INVOLVING MARKED PRICE

Marked price problems are generally harder for students than any other type of problem included on the test. However, a relatively easy markup problem was selected for this test; the fundamental processes required were easy, and if the student selected the correct method of procedure, he should have been able to solve the problem without any difficulty with his computation.

As a general rule, markup is based on the selling price. Occasionally it is based on cost, and in actual business the cost is always known. Thus, the process of determining markup based on a per cent of the cost is very simple. The problem used on this test bases the markup on the cost but does not give the student the amount of the cost price; only the selling price is given. The purpose of this type of problem is to test the students' knowledge of the relationships involved in a marked price problem.

The Problem

The problem is one which is short enough to enable the student to remember it in its entirety, yet it must be completely understood before it can be worked. The problem is as

follows: "A certain machine sold for $95.50. What must have been the cost if a profit of 25 per cent of the cost of the machine was made?"[1]

Correct solution.--The correct answer is limited by the fact that a profit was made. Therefore, the cost price must be smaller than the selling price. If the profit is based on cost, then cost must be unity or 100 per cent, and the profit is 25 per cent. After these facts are determined, the following solution can be effected:

> Cost + Profit = Selling Price
> 100% + 25% = 125%, or Selling Price
> Therefore, selling price, $95.50 = 125% of cost
> To find cost, which is 100%, divide $95.50 by 125%, and the answer is $76.40.

To check the answer, take 25 per cent of $76.40, which is $19.10, and add it to $76.40 to get the selling price, $95.50.

General Method of Attack

Good students.--The problem was no puzzle at all to A, who read it once and immediately stated the correct procedure for working it. In addition, after A had arrived at the correct answer, she checked her solution by the method given in the correct solution section above, and thus knew that her answer was correct.

B took even less time to work the problem than A did. One reading led to a quick and correct solution, and she, too,

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[1]Walter Maxey Williams, "Development of a Workbook For Business Mathematics Based on the Needs of Students of Business at North Texas State College" (Unpublished Master's thesis, North Texas State College), p. 141.

checked her answer to be sure it was correct. Each one of these first two students spent less than two minutes in solving the problem.

Student C was the only one of the three good students who required more than one reading to work the problem. Even after two readings she had a false start, and after correcting that mistake she later had a minor error that was also corrected. C finally arrived at the correct answer, and like A and B, she checked it to be sure it was right.

Average students.--D was guilty of the same false start that C made, but also found her error and proceeded to work the problem without further difficulty. She made no effort to check her answer; it is probable that because her answer was an even one she was fairly sure it was correct.

Student E again read the problem only once, thought he knew the procedure for working it, but his answer was far above the reasonable limit. His answer was such that the cost of the machine was larger than the selling price, an impossible fact since the problem clearly stated that a profit was made on selling the machine. No attempt was made to check his answer, so E must have been sure that he had worked the problem correctly.

F read the problem twice but did not have it in mind very well because he referred to parts of it as he worked it. He used the wrong method of attack, and his answer, while not so high as E's, was still above the $95.50 limit.

Poor students.--G evidently used the trial-and-error method in solving this problem, just as she did on other problems in this test. She used two methods in this problem, first an incorrect one, and then the correct one, but she thought her first answer was the right one. Even though she chose the wrong solution, her answer was within the limits of reason and actually very close to the correct answer. She used the method that was probably one of the easiest to use in a problem of this type, although it was incorrect.

H was the only one of the poor students to work the problem correctly, and he did so after only one reading and no false starts. The problem was clear to him, and his answer was just two cents off the correct answer because of a minor error near the end of the solution. Had he checked his answer he could have undoubtedly found and corrected this error.

Student I read the question three times, then proceeded to use the same procedure in working the problem that G did, and obtained the same answer. This is the second problem on the test that students G and I have worked exactly alike and obtained the same answers.

J read the problem once, and then was silent for a long time. Undoubtedly he read the question several times during the period of silence, but it was fully five minutes before he spoke again at which time he reread the problem. He then made a futile, incorrect start on the problem, but did not carry it very far. He obviously did not know what to do,

but he certainly spent enough time trying to understand the problem before leaving it to go to the next one.

Errors and Their Apparent Cause

As was expected, errors in the fundamental processes were not so numerous on this problem as they were on some of the other problems, and they were confined to the average and poor groups of students.

Good students.--Neither student A nor B made any error whatsoever in working this problem. Student C, however, made two minor errors, both of which she corrected in time to obtain the correct answer. At first she let 100 per cent equal the selling price, 25 per cent the profit, and, by subtracting, 75 per cent the cost. Actually, this procedure resulted in a 33 1/3 per cent profit on cost instead of a 25 per cent profit. She soon recognized this fact, and then correctly worked the problem. In checking her answer she made an error in multiplying $76.40 times 25 per cent, but she also corrected that error.

Average students.--Student D was as good as the good students on this particular problem, although she had previously omitted two problems because she did not know how to work them.

The first student to fail to work the problem correctly was E. His method was similar to C's false start; he arrived at the fact that 75 per cent was equal to the cost of the machine, and he proceeded to divide $95.50 by 75 per cent, and

his answer was an impossible $127.33. He actually used $95.50 as the cost, and his answer would be the correct selling price if a profit of 25 per cent of $127.33 was made. In other words, he completely changed the meaning of the problem as he worked it.

F was also very much confused by the problem. He incorrectly based the profit on $95.50, the selling price, by multiplying the selling price times 25 per cent and adding the product to $95.50. The profit, as he computed it, was $23.88, and after arriving at that figure he stated, "Cost $95.50, profit was $23.88, so the cost of the machine is $119.38." Within one sentence he stated that the cost of the machine was $95.50 and $119.38. That is evidence that he was unsure of his procedure in working the problem.

Poor students.--G started working the problem by the same procedure that F used, but was a little more logical in the final step than F was. She took 25 per cent of $95.50, let her answer represent the profit, and then subtracted that profit from the selling price to get $71.62. She based the profit on the selling price instead of the cost price as the problem states.

Later G worked the problem correctly, and arrived at the answer of $76.40. However, she believed that her first answer was correct, and did no further work on the problem. It is obvious that had she checked her two answers she could have determined which one was correct.

H started and worked the problem as correctly as did any of the students until he arrived at the very last part of the problem. In dividing $95.50 by 125 per cent he made an error and his final answer was $76.42--just two cents too much. He was the only student in the group whose method was right but whose computation was wrong.

I's solution was as near like G's as it could possibly be. However, I did not make the correct solution that G did; she made only one solution basing her 25 per cent profit on the selling price instead of the cost.

J's inability to comprehend is evidenced by the length of time he spent trying to understand the problem and the meaningless calculations he made at the beginning of the problem. His statement regarding the problem was as follows: "Selling price is 100 per cent; profit is 25 per cent; cost is 125 per cent." He did not indicate whether he realized that it was impossible to have the cost greater than the selling price when a profit was made, but, at any rate, no further work was done on the problem.

Summary

It is evident from the tabulation of the results of the solutions to the marked price problem, shown in Table 4, that it was not necessary to read the problem more than once. It was a short problem, and did not require a great deal of thought. Four students worked it correctly, and only one of them found it necessary to read the problem more than one time. A fifth

student, H, worked the problem correctly except for a minor error in division which caused his answer to be two cents more than the correct one, and he, too, read the problem only once. The five students who did not correctly work the problem read it an average of one and three-fifths times each.

TABLE 4

SUMMARY OF SOLUTIONS TO PROBLEM 5

Student	Correct Answer	Number of Times Problem Was Read	Types of Errors		
			Method of Attack	Fundamental Process	Unable to Comprehend
A	Yes	1	..	..	..
B	Yes	1	..	..	..
C	Yes	2	X[c]	X[a]	..
D	Yes	1	X[c]	..	..
E	No	1	X	..	..
F	No	2	X	..	..
G	No	1	X	..	..
H	No	1	..	X[b]	..
I	No	3	X	..	..
J	No	2	..	..	X

[a]Error in Multiplication
[b]Error in Division
[c]Errors Later Corrected

The students who worked it correctly determined that if the 25 per cent profit was based on cost, then cost was 100 per cent, and the selling price was 125 per cent. The other five students, were not able to grasp that important fact. Table 4 shows that four of the five used the wrong method of attack while another was completely unable to comprehend the problem.

Two of the four who attempted the problem but were unable to arrive at the correct answer had an answer that was greater than the selling price, which was impossible in this problem. The remaining two had solutions alike; they both worked the problem using an easy method of handling percentage, but their method had no relation to the problem they were working. They did not understand the situation, but used a "type" solution which seemed to them as if it would solve the problem.

CHAPTER VI

AN ANALYSIS OF THE METHODS USED IN SOLVING A STATED PROBLEM INVOLVING INVENTORY AND TURNOVER

Students study the subjects of inventory and turnover in high school business courses, and some of them study inventory and turnover briefly in the elementary grades. In college, inventory and turnover are studied in accounting as well as business mathematics, so most business students are exposed to them at least once and possibly twice during their college education.

An inventory is a list of goods on hand at a certain date, and can be calculated at either cost or selling price. "Average inventory" is the average value of the inventories that are taken during a given period of time.

"Turnover" is the number of times the average inventory is sold each year, or for some specific period of time. To find the rate of turnover it is necessary to divide the amount of goods sold by the average inventory. If the inventory is taken at cost, the amount of goods sold must be calculated at cost price. If the inventory is taken at selling price, the amount of goods sold must be calculated at the selling price. The rate of turnover is not a per cent, but the actual number of times the average inventory is sold.

The problem on the test involving inventory and turnover required the following three processes; calculation of net sales, finding the average inventory, and finding the rate of turnover.

The Problem

The following problem[1] was the inventory and turnover problem which was included on the test:

> The Jones Company takes inventory at selling price every six months. The inventory at the beginning of the year amounted to $54,860; at midyear, $46,832; and at the end of the year, $49,754. Gross sales for the year amounted to $101,500. Sales returns and allowances were .02 of the gross sales.
>
> (a) What are the total net sales? _____
> (b) What is the average inventory? _____
> (c) What is the rate of turnover? _____

Correct solution.--To find the net sales, take 2 per cent of the gross sales and subtract the product from gross sales. Thus, 2 per cent of $101,500 is $2,030; $2,030 subtracted from $101,500 gives $99,470 as the net sales.

For the second part of the problem, it is necessary to add the three inventories and divide by three. Thus, $54,860 plus $46,832, plus $49,754 equals $151,446, which, when divided by three, gives $50,482 as the average inventory.

Since the inventories were taken at selling price, the rate of turnover is found by dividing the net sales at selling

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[1]Walter Maxey Williams, "Development of a Workbook For Business Mathematics Based on the Needs of Students of Business at North Texas State College" (Unpublished Master's thesis, North Texas State College 1947), p. 112.

price by the average inventory. Thus, $99,470 divided by $50,462 gives 1.97 as the rate of turnover.

General Method of Procedure

Good students.--A started quickly and correctly after reading the problem only once, although for some reason she worked the average inventory part first. However, her procedure all the way through was similar to the correct solution above, and she arrived at the correct answer to all three parts of the problem.

B knew how to work the problem after one reading, but in the second step she made an error which, of course, carried into the third part and made the rate of turnover answer wrong also. She later, upon checking her work, caught her mistake and correctly reworked the last two parts of the problem.

C was completely confused on this problem. She did not reread the problem, an indication that she thought she understood it, and not one correct step was taken in the solution of any one of the three parts of the problem. In her first attempt at the problem, she omitted the last part, and did not work it until she had completed the test and was checking her work.

Average students.--Student D read the problem only once and made an attempt to work the first part, but was completely wrong in her procedure. The second part was correctly worked, but no attempt was made to work the final part of the problem. Had she known how to work it, her answer would have been incorrect because her net sales answer in part one was wrong.

Student E very promptly and correctly solved the first two parts of the problem, even though he had, as usual, read the problem only once. Although the third part was not clear to him, he did make an effort to solve it.

The next student, F, very quickly solved the first two parts of the problem, but the final part took much thought before he could decide on the method of attack to use. His decision was a wrong one, for the answer he obtained was far from being correct.

Poor students.--Student G read the problem, did the very first step of the first part correctly, and then stated, "I'll come back to that one." When she did come back to the problem she finished the correct solution to the first part, but then became completely lost on the second part. She did not know how to work the final part, and made no effort to solve it.

H worked the second part of the problem first and correctly, after reading the problem once. Two methods for working the first part of the problem were stated by H, but both were wrong. He used one of the methods and, of course, obtained the wrong answer. The method he used in the third part was absolutely correct, but his wrong answer in the first part of the problem made his final answer wrong.

Student I read the entire problem twice. She worked all three parts of the problem incorrectly, then on checking her work, she caught her mistake in the first part, but did not change her answers to the other two parts. From looking at

her answers on the test, one might think that she had misplaced the answers in putting them in the test blanks, but she stated, "The average inventory is 1.52 (pause), the rate of turnover would be $99,470 subtracted from $151,446 which would be $51,976."

Student J correctly solved the first two parts of the problem, although in reverse order. The first part gave him some trouble, which is probably the reason he skipped it and worked the second part first. His rate of turnover answer was similar to F's and about as far from the correct answer.

Errors and Their Apparent Cause

Good students.--Student A did not make any mistakes. Although she did state that "the rate of turnover is the sales divided into the average inventory," she immediately corrected her statement and solved the problem correctly.

Student B made an error in determining the average inventory. She added the inventories and divided by two instead of three. However, on checking her solutions after working all the problems, she found the mistake and correctly divided the total of the inventories by three.

She also made an error in calculating the rate of turnover because of the error made in determining the average inventory, but that was also corrected as she checked her work.

It is difficult to understand just what happened to C's reasoning on this problem. To get net sales she subtracted the sales returns and allowances from the ending inventory,

then subtracted the remainder from the gross sales. That is a completely illogical procedure and indicates she did not know how to work the problem. In the second part of the problem, she added the inventories and divided by four to get the average inventory. She said, "Average inventory would be the three inventories added and divided by four which would be $35,361." C was evidently under the impression that the inventory was taken three times a year. In that case, it would have been correct to divide by four. However, the problem stated that the inventory was taken twice a year; therefore, to find the average inventory it was necessary to divide by three.

She omitted the third part until a later time when she divided the gross sales into the average inventory, instead of dividing the average inventory into the net sales. The methods needed in the solution of this problem were not at all clear to student C.

Average students.--D added the three inventories to find the net sales! No logical explanation for such action can be given. Her answer resulted in net sales being much larger than gross sales, an impossible fact. She correctly calculated the average inventory, but no attempt was made to work the last part of the problem, and with the wrong answer obtained in the first part any attempt to work the last part would have been futile.

Student E made no mistake until he arrived at the last

part of the problem. Then, in trying to compute the rate of turnover, he divided the total of the three inventories by the gross sales. While the answer thus obtained was within reason, it certainly did not represent the rate of turnover.

F was able to work the first two parts of the problem, but failed completely on the final part. To get the rate of turnover he subtracted the average inventory from the net sales and divided the remainder by the average inventory. Of course, this procedure is completely wrong.

Poor students.--Student G worked the first part using the correct method, and would have had the correct answer to the second part had her division been correct and had she been able to recognize the correct answer when she had it. She added the inventories, divided by three, and obtained the wrong answer because of a mistake in division. She then decided that was the wrong way to work the problem after all. The second start was made by subtracting the ending inventory from the beginning inventory, and then subtracting the remainder from the mid-year inventory. This answer was then divided by three to get the average inventory. G was again using her trial-and-error methods; she had probably memorized a procedure for working a problem of this type, and could not remember all of it at this time.

For the final step she correctly stated that to find the rate of turnover, the average inventory should be divided into the net sales, but was so unsure of that procedure that she did

not follow it, and thus was not able to give an answer for the rate of turnover.

H correctly found the average inventory first, probably because he was sure how to do it. To find the net sales, then, he subtracted the average inventory from the total of the inventories, thus completely omitting the sales figure given in the problem. His procedure for finding the rate of turnover was correct, but the error made in step one caused his final answer to be wrong.

To find net sales, I subtracted the final inventory from gross sales, and made an error in subtracting. However, she later reworked this part of the problem and obtained the correct answer. Then to find the average inventory she divided the net sales into the total of the inventories, which gave her an answer more in the form of a rate of turnover than an average inventory. She had 1.52 as the average inventory, and the answer should have been in dollars and cents. To get the rate of turnover, she subtracted the net sales from the total of the inventories and obtained $51,976 as the answer. Had the last two answers been reversed, they still would have been wrong but at least would have been reasonable.

The final student, J, correctly worked the first two parts of the problem. On the last part he stated, "the rate of turnover is the cost of goods sold divided by the average inventory." That is the correct procedure if the inventory had been figured at cost instead of selling price.

Summary

The first part of the problem was very easy, and should have been correctly worked by all the students. Only six of the students correctly solved the first part, as Table 5 shows, and they did so after realizing that sales returns and allowances must be deducted from gross sales to arrive at net sales. The arithmetic was very simple once the student had decided what to do. Only two of the six students needed to read the problem twice; the average student read the problem only one and one-third times.

The students who failed to get the correct answer also read the problem an average of one and one-third times. Three of the four students who had wrong answers did not know what they were trying to find; "net sales" did not mean anything to them, and they were just manipulating some figures. The other student had a wrong answer because of an error in subtracting the sales returns and allowances from the gross sales.

Seven students correctly worked the second part of the problem, and again only two of them found it necessary to read the problem twice. The necessary thinking in this part consisted of the following: there were three inventories given, so to find the average of the inventories simply add them and divide the total by the number of inventories.

The three students who were not able to arrive at the correct answer read the problem an average of one and one-third times each; only one of them read it twice. Two of these

TABLE 5

SUMMARY OF SOLUTIONS TO PROBLEM 5

Student	Correct Answer			Number of Times Problem Was Read			Types of Errors														
							Method of Attack			Failure to Comprehend			Fundamental Process			Omission of Essential Data			Trouble With Terminology		
	Part			Part			Part			Part			Part			Part			Part		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
A	Yes	Yes	Yes	1	1	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
B	Yes	Yes	Yes	2	2	2	..	X[c]	..	..	..	..	..	..	..	..	..	..	..	..	..
C	No	No	No	1	1	1	X	X	X	..	..	..	..	..	..	..	..	..	X	..	X
D	No	Yes	No	1	1	1	..	..	..	..	..	X	..	..	..	..	..	..	X	..	X
E	Yes	Yes	No	1	1	1	..	..	X	..	..	..	..	..	..	..	..	..	..	..	X
F	Yes	Yes	No	1	1	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	X
G	No	No	No	1	1	1	..	..	X	..	..	..	X[b]	X[a]	..	..	..	..	..	X	X
H	No	Yes	No	2	2	2	X	..	..	..	..	..	..	..	..	X	..	..	X	..	..
I	Yes	No	No	2	2	2	..	X	X	..	..	..	X[a]	..	..	..	..	..	..	X	X
J	Yes	Yes	No	1	1	1	..	..	X	..	..	..	..	..	..	..	..	..	..	..	..

[a] Error in Division
[b] Error in Subtraction
[c] Error later corrected

students had no conception of the term "average inventory." In fact, one of the two did not even know it should be in dollars and cents. The third student made her error in dividing the total of the inventories by four instead of three.

Table 5 also indicates that only two students were able to solve the last part of the problem correctly. These two students knew what the rate of turnover was and that to find it the net sales should be divided by the average inventory. One of the students read the problem once, while the second one read it twice.

Of the eight students who did not work this part of the problem correctly, seven of them failed because they did not know what they were trying to find. It is evident on all seven of the students' solutions that they did not know what they were doing. The last of the eight students who had wrong answers used the right method in solving the problem, but errors that he had made in the first parts of the problem kept him from arriving at the correct answer.

CHAPTER VII

FINDINGS AND CONCLUSIONS

The use of the wire recorder in this study made it possible to discover certain things in the methods which students use to solve stated problems which would not be apparent on the written solutions. For example, from looking at a student's wrong solution to a particular problem it would be impossible to determine whether or not the student had the correct solution in mind also, but did not know it was correct. However, the wire recorder revealed such information, for often students orally gave two or three solutions to a problem. It was also possible, through the use of the wire recorder, to determine if the students thought through a problem before they attempted to work it, or if they merely used some procedure they had memorized for a particular type of problem. The number of times the problems were read by each student was also revealed by the wire recorder, but was not apparent from the students' written solutions.

Findings

The following statements present the findings of this study in the methods used by business mathematics students in solving stated problems:

1. The students had difficulty understanding the terminology

of several problems. The meaning of several terms in the problems were not clear to some of the students, and the problems could not be solved by anyone who did not know what he was trying to find. All of the students pronounced all the words in the problems correctly, but it was evident that they were not always sure of exactly what they were trying to find. This may be due to two things. First, the students may be deficient in their knowledge of business terms; second, stated problems are not always clearly worded; often two or more logical meanings can be obtained from a problem.

2. The students often tried to make a type solution fit the particular problem they were working, without realizing that there was a definite problem rather than just a job they had learned to do. There was much evidence of the fact that students had memorized solutions to different types of problems, and if a particular problem had some of the elements in it that the problem did for which a solution had been memorized, the students would use the memorized solution. Of course, some students were able to use the correct type solution for the right problem, but more often than not the memorized solution did not fit the particular problem.

3. The students did not evaluate their answers in terms of the conditions and limitations of the problems. Many impossible answers to problems were obtained, yet the students were not able to see that their answers were, according to the terms of the problems, impossible.

4. The students were prone to engage in meaningless manipulation of figures with evident lack of any relation to what they were supposed to be doing. If a problem was not clear to them, they would simply use some of the amounts and figures given in the problem, and add, subtract, multiply, or divide, as they saw fit.

5. The students often attempted to solve problems without an understanding of the basic relations between the numbers or amounts that were essential for the solution of such problems. This was particularly true on the percentage problems; a definite understanding of the relationship between the factors involved was needed, yet many students tried to work the problems without an understanding of that relationship.

6. Most of the students did not employ obvious checking procedures to determine the correctness of their solutions. Only the three good students consistently checked their answers, while the other students overlooked simple and very easy checking procedures. Such checking procedures would have helped several students determine the correct answer to some problems, for in many instances students had more than one answer to a problem, including the correct one, but they were unable to determine which one was correct.

7. Students often took the "easy way" of solving a problem when the correct method of working the problem was unknown. If a student could see some easy method of procedure that was remotely related to the problem he was solving, then he would

use that method instead of trying to understand the problem thoroughly enough to work it correctly.

8. The students often had the correct procedure needed for solving a problem in mind along with several other methods, but had no way of knowing which one was the correct method. In many instances the students gave orally the correct solution to a problem, but, not knowing that it was the correct solution, often used another method in working the problem. Also, students would often state they were going to work a problem a certain way, often the correct way, but then proceed to use another method.

9. Often a student missed a problem simply because he did not read it a sufficient number of times to thoroughly understand the problem situation. Many students omitted parts of problems that had not stayed in their minds because they had not read the problems enough times. There is not a set number of times a student needs to read a problem; it differs with the student and the type of problem, but it was obvious that several students did not read the problems enough.

10. The students' errors in method were numerous, but twelve errors in the fundamental processes were also made. Five of them were made in division; four of these were mistakes in not knowing the multiplication table, while one was a result of subtracting incorrectly while dividing. Four of the twelve errors were made in multiplication; two as a result of not knowing the multiplication table, and two in adding incorrectly

while multiplying. The other three errors were made in subtraction.

Conclusions

Without doubt there is a definite need for the improvement of students' methods of solving stated problems, and the business mathematics teacher can be very helpful in aiding the students in improving their methods. It is undoubtedly true that students learn a certain way or technique for solving each of the various types of problems. The result is that some of the students memorize the steps needed in the solution of each type of problem, and in many cases have no understanding of the problem situation or even the terminology of a problem. When solving a problem then, the student has to identify a certain problem as to the type under which it belongs, remember the various steps in solving that type of problem, and apply them to that particular problem. If the student fails to see how the series of steps applies to a given situation, or if he does not remember the correct technique, or if he does not know what type the problem is, then he is lost and cannot work the problem unless by trial and error he happens to stumble upon the correct procedure. He has not really learned to solve problems, he has just learned and memorized specific things for specific types of situations.

Obviously there is a need for teaching students some general reasoning process in problem solving. A logical breakdown of the reasoning process could contain the following steps:

(1) What does the problem mean? (2) What is to be found? (3) What data are needed and in what order? (4) How are they to be used in finding it? (5) What limitations are set by the conditions of the problem on the size and nature of the answer? (6) How can the answer be checked?

The foregoing steps are not set down as the only reasoning process, but they are logical and if teachers could bring their students to follow those steps, then students would have better problem-solving techniques. However, teachers should not stress the reasoning process to the point of overlooking the computations involved in solving problems. Both items are necessary for solving any kind of stated problem.

Students' methods can also be improved if teachers can foresee some of the difficulties which students have, as noted in this study, and develop some teaching techniques to help students overcome those errors.

APPENDIX

The Test

1. Mr. James owned 4/5 of a baseball club and sold 2/3 of his share for $16,800. What is the value of the whole club at this rate? _____ What fractional part of the club does he still own? _____

2. The costs of advertising of a certain concern amounted to 18% of its gross sales. If the expenses amounted to $3,850, find the gross sales. _____

3. Everett gives Fowler a $750, 5% note for one year. Four months after receiving the note Fowler discounts it for 7%. What are the proceeds? _____

4. An agent received $35 commission on a sale. If he received 8% on the sale, the sale amounted to _____.

5. A certain machine sold for $95.50. What must have been the cost if a profit of 25% on the cost of the machine was made? _____

6. The Jones Company takes inventory at selling price every six months. The inventory at the beginning of the year amounted to $54,860; at mid-year, $46,832; and at the end of the year, $49,754. Gross sales for the year amounted to $101,500. Sales returns and allowances were 2% of the gross sales.
   a. What are the total net sales? _____
   b. What is the average inventory? _____
   c. What is the rate of turnover? _____

Student A's Oral Solutions

1. (Read the problem once). If he owned 4/5 of the club and sold 2/3 of it for $16,800, that would be 2/3 of 4/5 which would be 8/24; 8/24 would equal $16,800; 1/24 would be 8 into that which would be $2,100; 24/24 would be $50,400; so the whole club would equal $50,400. If he sold 2/3 of 4/5, which was what he owned, he sold 8/24; that would be 4/5 divided by 2/3; 4/5 times 3/2 would be 6/5 which is 1 1/5. That is not right--8 from 24 would be 16, so he owned 16/24 which would be 2/3; 2/3 of 4/5 is 8/15, and 8/15 equals $16,800, or 1/15 equals $2,100; 15/15 equals 15 times $2,100 which would be $31,500. The value of the whole club is $31,500. He sold 2/3 of 4/5, and that means that he sold 8/15; 8 from 15 would be 7, so he kept 7/15.

2. (Read the problem once). The expenses were 18 per cent, so the gross sales are 100 per cent; 100 per cent minus 18 per cent, which are the expenses, would be 72 per cent. (Read the problem again). $3,850 is 18 per cent of what number, and that number is the gross sales. So divide the percentage into the amount; that would be 18 into $3,850; mark off two decimal places. The gross sales will be $21,388.89. To check, 18 per cent of that would be $3,850.0092.

3. (Read the problem once). You have to find the maturity value of the note. That would be $750 times 5 per cent which is $37.50. Then, $750 plus $37.50 equals $787.50, which is the maturity value. Then you take the length of time which the note

has left to run--he discounts it four months after he gets it--that would be 8 months that he discounts it for. He discounts the maturity value at 7 per cent; 8/12 times 7/100 times $787.50; that is how much they take off the maturity value. That is wrong; you discount the face value. You subtract this, $36.48, from $787.50 because that is the maturity value; $36.48 is the discount so the proceeds would be $751.07.

4. (Read the problem once). What number is $35.00 8 per cent of? So you divide 8 per cent, which is .08, into $35.00 and add two decimal places. The sale was $437.50. To check, take 8 per cent of that and that is $35.00 which is right.

5. (Read the problem once). It sold for $95.50, and if he made 25 per cent of the cost, then 100 per cent would be the cost, plus 25 per cent profit. 125 per cent equals $95.50; $95.50 is 125 per cent of something, so you divide 125 into $95.50; that would be $76.40 which is the cost. To check, take 25 per cent of $76.40, which is $19.10. Add them and get $95.50.

6. (Read the problem once). First, add the inventories, and that would be $151,446; that is how much they had. Then the gross sales were $101,500, and allowances were 2 per cent of that, and that would be $2,030. Then you subtract that from the gross sales to find the net sales; $99,470 would be the net sales. Divide the inventories by three. That would be $50,482. The rate of turnover is the sales divided into--no, the average inventory divided into the net sales; that is 1.97, which is the rate of turnover.

Student B's Oral Solutions

1. (Read the problem once). Two-thirds of 4/5 would equal $16,800; 8/15 equal $16,800; $16,800 divided by 8/15 equals $31,500. (Reread second part of the problem). Subtract 2/3 from 4/5; he still owns 2/15.

2. (Read the problem twice). What amount does $3,850 equal 18 per cent of? Eighteen per cent into $3,850 is $21,388.88, which is the gross sales.

3. (Read the problem once). The first thing you have to do is figure the maturity value. You take the face value times the percentage, times the interest, times the time, which is one year. The interest on the note is $37.50. Then you add that onto the face value of the note to find the maturity value, which is $787.50. Figure up the time it has to run which is 6 months. So you put 6 over 12; the percentage of discount is 7 per cent; that is $27.56. You subtract that figure from the maturity value of the note which is $787.50; proceeds of the note are $759.94.

4. (Read the problem once). Eight per cent of X is $35.00. You divide $35.00 by 8 per cent which gives you $437.50 which is the amount of the sale.

5. (Read the problem once). The cost is 100 per cent and a profit of 25 per cent was made. Add those two together; that is 125 per cent which is equal to $95.50, the selling price. So you divide $95.50 by 125. The answer to that is $76.40.

6. (Read the problem once). The total net sales-- you

take the gross sales less sales returns and allowances. That would be 2 per cent of $101,500. Total net sales are $99,470. Add all the inventories and divide by 2. The sum of the inventories is $151,446; divide that by 2; the average inventory is $75,723. The rate of turnover is the net sales divided by the average inventory. The rate of turnover is 1.31.

(At this point, the student checked some of her answers).

3. After you get the maturity value, $787.50, you multiply $787.50 times 7 per cent times 8/12 instead of 6/12. You get as an answer $36.75. Subtract that from $787.50 which will give you $750.75. That is the proceeds.

6. (Read the problem again). First find the net sales. You add all the inventories and divide by the number of inventories, and I divided by 2. The total inventories would be $151,446; divide by 3; the average inventory is $50,482. Divide the net sales by the average inventory. The rate of turnover is 1.97.

Student C's Oral Solutions

1. (Read the problem once). Four-fifths of a baseball club (pause), 4/5 of $16,800 equals $14,080; $14,080 would be 4/5 of the club. He sold 2/3 of that--no, 2/3 of 4/5 equals 8/15; 1/15 would be $16,800 divided by 8, then 15/15 would be $31,500. (Read the second part of the problem). He sold 2/3 of 4/5 so he still owns 1/3 of 4/5; 4/5 times 1/3 equals 4/15 which he still owns.

2. (Read the problem once). Costs of advertising amounted to 18 per cent of the gross sales. Expenses amounted to $3,850; $3,850 equals 18 per cent; 18 divided into $3,850 would be 1 per cent; 18 into $3,850 would be $213.89; $213.89 times 100 would be $21,389. To check, $21,389 times 18 per cent equals $3,860.02. Divide again 18 into $3,850; $213.33 times 100 equals $21,333. To check, $21,333 times 18 per cent equals $3,839.94; 18 per cent is equal to $3,850; the whole thing would be 100 per cent which is $21,333.

3. (Read the problem twice). First multiply $750 times 5 over 100 times one year, or just 5 per cent times $750 which is $37.50; $750 times 7 over 100, times 8 over 12, is $35.00; $387.50 minus $35.00 equals $352.50. That is not right--oh, $37.50 minus $35.00 equals $2.50; $750 plus $2.50 equals $752.50.

4. (Read the problem once). Eight per cent equals $35.00; 1 per cent equals 8 into $35.00. The answer is $438.00.

5. (Read the problem once). Profit is 25 per cent of the cost. (Read the problem again). So, 100 per cent minus 25

per cent equals 75 per cent which equals $95.50--no, 100 per cent plus 25 per cent; 125 per cent equals $95.50. Divide 125 into $95.50 which is $76.40. To check, take 25 per cent of that; answer, $19.00. It should have been $19.10. Add $76.40 and $19.10 and get $95.50. The answer, then, is $76.40.

6. (Read the problem once). Gross sales amounted to $101,500. Sales returns and allowances were 2 per cent of gross sales which is $2,030; $2,030 from the ending inventory would be $47,724. Subtract that from gross sales and that would be $53,780; net sales were $53,780. The average inventory would be the three inventories added and divided by four which would be $35,361.50. For rate of turnover, $101,500 into $35,361.50. The answer is .348.

Student D's Oral Solutions

1. (Read the problem once). He sold 2/3 of his share. (Read the problem again).

2. (Read the problem twice). The expenses, $3,850, equal 18 per cent; cost equals 100 per cent; divide $3,850 by 18.

3. (Read the problem twice).

4. (Read the problem once). Eight per cent equals $35.00. Divide $35.00 by 8 per cent. That is $437.50.

5. (Read the problem once). The selling price equals $95.50, which equals 100 per cent--no, cost equals 100 per cent; profit equals 25 per cent. Selling price, then, equals 125 per cent; $95.50 divided by 125 per cent gives cost, which equals $76.40.

6. (Read the problem once). The inventory at the beginning of the year was $54,860; at mid-year, $46,832; at the end of the year, $49,754. Add the inventories, then you have the total of net sales; $151,446 is the net sales. The average inventory is $151,446 divided by three. The average inventory is $50,482.

(The student finished working problem two).

2. The gross sales are $21,388.88.

Student K's Oral Solutions

1. (Read the problem once). Four-fifths equals $16,800; 2/3 of 4/5 equals 8/15. That is times--or divide 8/15 into $16,800, and you would put $16,800 times 15/8 which equals $31,500; $16,800 plus $31,500 would be $48,300. That is the value of the whole club. You would multiply $31,500 times 4--no, find the common denominator; 12/15 minus 10/15 equals 2/15. He still owns 2/15 of the club.

2. (Read the problem once). Divide 82 into $3,850; point off two places. Gross sales would be $4,695.

3. (Read the problem once). Multiply $750 times 5 over 100 times 12 over 12; that would be $37.50; $37.50 would be the interest. So $750 plus $37.50 would be $787.50, which is the maturity value. Multiply that by 7 over 100, times 4 over 12, which would be $183.75. Subtract $183.75 from $787.50; proceeds are $603.75.

4. (Read the problem once). First divide 92 into $35.00. The sale amounted to $380.43.

5. (Read the problem once). Take $95.50 and divide it by 75 per cent. The cost of the merchandise was $127.33.

6. (Read the problem once). Take $101,500 times 2 per cent, and that would be $2,030. Subtract that from $101,500. Net sales are $99,470. The inventory is, at the beginning of the year, $54,860; at mid-year, $46,446; and at the end of the year, $49,754. That would be $151,446. Divide that by 3; the average inventory is $50,482. The rate of turnover is 1.49.

Student F's Oral Solutions

1. (Read the problem once). Four-fifths of a baseball club--sold 2/3 of his share; 2/3 of 4/5 would be $16,800. Two-thirds equals $16,800; the value of the club is $8,400--no, 2/3 equals $16,800, then 1/3 equals $8,400. The value of the whole club is $25,200. (Read the second part again). Sold 2/3 of the club; 1/6 would be the amount that he still owns.

2. (Read the problem once). Eighteen per cent of its gross sales; $3,850 multiplied by 18 per cent is $693. Subtract that from $3,850; that would give you $3,157 as the sales.

3. (Read the problem once). The value of the note is $750; 5 per cent for one year. Discounted for 7 per cent for four months. There are 12 months in a year; there would be eight months left; 7 per cent times $750 is $52.50. That times 2 is $105; divide that by 3, and you get $35.00; $35.00 is the discount; subtract it from $750. The proceeds are $715.

4. (Read the problem once). The commission is $35.00. If he received 8 per cent on the sale, then $35.00 is 8 per cent of sales; 100 per cent equals total sales; 8 per cent equals $35.00; 8 into $35.00 equals $4.38. If one per cent equals $4.38, then 100 per cent equals $438.00; $438.00 were the sales he made.

5. (Read the problem once). It sold for $95.50. (Read the problem again). Take 25 per cent of $95.50 which is $23.88. Cost is $95.50; profit was $23.88; the cost of the machine is $119.31.

6. (Read the problem once). Gross sales are $101,500; sales returns are 2 per cent; 2 per cent of $101,500 is $2,030. That is the sales returns so subtract that from the gross sales which gives you $99,470. Beginning inventory is $54,860; at mid-year, $46,832; at the end of the year, $49,754. Add them, and you get $151,446. There are three inventories so multiply by three. The average inventory is $50,482. The net sales are $99,470; average inventory is $50,482; subtract and that gives you $48,988; $48,988 divided by $50,482, the average inventory, gives you the rate of turnover, 9.74.

Student G's Oral Solutions

1. (Read the problem twice). Divide the value, $16,800, by 4/5, which is $16,800 times 5/4; that equals $11,000. (Read the problem again). Two-thirds of 4/5 is 8/15.

2. (Read the problem three times). Eighteen per cent into $3,850; gross sales were $21,388.

3. (Read the problem once). First, $750, times 7, times 4 over 12, equals $35.00; $750, times 5, times 12 over 12 equals $37.50; $750, times 7, times 4 over 12 equals $14.13 instead of $35.00. Subtract $14.13 from $37.50 and get $23.37. That is the proceeds.

4. (Read the problem once). If 8 per cent equals $35.00, then 8 per cent into $35.00 is $437.50.

5. (Read the problem once). The selling price, $95.50, times 25 per cent is $23.88. Subtract that from $95.50, and the answer is $71.62; that is the cost of the machine.

6. (Read the problem once). Gross sales, $101,500, times 2 per cent is $2,030. I'll come back to that one.

(After checking some of her computations in the other problems, the student came back to number six).

6. Take $2,030 from $101,500, and the answer is $98,470; that is the net sales. Add $54,860, $46,832, and $49,754, and you get $151,446; divide that by three, and get $53,615; $54,860 minus $49,754 is $4,006; $4,006 from $46,832 is $46,826. Divide that by three, and the average inventory is $14,275.

Student H's Oral Solutions

1. (Read the problem once). Take 4/5 of what Mr. James owned and multiply by 2/3; 8/15 equals his share. The value of the whole club is 15/15; 15/15 minus 8/15 equals 7/15. Divide 7/15 into $16,800; that is 15/7 times $16,800; $36,000 is the value of the whole club. (Read the second part of the problem). The fractional part that he still owns is 7/15.

2. (Read the problem twice).

3. (Read the problem twice). Seven over 100, times 120 over 360 equals $17.50, which is the discount. Take $17.50 from $750; $732.50 is the proceeds.

4. (Read the problem once). The commission was $35.00.

5. (Read the problem once). The cost equals 100 per cent; 25 per cent equals the profit; the selling price would be 125 per cent. Divide that into the price; 125 divided into $95.50 is $76.42; that is the cost of the machine.

6. (Read the problem once). First find the average inventory. At the beginning of the year, $54,860; at mid-year, $46,832; and at the end of the year, $49,754. Add them, and divide by three; the average inventory is $50,482. (Read the problem again). Divide average inventory into gross sales to find total net sales--no, subtract average inventory from gross sales to find net sales; net sales are $100,964. To find the rate of turnover you must divide average inventory into the net sales; the rate of turnover is 2 per cent.

Student I's Oral Solutions

1. (Read the problem twice). To get what one part of this is--$16,000 divided by 4/5 to get what one equals; $13,440 is what one would equal. Four times this would be what the value of the whole club is worth at this rate. What fractional part does he still own? Multiply $16,000 times 5/4, and that would equal $21,000; 4/5 from 5/5 would be 1/5; he sold 2/3; he had 1/3 of 4/5 left. He had 1/3 of the club left.

2. (Read the problem once). The cost of advertising--$3,850 multiplied by 18 per cent is $693; subtract $693 from $3,850. Gross sales are $3,157.

3. (Read the problem twice). Four months after he received it he discounted it; $750, times 7 over 100, times 240 over 360. That would be $35.00; $750, times 5 per cent, times 120 over 360; that would be $12,50; $12.50 would be for four months; $35.00 minus $12.50 leaves $22.50 as the proceeds.

4. (Read the problem once). Eight per cent--if he got 8 per cent on the sale, then multiply 8 per cent times $35.00. That would be $2.80; add $2.80 to $35.00; that would be $37.50, which is what the sale amounted to.

5. (Read the problem twice). What must have been the cost if a profit of 25 per cent on the cost of the machine was made? Take $95.50 times 25 per cent which is $23.88; subtract that from $95.50, which makes the cost $71.62.

6. (Read the problem once). The inventory at the beginning of the year amounted to $54,860; at mid-year, $46,832;

and at the end of the year $49,754. Take $101,500 and subtract $54,860; $96,640 is the answer, and that would be total net sales. What is the average inventory? You would add the three inventories, and that would be $151,446. You would divide; 1.52 is the average inventory. What is the rate of turnover? Subtract $101,500 from $151,446, and the average turnover would be $45,610.

(The student reviewed her answers to problems one through five, and read each problem another time).

6. (Read the problem once). The sales, $101,500, times 2 per cent is $2,030; $2,030 from $101,500 is $99,470; $54,860 from $99,470 is $45,610. What is the average inventory? Divide $99,470 into $151,446; the average inventory is 1.52. To get the rate of turnover subtract $99,470 from $151,446; that would be $51,976.

Student J's Oral Solutions

1. (Read the problem once). Two-thirds is equal to $16,800; 2 times $16,800, divided by 3 equals $12,533.

2. (Read the problem once). Eighteen per cent of gross sales would be $3,850; 100 per cent minus 18 per cent equals 82 per cent. Multiply 82 per cent by $3,850, which would be $3,157.

3. (Read the problem once). First, $750, times 5 per cent, times 1 equals $37.50. (Read the last part of problem again). Add $37.50 to $750 which is $787.50. Then, $787.50 times 7 per cent, times 2/3. That gives $110.35; add that to $787.50; the answer is $897.75.

4. (Read the problem once). Eight per cent of what number is $35.00? Divide $35.00 into 8--no, 8 into $35.00; that is $437.00.

5. (Read the problem twice). Selling price is 100 per cent; profit is 25 per cent; cost is 125 per cent.

6. (Read the problem once). Add the inventories; $54,860 plus $46,832, plus $49,754 is $151,446. Divide that by 3 to get the average inventory; the average inventory is $50,482. Sales returns and allowances were 2 per cent of gross sales; multiply; $2,030. (Long pause). Subtract that from gross sales; the answer is $99,470. The rate of turnover is the cost of goods sold divided by the average inventory. Subtract average inventory from net sales; the answer is $48,988; divide that by $50,482. The rate of turnover is 97 per cent.

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