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Date May 5, 1960

A STUDY OF ERRORS IN ARITHMETICAL OPERATIONS DEMONSTRATED BY SOPHOMORE STUDENTS IN A SELECTED COLLEGIATE SCHOOL OF NURSING

by

Marjorie Boyer Robinette
B.S., University of California, 1944

A Thesis submitted to the Faculty of the Graduate School of the University of Colorado in partial fulfillment of the requirements for the Degree

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Robinette, Marjorie Boyer (M.S., Nursing)

A Study of Errors in Arithmetical Operations Demonstrated by Sophomore Students in a Selected Collegiate School of Nursing

Thesis directed by Assistant Professor Patricia Vander Leest

This study was undertaken to ascertain mathematical weaknesses demonstrated by nursing students beginning clinical practice in a selected collegiate school of nursing.

The purposes of the study were: (1) to ascertain the mathematical weaknesses of the nursing students beginning clinical practice in a selected school of nursing as demonstrated by a faculty prepared evaluation instrument, (2) to gather data which might be beneficial in planning a remedial course of basic mathematic principles for nursing students, and (3) to present data which could be used as a guide to curriculum revision.

The normative survey was the method used. A diagnostic arithmetic test, prepared by an especially appointed committee of the Medical-Surgical Nursing Faculty of the collegiate school of nursing, was the tool used to gather the data. The test items covered the basic arithmetical operations of addition, subtraction, multiplication, and division. Problems with fractions, decimals, percentages,

ratios, and conversions from one to the other were also included.

Data obtained by the study revealed the need of the students for remedial work in arithmetic. The relatively high average scores gave the impression that the class as a whole was competent in arithmetical ability; however, the arithmetical operations required in the problems were fundamentals which should have presented no difficulty to the high school graduate. Therefore, the errors which occurred pointed out specific areas of arithmetical weakness which were: (a) fractions, (b) decimals, and (c) the conversion from one form of fraction to another.

This abstract of about 250 words is approved as to form and content. I recommend its publication.

Signed Patricia VanderLeest
Instructor in charge of thesis

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CHAPTER I

THE PROBLEM

Statement of the Problem

This study was undertaken to ascertain mathematical weaknesses demonstrated by nursing students beginning clinical practice in a selected collegiate school of nursing.

Importance of the Study

In recent years there has been a growing concern that the young people of our country are unable to use the basic principles of mathematics to advantage in their daily life. Stern states that modern teaching methods in the elementary grades have so overdone the adjusting of mathematics to conform with the child's interests and mental capacities that the arithmetic itself is camouflaged and consequently poorly learned.[1]

A study of the errors made by students of nursing in administering medications revealed that thirteen per cent of the errors were due to underdosage or overdosage.[2] Many

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[1]Catherine Stern, Children Discover Arithmetic (New York: Harper and Brothers, 1949), p. 3.

[2]Anne K. Byrne, "Errors in Medication," The American Journal of Nursing, 53:829, July, 1953.

nursing students, aware of their obligation to become safe practitioners, are concerned because they cannot readily apply the basic principles of mathematics when computing dosages.

The accurate administration of drugs is continually stressed throughout the education of the nursing student. Facility and accuracy in arithmetic are essential to the nurse to insure proper computation of dosages. Modell and Place list among the essential qualifications of a nurse administering medicine the following:

> Knowledge of the units of weight and measures used in dosage and in translation from one system of measure to another . . . and facility in the arithmetic of dosage calculation.
>
> The failure of the nurse in any of these may turn out to be a serious matter for the patient; it may make the difference between a dose which is effective and one which is ineffective, or even worse, the difference between the effective dose and one which poisons him.[3]

They feel that without the ability to accurately compute the nurse is insecure about one of her critical functions, the calculation of the dose she gives her patient.[4]

Stocking and Cataline, in their textbook explaining the arithmetic used in pharmacy, warn their students:

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[3]Walter Modell and Doris J. Place, The Use of Drugs, (New York: Springer Publishing Company, Inc., 1955), p. 275.

[4]Modell and Place, op. cit., p. 292.

> It must be understood from the beginning that it is of utmost importance that your work be accurately done. Inaccuracy has no place in pharmacy. A misplaced decimal point or an incorrect addition, subtraction, multiplication or division in the calculations involved in the compounding of a prescription calling for a potent ingredient may result in the death of a patient.[5]

This same warning must be heeded by the nurse giving the medication, especially if computation of the dosage is required.

The use of two systems of measurements in many hospitals makes it imperative for a nurse to be able to accurately convert from one system to another. The American Pharmaceutical Association has illustrated their recognition of this problem by officially adopting one system of measurement--the metric system--for use in dispensing all drugs.[6] However, until this policy is adopted by all hospitals, the nurse must be able to mathematically handle both systems of measurement.

Statement of the Purposes

The purposes of the study were: (1) to ascertain the mathematical weaknesses of the nursing students begin-

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[5]Charles H. Stocking and Elmon L. Cataline, Arithmetic of Pharmacy, (Princeton: D. Van Nostrand Company, Inc., 1952), p. v.

[6]Pharmacopeial Society, Pharmacopeia of the United States of America, Official Publication of the Pharmacopeial Society (Easton: Mack Publishing Company, 1959), p. 15.

ning clinical practice in a selected school of nursing as demonstrated by a faculty prepared evaluation instrument, (2) to gather data which might be beneficial in planning a remedial course of basic mathematic principles for nursing students, and (3) to present data which could be used as a guide to curriculum revision.

Scope and Limitations of the Study

The diagnostic arithmetic test[7] of the entire population of eighty-nine students was used for the study. The limitations of the study were: (1) the data collected were limited to the results of the arithmetic tests given one class of nursing students beginning clinical practice at a selected collegiate school of nursing, (2) the test used was not a standardized test but a faculty prepared instrument, (3) because it was newly prepared, the reliability and validity of the test had not been established.

Organization of the Remainder of the Thesis

The remainder of the thesis is divided into four chapters. Chapter II provides a resume of the literature reviewed in nursing and related fields as it applied to the problem.

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[7] A test designed to diagnose the amount and nature of arithmetic weaknesses in those examined.

The normative survey or descriptive method used in the study is explained in Chapter III. This includes a description of the population from which the data were obtained, the technique for gathering the data, the data gathering device used, and the method in which the data were tabulated.

Chapter IV offers an analysis and interpretation of the data gathered. The conclusions and recommendations are presented in Chapter V.

Appendix A contains a complete enumeration of the errors by test items. A copy of the diagnostic arithmetic test is found in Appendix B.

CHAPTER II

REVIEW OF THE LITERATURE

A review of the literature was made to determine if the problem of mathematical deficiency in college students was prevalent in other disciplines and to survey the findings and conclusions of similar studies of mathematical proficiency completed in nursing and other fields.

The review included The American Journal of Nursing from 1946 through 1959, Nursing Outlook from 1953 through 1959, Nursing Research from 1952 through 1959, periodicals listed in Educational Index from 1955 through 1959, and available nursing textbooks.

For the purposes of clarity the chapter is presented in two sections: (1) Related Literature of the Educational Profession and (2) Realization of the Problem by the Nursing Profession.

Related Literature of the Educational Profession

Many articles have been written complaining that students entering college have difficulty using the basic functions of arithmetic. Habel stated that college professors since the turn of the century and probably before, "have sat in judgment of Freshmen and found them seriously deficient in reading, mechanics of English, study habits, and

the fundamentals of mathematics, especially arithmetic."[7]

Studies conducted in colleges have tended to bear out this criticism. One such study reported that only a few of the 1,811 freshmen, entering six state colleges in Oklahoma in 1955, had a satisfactory understanding of and an ability to use the essentials for functional competence in mathematics that were recommended, as a part of the general education of all citizens, by the Commission of Post War Plans of the National Council of Teachers of Mathematics. The following ten topics were listed as the essentials in which the freshmen showed the least functional competence:

1. Drawing conclusions
2. Estimating answers
3. Measurement
4. Use of approximate numbers
5. Basic geometric concepts
6. Reading and interpreting tables
7. Use of formulas
8. Consumer problems involving per cents but also requiring some other knowledge
9. Basic algebraic simplication
10. Ratio and proportion[8]

Another study, which was concerned with the arithmetical and algebraic disabilities of students beginning their first year of college physics, reported the following

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[7]Elmer A. Habel, "Implications Arising Out of Students' Errors," The Journal of Higher Education, 29:82, February, 1958.

[8]Kathrine C. Mires, "General Mathematics for College Freshmen," The Mathematics Teacher, 50:516, November, 1957.

conclusions:

1. The students in question have difficulty with operations involving percentages and decimals. The greatest inaccuracy occurred in changing a certain per cent to a decimal. The reverse process was less difficult.
2. Division of fractions and mixed numbers by decimal quantities and the reverse of these operations were also very difficult for the students.
3. The percentage of incorrect responses was relatively high on the more complex operations with arithmetic fractions such as dividing a mixed number by a mixed number.
4. The percentage of inaccuracy in the simpler operations with decimals and fractions is relatively low. If a skill involves both decimals and fractions, it is much more difficult than a skill involving only one of these general topics.
5. The application of the four fundamental processes to denominate numbers presented difficulty to approximately one-third of the students participating in this study.[9]

The criticism of the mathematical preparation of students by the schools has also been echoed by parents, employers and the general public. Many professional organizations such as the American Mathematical Society, the Mathematical Association of America, and the National Council of Teachers of Mathematics are aware of the present-day shortcomings, both in the teaching of mathematics and in the content of the courses taught. To help solve these serious problems they combined their efforts to help form the School

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[9]William R. Lueck, The Arithmetical and Algebraic Disabilities of Students Pursuing First Year College Physics (Des Moines: University of Iowa, 1932), p. 32-33.

Mathematics Study Group under the direction of Professor Begle of Yale. This group believed that proper mathematics instruction in our elementary and secondary schools was of the utmost importance in the scientific training of our young people. The group agreed that the present mathematics curriculum is out of phase with the actual needs of today's student as well as with the development within the field of mathematics itself:

> The world of today demands more mathematical knowledge on the part of more people than the world of yesterday, and the world of tomorrow will demand even more. It is therefore important that mathematics be taught in a vital and imaginative way which will make students aware that it is a living, growing subject which plays an increasingly important part in the contemporary world.[10]

Langer agreed that the challenge to education today calls for more effective teaching of mathematics. He states:

> Today, others, without any stimulus on our part, are calling for more widespread mathematical competency, and are doing so with a consistency that astonishes even us. They are telling the public--no they are warning it--that a great increase in the supply of persons with mathematical training is nothing less than critical for our national safety, for the very preservation of our mode of life.[11]

Educators and the public in general have become

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[10] E. G. Begle, "The School Mathematics Study Group," The Mathematics Teacher, 51:616, December, 1958.

[11] Rudolph E. Langer, ' "To hold, as 'twere, the mirror up to nature; to show the very age and body of the time." ' The Mathematics Teacher, 52:594, December, 1959.

increasingly aware of the unspoken international competition for increased scientific knowledge:

> Any consideration of mathematics at the present time must feature the fact that Russia is now outstripping us, training far more mathematicians, engineers and scientists than we are and, in general, placing a greater emphasis on the intensity and quality of mathematical training for superior youth. . . . The shortage of technical experts points an accusing finger at the whole field of mathematic education beginning with the curriculum and instruction in elementary school and continuing through graduate school. High school students have avoided mathematics in the past for reasons which are good and sufficient to them, undoubtedly they will tend to do so in the future.[12]

As a result of this increased interest, the mathematics curriculum in the public schools has been carefully studied by many groups in an endeavor to discover what is lacking. Brown described a survey of the research in mathematical education for the years 1955 and 1956 which showed considerable experimentation with the content of high school mathematics:

> Many of the pupils who take general mathematics do not go on to college. For this reason, some educators have looked to the mathematics used by the semi-skilled and unskilled workers as a key to the content of general mathematics. One mathematics education investigator concluded that seventh-grade mathematics would fill the needs of most workers.[13]

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[12]Habel, op. cit., p. 81.

[13]Kenneth E. Brown, "Research In Teaching High School Mathematics," The Mathematics Teacher, 51:593, December, 1958.

Brown emphasized that building curriculum on such findings is very questionable. It caters to the status-quo and does not consider that in future years a greater ability in the use of mathematics may be required of the student.

Kline admitted that there is considerable agitation in mathematical circles for reform of the high school mathematics curriculum. "The interest in reform is both understandable and commendable. There is rather universal agreement that the present mathematics curriculum is poor. In fact the evidence is unmistakable."[14]

The elective system of choosing high school courses has also received a great deal of criticism. Many educators indicated that the students, even the bright ones, avoided the science and mathematics courses and gravitated toward the easier ones. The Research Division of the National Education Association disagreed with this viewpoint, and stated that actual studies show that more high school students take sciences and mathematics than ever before.[15]

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[14]Morris Kline, "The Status of Reform in the Mathematics Curriculum," The California Journal of Secondary Education, 33:421, November, 1958.

[15]Research Division National Education Association, "Science and Mathematics in High Schools," National Education Association Research Bulletin, 35:163, December, 1957.

Kline, however, concluded that the vast majority of the students who take mathematics dislike it, so they take as little as possible and are happy to be through with it.[16] Dr. Conant pointed out that not enough girls are encouraged to take more than a minimum of science and mathematics nor made aware of the future awaiting them in those fields.[17] He believed that all future college students should be required to have three years of mathematics, and that four years would be preferable in many cases.[18] Habel agreed that frequently high school pupils are not even informed of their possible need of mathematics in college and later life and believed that better counseling would encourage them to enroll in the mathematics courses.[19]

Potter reported that certain "blocks to learning mathematics" are the causative factors in student inability to solve arithmetic problems. One of these "blocks" is the fact that mathematics has a bad reputation; that is, it is known to be too hard, useless, and a general bore. Sometimes the subject is actually not understood by the pupil.

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[16] Kline, loc. cit.

[17] James B. Conant, The American High School Today (New York: McGraw-Hill Book Company, Inc., 1959), p. 22-23.

[18] Ibid. p. 57.

[19] Habel, op. cit., p. 85.

This may be caused by such things as absence, poor teaching, pupil inattention, undue pressure at home, or dislike of the teacher. Another factor which she believed lowered student motivation was the common practice of peer acceptance or actual approval of low grades in mathematics.[20]

In a recent article, Read listed several pages of criticisms which were representative of the cry of the public today for better mathematical instruction in the schools. One such criticism was: "The college professor is now obliged, during the freshman year, to spend a large part of his time and energy in reviewing what the student is supposed to have learned in high school."[21] All the quotations, however, were from professional journals published by mathematical or scientific groups from 1917 to 1932. This brought to light that, although public opinion has started a multitude of studies and action, the problems today seem to be similar to those of thirty or forty years ago.

Some authors, however, stated that the schools have undertaken a monumental task in curriculum revision and are

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[20] Mary A. Potter, "Remedial Teaching That Builds Understanding," The Mathematics Teacher, 51:365, May, 1958.

[21] Cecil B. Read, "What's Wrong With Mathematics?" School Science and Mathematics, 58:182, March, 1958.

achieving effective teaching of mathematics:

> How else can one explain the rapid strides made in the field of mathematics and allied fields in this century? It is being said by reputable mathematicians that more new mathematics has been developed since 1900 than was known at that time. Surely some of our students managed to avoid being stymied in their development by the loudly condemned methods claimed to be prevalent in our classrooms.[22]

He admitted that the work of mathematics teachers has been widely criticized and believed that the criticism has been helpful and will continue to be so when it is constructive and unprejudiced by special interests. He suggested inventory testing of the students to discover where their difficulties lie and the application of the principles of the psychology of learning in building remedial courses where needed.[23]

Realization of the Problem by the Nursing Profession

Statements in the textbooks of nursing reviewed indicated that the profession as a whole was concerned that nursing students be able to accurately calculate and administer medicines. McClain and Gragg warned that every dose

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[22]Francis G. Lankford, Jr., "Implication of the Psychology of Learning for the Teaching of Mathematics," The Growth of Mathematical Ideas, Grades K-12, Twenty-fourth Yearbook of the National Council of Teachers of Mathematics, (Washington, D.C.: National Council of Teachers of Mathematics, 1959), 402.

[23]Ibid.

of medicine is potentially dangerous:

> The smaller the effective dose of the drug, the greater is the need for exactness in calculating and measuring. Every nurse should know the principles of calculation and be very careful in her figuring since a misplaced decimal point or number may have serious results.[24]

Falconer and Norman emphasized that extra care must be taken when conversion from one system of measurement to the other is involved:

> If it is essential to change from one type of measure to another, and if the nurse has any doubt as to the dosage, the physician should be consulted for the exact amount he wishes used. If dosage must be changed--from one system to another, for example--the nurse should check carefully and if in any doubt, have a second person check the order.[25]

Mehta considered pharmacy arithmetic as one of the most difficult but important aspects of pharmacy for nurses. He stressed knowledge of the metric and apothecary systems, conversion from one system to another, household measures and their conversion into metric and apothecary systems, and the computation of children's dosages.[26]

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[24]M. Esther McClain and Shirley H. Gragg, Scientific Principles in Nursing, (St. Louis: C. V. Mosby Company, 1958), p. 392.

[25]Mary W. Falconer and Mabelclair Ralston Norman, The Drug, The Nurse, The Patient, (Philadelphia: W. B. Saunders Company, 1958), p. 70.

[26]H. R. Mehta, Pharmacy for Nurses, (Boulder: Delta Publishing Company, 1959), p. 2.

A careful review of the nursing literature revealed a recognition of the necessity for correct calculation in the accurate administration of medications and that these basic abilities are expected of both the nursing student and the graduate professional nurse. It also indicated that fundamental arithmetic skills were requisite for correct calculations and accurate administration of drugs. However, no studies were found that investigated either the overall problem of calculation ability in the administration of drugs or the specific problem of arithmetical skill in these calculations.

Summary

The educational profession indicated an awareness that the world of today requires the student to possess more mathematical ability than ever before. Many studies have been done to evaluate the problem and facilitate curriculum changes. These studies have pointed out that many high school graduates lack mathematical ability due to poor subject learning, elective avoidance of the subject, and lack of motivation to pursue mathematical classes.

The nursing textbooks and periodicals reviewed gave evidence of increasing recognition by the nursing profession that nurses must be able to calculate accurately to

be safe practitioners. However, the paucity of articles written on the subject revealed that few studies have been done to determine what arithmetical deficiencies nursing students exhibit.

CHAPTER III

METHODOLOGY

The problem of this study was to ascertain the prevailing mathematical background of a selected group of students as revealed by a diagnostic arithmetic test. The normative survey method of educational research was used. Good, Barr and Scates state that this method is directed toward ascertaining the prevailing conditions in the specific area to be studied.[1] This method of research tends to focus attention on needs, that might remain unobserved,[2] and is concerned with a description of the facts and conditions as they exist, without imposition of control over factors influencing the materials under investigation.[3]

Population of the Study

The population used for this study consisted of the entire sophomore class of eighty-nine nursing students in a

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[1]Carter V. Good, A. S. Barr and Douglas E. Scates, The Methodology of Educational Research (New York: Appleton-Century Company, Inc., 1941), p. 292.

[2]Ibid.

[3]Orvil S. Barr, Robert S. Davis and Palmer O. Johnson, Educational Research and Appraisal (Chicago: Lippincott Company, 1953), p. 337.

selected university school. In their first year of college, which was on the main campus of the university, the students were given a course in Pharmacology which included instruction in computation of dosages. Since the purpose of the study was not to generalize the findings of the study beyond the one university class, the students tested constituted the entire population under investigation. This eliminated the necessity for establishing sampling procedures and sampling statistics.

Technique for Gathering the Data

The data gathered for the study were obtained from the results of a diagnostic arithmetic test given one class of nursing students beginning clinical practice. The primary purpose of the test was to aid in evaluating the mathematical ability of each student, with the goal of individual remedial work. Since the data were at hand it seemed desirable to do a secondary analysis to yield conclusions and generalizations which could be applied to the group and to implement curriculum revision.

Description of the Test

The diagnostic arithmetic test was prepared by a committee appointed by the Medical-Surgical Nursing Faculty and was submitted to the total group for approval. The test

was administered by a member of the Medical-Surgical Nursing teaching staff. The test was not a speed test and ample time was given to allow each student to complete the test. The test items covered the basic arithmetic operations of addition, subtraction, multiplication, and division. Problems with fractions, decimals, percentages, ratios, and conversions from one to the other were also included. The test was designed so a perfect score was entirely attainable by a student with an adequate knowledge of basic mathematics. Since the examination was used for the first time with this class of students, its reliability and validity had not been established. A copy of the diagnostic arithmetic test is found in Appendix B.

Tabulation of the Data

The tests were graded by the investigator. A key was used to insure standard grading of each paper. All problems not answered were counted as errors. Since there was no time limit on the test, the investigator felt free to assume that unanswered problems indicated a lack of knowledge. The raw score was established for each student and a percentage grade was calculated. A frequency of error was recorded for each problem in the examination. A complete enumeration of errors by test items is found in Appendix A. From this

information it was then possible to tabulate the number of errors which occurred for each type of problem. Categories were established which included: addition, subtraction, multiplication, division, whole number, fraction, decimal, ratio, and conversion. Percentages of error were also calculated for each of these areas.

CHAPTER IV

ANALYSIS AND INTERPRETATION

The data presented in this chapter were obtained from the results of the diagnostic arithmetic test given eighty-nine nursing students beginning clinical practice. These data were studied to ascertain what mathematical weaknesses were demonstrated by establishing (1) the range of scores, (2) the central tendencies of the scores, and (3) the percentages of error in each area tested. Each of these analytical approaches will be discussed separately.

Range of Scores

The range of scores was examined to determine the differences displayed by the students. The raw scores ranged from a perfect score of one hundred thirty to the lowest score of eighty-seven. This gave a range of forty-three points. The percentage scores, therefore, ranged from 100 per cent to a low of 67 per cent; a difference of thirty-three points between the highest and lowest scores. One-fourth of the students received a score between 95 and 97 per cent. One-half of the scores were between 91 and 97 per cent. (See Table I, page 23.)

Central Tendencies of Scores

The central tendencies of the scores were calculated

TABLE I

ARRAY OF THE DIAGNOSTIC ARITHMETIC TEST SCORES, BY RAW SCORES, FREQUENCY, AND PERCENTAGE GRADES

Raw Score	Frequency	Percentage Grade	Raw Score	Frequency	Percentage Grade
130	1	100	108	1	83
129	9	99	107	2	82
128	5	98	106	0	81
127	2	98	105	0	81
126	4	97	104	1	80
125	4	96	103	1	79
124	8	95	102	0	78
123	6	95	101	0	78
122	7	94	100	1	77
121	5	93	99	0	76
120	3	92	98	1	75
119	3	92	97	0	75
118	4	91	96	1	74
117	4	90	95	1	73
116	4	89	94	1	72
115	2	88	93	0	72
114	0	87	92	0	71
113	3	87	91	0	70
112	0	86	90	1	69
111	0	85	89	0	69
110	1	85	88	0	68
109	2	84	87	1	67

to discover existing similarities. The median raw score was one hundred twenty-two which had a percentage score of 94. The mean raw score was one hundred nineteen. This was derived by finding the arithmetical average of all the raw scores. The percentage score for the arithmetical mean was 92. This indicated that more than half the class, or fifty-seven of the eighty-nine students, were above the mean score. There were five students with grades below the 75 per cent mark. These scores caused the slight lowering of the arithmetical mean below the class median score. The modal response was comparatively high. The score of one hundred twenty-nine, or 99 per cent, was attained by nine students. Another eight students scored one hundred twenty-four or 95 per cent.

Percentages of Error

Since there was an unequal number of problems in each section of the test, some method of comparison was needed to make the data more meaningful. The percentage of error was computed for each category tabulated to facilitate this comparison.

Each test contained one hundred thirty problems. This gave a total of 11,570 problems for the eighty-nine tests. There were nine hundred ninety-four errors which gave a total error of 9 per cent.

For the purpose of clarity the remainder of this discussion of the percentages of error will be presented in three sections: (1) Unit I, which includes the analysis by types of numbers and arithmetical operations, (2) Unit II, which covers the recognition of smaller fractions, and (3) Unit III, which describes the findings in the conversion from one type of fraction to another.

Unit I. Unit I includes the problems of addition, subtraction, multiplication, and division using whole numbers, decimals, and fractions. Table II, on page 26, is a summary table which presents the number of problems, the number of errors, and the percentages of error in each of the types of numbers by the arithmetical operations. In the eighty-nine test papers there were 6,408 problems in this unit. Errors which occurred in four hundred forty-six of these problems gave a 7 per cent error for the entire unit.

In the 3,560 problems which employed only whole numbers there were one hundred twenty errors or an error of 3 per cent. The data tabulated for the whole numbers may be found in Table III on page 27. The largest percentage of error, 6 per cent, occurred in the operations of multiplication and division. There were forty-nine errors in the eight hundred one division problems. In the nine hundred seventy-nine multiplication problems there were fifty-four

TABLE II

NUMBER OF PROBLEMS, NUMBER OF ERRORS, AND PERCENTAGES OF ERROR IN WHOLE NUMBERS, DECIMALS, AND FRACTIONS, BY ARITHMETICAL OPERATIONS

	Number of Problems	Number of Errors	Percentage of Error
Whole Number			
Addition	890	8	1
Subtraction	890	9	1
Multiplication	979	54	6
Division	801	49	6
Sub-total	3,560	120	3
Decimal			
Addition	534	23	4
Subtraction	534	24	4
Multiplication	445	42	9
Division	534	68	13
Sub-total	2,047	157	8
Fraction			
Addition	178	48	27
Subtraction	267	43	16
Multiplication	178	48	27
Division	178	30	17
Sub-total	801	169	21
Total	6,408	446	7

errors. Addition and subtraction of whole numbers offered little difficulty for the students. In each operation an error of 1 per cent occurred. There were errors in nine of the eight hundred ninety subtraction problems. In the same number of addition problems there were eight errors.

TABLE III

NUMBER OF PROBLEMS, NUMBER OF ERRORS, AND PERCENTAGES OF ERROR IN WHOLE NUMBERS, BY ARITHMETICAL OPERATIONS

	Number of Problems	Number of Errors	Percentage of Error
Addition	890	8	1
Subtraction	890	9	1
Multiplication	979	54	6
Division	801	49	6
Total	3,560	120	3

Problems which involved decimals were more difficult for the students. Errors occurred in one hundred fifty-seven of the 2,047 problems, which gave an error of 8 per cent. Table IV, on page 28, shows the number and percentages of error in each of the arithmetic operations. Division proved to be the most difficult for the students. There was an error of 13 per cent with sixty-eight of the five hundred thirty-four problems being wrong. The operation of multi-

plication was the second most difficult with forty-two errors in four hundred forty-five problems or a percentage of error of 9. Addition and subtraction were less difficult for the students. An error of 4 per cent occurred in both operations. The subtraction problems had twenty-four errors in five hundred thirty-four problems. Twenty-three errors occurred in five hundred thirty-four addition problems.

TABLE IV

NUMBER OF PROBLEMS, NUMBER OF ERRORS, AND PERCENTAGES OF ERROR IN DECIMALS, BY ARITHMETICAL OPERATIONS

	Number of Problems	Number of Errors	Percentage of Error
Addition	534	23	4
Subtraction	534	24	4
Multiplication	445	42	9
Division	534	68	13
Total	2,047	157	8

The problems in Unit I which presented the greatest difficulty to the students were those containing fractions. Table V, on page 29, shows there were eight hundred one problems and one hundred sixty-nine, or 21 per cent, were incorrect. The largest number of errors occurred in the addition and multiplication problems. In each of these

operations, there were forty-eight errors in one hundred seventy-eight problems or a percentage of error of 27. Division of fractions also proved to be troublesome. Of the one hundred seventy-eight problems, thirty or 17 per cent were incorrect. The subtraction problems were the least difficult, with forty-three errors in two hundred sixty-seven problems or an error of 16 per cent.

TABLE V

NUMBER OF PROBLEMS, NUMBER OF ERRORS, AND PERCENTAGES OF ERROR IN FRACTIONS, BY ARITHMETICAL OPERATIONS

	Number of Problems	Number of Errors	Percentage of Error
Addition	178	48	27
Subtraction	267	43	16
Multiplication	178	48	27
Division	178	30	17
Total	801	169	21

Table VI, on page 30, is a summary table which presents the number of problems, the number of errors, and the percentages of error in each of the arithmetical operations by types of numbers. In the eighty-nine test papers there were 6,408 problems. Errors which occurred in four hundred forty-six of these problems gave a 7 per cent error.

TABLE VI

NUMBER OF PROBLEMS, NUMBER OF ERRORS, AND PERCENTAGES OF ERROR IN THE ARITHMETICAL OPERATIONS, BY TYPES OF NUMBERS

	Number of Problems	Number of Errors	Percentage of Error
Addition			
Whole Number	890	8	1
Decimal	534	23	4
Fraction	178	48	27
Sub-total	1,602	79	5
Subtraction			
Whole Number	890	9	1
Decimal	534	24	4
Fraction	267	43	16
Sub-total	1,691	76	4
Multiplication			
Whole Number	979	54	6
Decimal	445	42	9
Fraction	178	48	27
Sub-total	1,602	144	9
Division			
Whole Number	801	49	6
Decimal	534	68	13
Fraction	178	30	17
Sub-total	1,513	147	9
Total	6,408	446	7

Table VII compares, by types of numbers, the errors which occurred in addition. The students displayed their ability in this operation with only seventy-nine errors in 1,602 problems, which gave a percentage of error of 5. The most difficult area was the addition of fractions. An error of 27 per cent, which resulted from forty-eight incorrect answers in one hundred seventy-eight problems, was proof of this difficulty. The addition of decimal numbers was less difficult. There were twenty-three errors in five hundred thirty-four problems or an error of 4 per cent. The error in the addition of whole numbers was only 1 per cent or eight errors in eight hundred ninety problems.

TABLE VII

NUMBER OF PROBLEMS, NUMBER OF ERRORS, AND PERCENTAGES OF ERROR IN ADDITION, BY TYPES OF NUMBERS

	Number of Problems	Number of Errors	Percentage of Error
Whole Number	890	8	1
Decimal	534	23	4
Fraction	178	48	27
Total	1,602	79	5

Table VIII shows the errors which occurred in the operation of subtraction. This operation was the least difficult for the students. Only seventy-six errors occurred in 1,691 problems which gave an error of 4 per cent. The subtraction of fractions had the largest number of errors. There were forty-three incorrect responses in two hundred sixty-seven problems which gave an error of 16 per cent. The percentage of error for the subtraction of decimals was 4 per cent with twenty-four errors in five hundred thirty-four problems. Whole number subtraction was relatively simple for the students. Only nine errors, or 1 per cent, occurred in the eight hundred ninety problems.

TABLE VIII

NUMBER OF PROBLEMS, NUMBER OF ERRORS, AND PERCENTAGES OF ERROR IN SUBTRACTION, BY TYPES OF NUMBERS

	Number of Problems	Number of Errors	Percentage of Error
Whole Number	890	9	1
Decimal	534	24	4
Fraction	267	43	16
Total	1,691	76	4

Multiplication seemed to be more difficult for the students than either addition or subtraction. Table IX shows a 9 per cent error was recorded with one hundred forty-four errors in 1,602 problems. The most difficult multiplication problems contained fractions. Of the one hundred seventy-eight problems, forty-eight or 27 per cent were incorrect. The multiplication of decimals proved less difficult; however, forty-two wrong responses were given in the four hundred forty-five problems. This was a 9 per cent error. The multiplication of whole numbers showed a percentage of error of 6. Of the nine hundred seventy-nine problems, fifty-four were incorrect.

TABLE IX

NUMBER OF PROBLEMS, NUMBER OF ERRORS, AND PERCENTAGES OF ERROR IN MULTIPLICATION, BY TYPES OF NUMBERS

	Number of Problems	Number of Errors	Percentage of Error
Whole Number	979	54	6
Decimal	445	42	9
Fraction	178	48	27
Total	1,602	144	9

Table X indicates that the arithmetical operation of division presented the greatest difficulty to the students. Incorrect answers were given to one hundred forty-seven of the 1,513 problems. This gave a percentage of error of 10. The largest number of errors occurred in the division of fractions. Of the one hundred seventy-eight problems, thirty or 17 per cent were wrong. Decimals in division were also difficult for the students. Incorrect answers were given in sixty-eight, or 13 per cent, of the five hundred thirty-four problems. Even the division of whole numbers scored a 6 per cent error. There were forty-nine wrong responses in eight hundred one problems.

TABLE X

NUMBER OF PROBLEMS, NUMBER OF ERRORS, AND PERCENTAGES OF ERROR IN DIVISION, BY TYPES OF NUMBERS

	Number of Problems	Number of Errors	Percentage of Error
Whole Number	801	49	6
Decimal	534	68	13
Fraction	178	30	17
Total	1,513	147	10

Table XI readily shows the areas of Unit I in which the greatest percentages of error occurred. Fractions were much more difficult than whole numbers or decimals. When the four arithmetical operations were compared, the students displayed the least ability in multiplication and division.

TABLE XI

COMPARISON OF THE PERCENTAGES OF ERROR, BY TYPES OF NUMBERS AND OPERATIONS

	Addition	Subtraction	Multiplication	Division	Total
Whole Number	1	1	6	6	3
Decimal	4	4	9	13	8
Fraction	27	16	27	17	21
Total	5	4	9	9	7

Unit II. This unit consists of problems in the recognition of the value of fractions. The student was asked to compare two fractions and circle the smaller. There were ten such problems on the test giving a total of eight hundred ninety problems for the eighty-nine tests. Only six incorrect answers were given, which was a 1 per cent error. The students were able to recognize the value of fractions in most instances.

Unit III. The last unit consisted of an incomplete table. A common fraction, decimal fraction, a fraction as a percentage, or a fraction as a ratio was given in the table. The students were required to convert the value into the other three forms. This unit was by far the most difficult part of the entire test for the students. There were six hundred fifty-five incorrect responses in the 4,272 problems, which gave a 15 per cent error. Table XII, on page 37, shows the number of problems, the number of errors, and the percentages of error in each type of conversion. The greatest percentage of error, 30 per cent, occurred when the students attempted to convert values into ratios. An error of 29 per cent was recorded in the problems which required conversion of a fraction written as a per cent into the other three forms. The errors in each area of conversion will be discussed separately.

Table XIII, on page 38, shows a 7 per cent error occurred when common fractions were converted into decimals, percentages, and ratios. There were seventy errors in 1,068 problems. The changing of common fractions into ratios was the most difficult. There were thirty-five errors in three hundred fifty-six problems which gave an error of 10 per cent. The conversion of common fractions into percentages resulted in a 5 per cent error. There were nineteen errors

TABLE XII

NUMBER OF PROBLEMS, NUMBER OF ERRORS, AND PERCENTAGES OF ERROR IN CONVERSION; BY COMMON FRACTIONS, DECIMALS, PERCENTAGES, AND RATIOS

Conversion from:	Conversion to:														
	Common Fraction			Decimal Fraction			Fraction as Percentage			Fraction as Ratio			Total		
	Number of Problems	Number of Errors	Percentage of Error	Number of Problems	Number of Errors	Percentage of Error	Number of Problems	Number of Errors	Percentage of Error	Number of Problems	Number of Errors	Percentage of Error	Number of Problems	Number of Errors	Percentage of Error
Common Fraction				356	16	4	356	19	5	356	35	10	1,068	70	7
Decimal Fraction	356	41	12				356	8	2	356	96	27	1,068	145	14
Fraction as Percentage	356	78	22	356	44	12				356	193	54	1,068	315	29
Fraction as Ratio	356	28	8	356	50	14	356	47	13				1,068	125	12
Total	1,068	147	14	1,068	110	10	1,068	74	7	1,068	324	30	4,272	655	15

in the three hundred fifty-six problems. A percentage of error of 4, or sixteen errors, occurred when changing the three hundred fifty-six common fractions into decimals.

TABLE XIII

NUMBER OF PROBLEMS, NUMBER OF ERRORS, AND PERCENTAGES OF ERROR IN CONVERSION FROM A COMMON FRACTION TO A DECIMAL, PERCENTAGE, AND RATIO

Conversion from a Common Fraction to:	Number of Problems	Number of Errors	Percentage of Error
Decimal Fraction	356	16	4
Fraction as Percentage	356	19	5
Fraction as Ratio	356	35	10
Total	1,068	70	7

When decimal fractions were changed into common fractions, percentages, and ratios an error of 14 per cent resulted. There were one hundred forty-five errors in the 1,068 problems. The conversion of decimals into ratios had the highest percentage of error. There were ninety-six errors in three hundred fifty-six problems, or a 27 per cent error. Changing decimals into common fractions gave a 12 per cent error due to forty-one wrong responses in three hundred fifty-six problems. An error of only 2 per cent

occurred when decimals were converted to percentages. There were eight errors in the three hundred fifty-six problems. (See Table XIV.)

TABLE XIV

NUMBER OF PROBLEMS, NUMBER OF ERRORS, AND PERCENTAGES OF ERROR IN CONVERSION FROM A DECIMAL FRACTION TO A COMMON FRACTION, PERCENTAGE, AND RATIO

Conversion from a Decimal Fraction to:	Number of Problems	Number of Errors	Percentage of Error
Common Fraction	356	41	12
Fraction as Percentage	356	8	2
Fraction as Ratio	356	96	27
Total	1,068	145	14

The problems which required the converting of fractions written as per cent into the other three forms proved very difficult for the students. As shown in Table XV, on page 40, there were three hundred fifteen errors in the 1,068 problems which gave a 29 per cent error. The changing of percentages to ratios was the most difficult conversion. There were one hundred ninety-three errors, or a percentage of error of 54, in the three hundred fifty-six problems. A 22 per cent error occurred when converting percentages into

common fractions. There were seventy-eight incorrect responses in the three hundred fifty-six problems. There were forty-four errors, or 12 per cent, changing three hundred fifty-six percentages to decimal fractions.

TABLE XV

NUMBER OF PROBLEMS, NUMBER OF ERRORS, AND PERCENTAGES OF ERROR IN CONVERSION FROM A PERCENTAGE TO A COMMON FRACTION, DECIMAL, AND RATIO

Conversion from a Fraction as a Percentage to:	Number of Problems	Number of Errors	Percentage of Error
Common Fraction	356	78	22
Decimal Fraction	356	44	12
Fraction as Ratio	356	193	54
Total	1,068	315	29

There was a 12 per cent error, as shown in Table XVI on page 41, when ratios were converted to common fractions, decimals, and percentages. In the 1,068 problems there were one hundred twenty-five incorrect responses, which gave a 12 per cent error. Changing ratios to decimals resulted in the highest percentage of error. There were fifty errors, or 14 per cent, in the three hundred fifty-six problems. A 13 per cent error, forty-seven errors in the three hundred fifty-six

problems, resulted when ratios were converted to percentages. Changing ratios to common fractions gave an 8 per cent error. There were twenty-eight wrong answers in the three hundred fifty-six problems.

TABLE XVI

NUMBER OF PROBLEMS, NUMBER OF ERRORS, AND PERCENTAGES OF ERROR IN CONVERSION FROM A FRACTION AS A RATIO TO A COMMON FRACTION, DECIMAL, AND PERCENTAGE

Conversion from a Ratio to:	Number of Problems	Number of Errors	Percentage of Error
Common Fraction	356	28	8
Decimal Fraction	356	50	14
Fraction as Percentage	356	47	13
Total	1,068	125	12

When decimals, percentages and ratios were converted into common fractions, a 14 per cent error occurred. (See Table XVII on page 42.) There were one hundred forty-seven errors in the 1,068 problems. Changing percentages to common fractions was the most difficult and there were seventy-eight errors in the three hundred fifty-six problems. This was an error of 22 per cent. There were forty-one errors, or 12 per cent, changing three hundred fifty-six decimals

into common fractions. The conversion of ratios into common fractions resulted in an 8 per cent error. There were twenty-eight incorrect responses in three hundred fifty-six problems.

TABLE XVII

NUMBER OF PROBLEMS, NUMBER OF ERRORS, AND PERCENTAGES OF ERROR IN CONVERSION TO A COMMON FRACTION FROM A DECIMAL, PERCENTAGE, OR RATIO

Conversion to a Common Fraction from:	Number of Problems	Number of Errors	Percentage of Error
Decimal Fraction	356	41	12
Fraction as Percentage	356	78	22
Fraction as Ratio	356	28	8
Total	1,068	147	14

A 10 per cent error occurred when converting values to a decimal fraction. There were one hundred ten errors in 1,068 problems. Table XVIII, on page 43, presents the data concerning the conversion to decimal fractions. The conversion of ratios to decimals was the most difficult and fifty errors occurred in the three hundred fifty-six problems. This was an error of 14 per cent. There were forty-four errors, or 12 per cent, changing three hundred fifty-six

fractions as percentages to decimals. Converting common fractions to decimals resulted in a 4 per cent error. There were sixteen incorrect answers in three hundred fifty-six problems.

TABLE XVIII

NUMBER OF PROBLEMS, NUMBER OF ERRORS, AND PERCENTAGES OF ERROR IN CONVERSION TO A DECIMAL FRACTION FROM A COMMON FRACTION, PERCENTAGE, OR RATIO

Conversion to a Decimal Fraction from:	Number of Problems	Number of Errors	Percentage of Error
Common Fraction	356	16	4
Fraction as Percentage	356	44	12
Fraction as Ratio	356	50	14
Total	1,068	110	10

In converting a percentage from the other three forms of fractions, a 7 per cent error was recorded. There were seventy-four incorrect responses in the 1,068 problems. The most difficult type of conversion was from ratios to percentages. A 13 per cent error occurred with forty-seven errors in the three hundred fifty-six problems. A 5 per cent error, or nineteen errors in three hundred fifty-six problems, resulted when common fractions were converted to

percentages. Only eight errors, or 2 per cent, occurred when changing the three hundred fifty-six decimals into percentages. Table XIX contains the data on conversion to fractions as percentages.

TABLE XIX

NUMBER OF PROBLEMS, NUMBER OF ERRORS, AND PERCENTAGES OF ERROR IN CONVERSION TO A PERCENTAGE FROM A COMMON FRACTION, DECIMAL, OR RATIO

Conversion to a Fraction as a Percentage from:	Number of Problems	Number of Errors	Percentage of Error
Common Fraction	356	19	5
Decimal Fraction	356	8	2
Fraction as Ratio	356	47	13
Total	1,068	74	7

The most difficult conversion problems were from common fractions, decimal fractions, and percentages into ratios. Of the 1,068 problems there were three hundred twenty-four errors, or a percentage of 30. The largest number of errors occurred when the students attempted to change percentages to ratios. Of the three hundred fifty-six problems, one hundred ninety-three, or 54 per cent, were wrong. Changing decimals to ratios was also difficult for

the students. Ninety-six, or 27 per cent, of the three hundred fifty-six problems were incorrect. A 10 per cent error was recorded when the students converted common fractions to ratios. There were thirty-five errors in the three hundred fifty-six problems. (See Table XX.)

TABLE XX

NUMBER OF PROBLEMS, NUMBER OF ERRORS, AND PERCENTAGES OF ERROR IN CONVERSION TO A FRACTION AS A RATIO FROM A COMMON FRACTION, DECIMAL, OR PERCENTAGE

Conversion to a Ratio from:	Number of Problems	Number of Errors	Percentage of Error
Common Fraction	356	35	10
Decimal Fraction	356	96	27
Fraction as Percentage	356	193	54
Total	1,068	324	30

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The problem considered in this investigation was to ascertain mathematical weaknesses demonstrated by nursing students beginning clinical practice in a selected collegiate school of nursing. Suggestions for the planning of a remedial arithmetic course and possible curriculum revision were also sought.

The review of literature revealed that educators and the general public have expressed concern over the inability of high school graduates to use basic mathematics to advantage in their daily life. Many studies have been undertaken in an attempt to identify the extent and cause of this problem. Nursing educators also indicated an awareness that nurses must possess adequate mathematical skills to insure their ability to compute dosages accurately when administering medications.

The normative-survey method was used and a secondary analysis of the data obtained from the results of a diagnostic arithmetic test was made. A frequency of error was recorded for each item in the test, then the number of errors and the percentage of error were tabulated for each

type of problem in the selected categories. Analysis of the test results were considered from three approaches: (1) the range of scores, (2) the central tendencies of the scores, and (3) the percentages of error in each area tested.

The raw scores ranged from a perfect score of one hundred thirty to the lowest score of eighty-seven. The range of the percentage scores was from 100 per cent to 67 per cent. The median raw score for the class was one hundred twenty-two, or 94 per cent. The mean raw score was one hundred nineteen, or 92 per cent. The mode, however, was higher with a score of one hundred twenty-nine, or 99 per cent.

There was a total error of 9 per cent on the test. Unit I consisted of problems in addition, subtraction, multiplication, and division using whole numbers, decimals, and fractions. The problems which employed fractions had the greatest percentage of error. The division of decimals was also difficult for the students. The recognition of the smaller fraction in Unit II offered only a slight problem to the class as a whole and scored an error of 1 per cent. Unit III consisted of problems in conversion from one type of fraction to another. The total error for this unit was 15 per cent, but the percentages of error in the individual

categories ranged from 2 to 54. Problems which involved changing common fractions, decimal fractions, and percentages into ratios were the most difficult. Converting fractions as per cent into the other three forms also recorded a high percentage of error.

Conclusions

As a result of the data obtained in the study the following conclusions were made:

1. The mode score of 99 per cent and the mean score of 92 per cent gave the impression that the class as a whole was competent in arithmetical ability; however, the arithmetical operations in the problems were fundamentals which should have presented no difficulty to the high school graduate. Therefore, the errors which occurred pointed out specific areas of arithmetical weakness which were: (a) fractions, (b) decimals, and (c) conversion from one form of fraction to another.

2. No definite pattern of errors could be identified for the group as a whole; therefore, the planning of remedial work would be on an individual basis.

Recommendations

Based on data obtained from this study the following recommendations are made:

1. That this diagnostic arithmetic test be used again to ascertain if similar results would occur with another class of students.

2. That use of the test be continued to establish the validity and reliability of the examination.

It is further recommended that since mathematical ability is so important to both nursing students and professional nurses, the need for an adequate background in arithmetic should be continually stressed throughout their educational program. This important truth could be pointed out to prospective nursing students during career counseling opportunities. This would allow the student, through remedial arithmetic courses, to correct any deficiencies before beginning her nursing education. It is also suggested that nursing schools continue to give arithmetic pre-tests to incoming students to help them identify their mathematical deficiencies and plan remedial programs.

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APPENDIX A

ENUMERATION OF ERRORS BY TEST ITEMS

ENUMERATION OF ERRORS BY TEST ITEMS

UNIT I--Arithmetical Operations

Addition

Whole Numbers

1.	0
2.	0
3.	0
4.	0
5.	0
6.	2
7.	1
8.	3
9.	0
10.	2

Decimals

11.	2
12.	6
13.	5
14.	6
15.	1
16.	3

Subtraction

Whole Numbers

17.	0
18.	0
19.	0
20.	0
21.	0
22.	0
23.	2
24.	3
25.	1
26.	3

Decimals

27.	2
28.	7
29.	2
30.	5
31.	4
32.	4

Multiplication

Whole Numbers

33.	2
34.	0
35.	0
36.	3
37.	10
38.	8
39.	6
40.	4
41.	11
42.	5
43.	5

Decimals

44.	8
45.	8
46.	10
47.	3
48.	13

Division

Whole Numbers

49.	0
50.	12
51.	1
52.	0
53.	2
54.	0
55.	5
56.	11
57.	18

Decimals

58.	5
59.	4
60.	11
61.	9
62.	11
63.	16
64.	12

General Fractions

65.	(-)	2
66.	(x)	4
67.	(÷)	3
68.	(+)	26
69.	(-,+)	22
70.	(-)	19
71.	(x)	44
72.	(÷)	27

ENUMERATION OF ERRORS BY TEST ITEMS
(continued)

UNIT II--Recognition of Smaller Fraction

73.	2	78.	2
74.	0	79.	0
75.	0	80.	1
76.	0	81.	0
77.	1	82.	0

UNIT III--Conversion to:

Common Fractions		Decimal Fractions		Fractions as Percentage		Fractions as Ratio	
83.	5	95.	1	107.	3	119.	9
84.	12	96.	5	108.	6	120.	9
85.	6	97.	7	109.	6	121.	8
86.	18	98.	3	110.	4	122.	9
87.	37	99.	31	111.	0	123.	14
88.	14	100.	4	112.	2	124.	37
89.	13	101.	3	113.	0	125.	19
90.	14	102.	6	114.	6	126.	26
91.	10	103.	19	115.	18	127.	39
92.	7	104.	13	116.	13	128.	18
93.	4	105.	6	117.	5	129.	17
94.	7	106.	12	118.	11	130.	19

APPENDIX B

DIAGNOSTIC ARITHMETIC TEST

DIAGNOSTIC ARITHMETIC TEST

UNIT I--ARITHMETIC OPERATIONS

Addition

Directions: Carry all answers out to the second decimal.

1. 0 +7	2. 8 +9	3. 5 +8	4. 16 +18	5. 14 +17
6. 15 +19	7. 360 +228	8. 196 +245	9. 726 +415	10. 1019 +2488

11. 0.4 + 1.3 + 0.004 + 2.35 = _____

12. 0.0046 + 182 + 5.4 + 0.005 = _____

13. 0.4605 + 0.907 + 27.5008 + 15.34 = _____

14. 9.89 + 0.045 + 0.068 + 1.952 = _____

15. 4.006 + 15 + 0.092 + 0.45 = _____

16. 198.05 + 162.98 + 319.0007 = _____

UNIT I--(continued)

Subtraction

17. $\begin{array}{r} 9 \\ -6 \\ \hline \end{array}$ 18. $\begin{array}{r} 7 \\ -0 \\ \hline \end{array}$ 19. $\begin{array}{r} 5 \\ -5 \\ \hline \end{array}$ 20. $\begin{array}{r} 14 \\ -11 \\ \hline \end{array}$ 21. $\begin{array}{r} 53 \\ -38 \\ \hline \end{array}$

22. $\begin{array}{r} 72 \\ -19 \\ \hline \end{array}$ 23. $\begin{array}{r} 582 \\ -333 \\ \hline \end{array}$ 24. $\begin{array}{r} 706 \\ -521 \\ \hline \end{array}$ 25. $\begin{array}{r} 989 \\ -197 \\ \hline \end{array}$ 26. $\begin{array}{r} 2070 \\ -1035 \\ \hline \end{array}$

27. 3.05 - 1.4 = _____

28. 0.8592 - 0.4597 = _____

29. 150.6 - 1.43763 = _____

30. 79.843 - 6.34 = _____

31. 3.95 - 1.6425 = _____

32. 984 - 892.169 = _____

UNIT I--(continued)

Multiplication

33. $\begin{array}{r} 7 \\ \times 3 \end{array}$

34. $\begin{array}{r} 9 \\ \times 8 \end{array}$

35. $\begin{array}{r} 0 \\ \times 8 \end{array}$

36. $\begin{array}{r} 25 \\ \times 13 \end{array}$

37. $\begin{array}{r} 19 \\ \times 27 \end{array}$

38. $\begin{array}{r} 72 \\ \times 68 \end{array}$

39. $\begin{array}{r} 270 \\ \times 190 \end{array}$

40. $\begin{array}{r} 489 \\ \times 300 \end{array}$

41. $\begin{array}{r} 976 \\ \times 241 \end{array}$

42. $\begin{array}{r} 2002 \\ \times 1533 \end{array}$

43. $1000 \times 1000 =$ _____

44. $0.385 \times 6.3 =$ _____

45. $22.5 \times 1.505 =$ _____

46. $415.78 \times 16 =$ _____

47. $0.125 \times 0.015 =$ _____

48. $0.065 \times 123 =$ _____

UNIT I--(continued)

Division

49. 1) 4 50. 0) 7 51. 6) 0 52. 13) 39

53. 12) 36 54. 67) 268 55. 150) 516

56. 495) 2171 57. 373) 5640 58. 2.1) 1.45

59. 1.004 ÷ 8.92 = _____

60. 1.892 ÷ 1.24 = _____

61. 80.6 ÷ 10 = _____

62. 0.075 ÷ 262 = _____

63. 8 ÷ 0.064 = _____

64. 945.65 ÷ 0.025 = _____

UNIT I--(continued)

General Fractions

Directions: Calculate as signs indicate.

65. 1/3 - 1/4 = _____

66. 1/2 x 1/3 = _____

67. 1/4 ÷ 1/3 = _____

68. 2/3 + 2/5 + 1/4 = _____

69. 7/8 - 1/4 + 2/5 + 7/8 = _____

70. 2 1/4 - 1 2/3 = _____

71. 1 7/10 x 3 4/9 x 2 2/3 = _____

72. 125 3/4 ÷ 2/3 = _____

UNIT II--RECOGNITION OF SMALLER FRACTION

Directions: Circle the Smaller Fraction

73.	1/150	1/120	78.	1/500	1/300
74.	1/100	1/75	79.	1/2000	1/3000
75.	1/200	1 /1500	80.	1/6	1/8
76.	1/250	1/100	81.	1/40	1/50
77.	1/300	1/150	82.	1/25	1/35

UNIT III--CONVERSION OF FRACTIONS

Directions: In the following exercise convert each expression to its appropriate equivalents and arrange answers in the tabular form.

Common Fractions	Decimal Fractions	Percent	Ratio
7/10	95.	107.	119.
3/7	96.	108.	120.
1/6	97.	109.	121.
3/5	98.	110.	122.
83.	0.03	111.	123.
84.	2.4	112.	124.
85.	0.72	113.	125.
86.	0.0315	114.	126.
87.	99.	1/6%	127.
88.	100.	0.02%	128.
89.	101.	0.4%	129.
90.	102.	2%	130.
91.	103.	115.	1:3000
92.	104.	116.	1:40
93.	105.	117.	1:5
94.	106.	118.	1:200

Work area